Revisiting Applying Real Option Theory to Measuring the Lost Value of a Contract Renewal Option

By Scott A. Barnes, CPA, CFF, CGM

Many academics and practicing managers now recognize that the net present value (NPV) approach to valuing future discounted cash flows (DCF) has certain limitations and cannot properly capture the value of management’s flexibility to make a future decision of whether to exercise or not exercise the option to renew and/or extend a contractual agreement.¹ There is a value to flexibility and potential value to an option to renew and/or extend a contractual agreement depending upon the terms of the contract. During the term of any contract, both parties to the contract are learning and becoming familiar with the performance obligations and gaining an understanding of each party’s capabilities. That is precisely the reason renewal rights and contract extension provisions are included as standard provisions in the negotiation of many supply contracts, licensing agreements and real estate leases. In the long term, each side to the contract wants the best of both worlds where certain risks can be reduced or avoided outright. Accordingly, a renewal option can exist to lock in upside profitability through the ability to continue the contractual arrangement at a future date. Likewise, an option can exist to abandon the contract if the economics, as measured at a future date, are determined to be unsatisfactory.

¹ Real Options and Investment Under Uncertainty. Classical Readings and Recent Contributions, Chapter 7, “Real Options: An Overview”, p. 103. by Lenos Trigeorgis.
When contractual disputes arise and the task of quantifying lost profits or lost value under the contract is required, a common issue is whether economic damages for any renewal or extension period should or can be measured. Many courts have limited lost profits or lost value damages to the initial term of the contract, viewing the inclusion of economic damages to future renewal periods as too speculative. However, what has been long overlooked in many contract disputes involving the measurement of economic damages is the specific value attributable to an option to renew and/or extend a contractual arrangement itself. The academic and professional research behind the valuation theory of options (both financial and real options) is one of the most thoroughly published and peer reviewed areas of finance and economics. The outcome of that research is a methodology and guidance to measuring the value (i.e., lost value) to a contractual renewal option through the use of Real Option theory.

**Background and Methodology of Valuing Real Options**

A Real Option is defined as the right but not the obligation to undertake a business decision, project or investment now or in the future. The theory and valuation methodologies for “Real Options” have been recognized in academic research for more than 40 years and date to the seminal work by Stewart C. Meyers in 1977. Myers (1977) recognized the importance of considering investment opportunities as growth options, and W. Carl Kester (1984) concluded that one answer is to think of future investment opportunities as analogous to ordinary call options on securities. Following Myers’ work, a significant amount of the early academic research in Real Options focused on the mining and oil and gas industries. Academic research eventually broadened to incorporate Real Option theory into a broader set of investment decisions, including (1) the abandonment option, (2) the flexibility to switch, (3) the option to enter and exit, (4) the right to defer, and (5) the option to exploit successive innovations. A partial listing of the academic studies on Real Options is summarized in Table 1.

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### Table 1
Summary of Real Options Studies

<table>
<thead>
<tr>
<th>Option Type</th>
<th>Description of Study</th>
<th>Study Authors &amp; Date of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abandonment</td>
<td>The option to stop use of the assets, realizing the salvage value.</td>
<td>Bonini (1977); Myers and Majd (1990); Berger, Ofek, and Swary (1996)</td>
</tr>
<tr>
<td>Flexibility to Switch</td>
<td>The option to alter output or input mixes in response to changes in demand or prices.</td>
<td>Kulatilaka (1988, 1993); Kulatilaka And Marcus (1988); Triantis and Hodder (1990); Kulatilaka and Trigeorgis (1994)</td>
</tr>
<tr>
<td>Enter and Exit</td>
<td>The option to exit an investment activity and re-enter as conditions become more favorable.</td>
<td>Robichek and Van Horne (1967); Brennan and Schwartz (1985); McDonald and Siegel (1985); Trigeorgis and Mason (1987); Pindyck (1988); Dixit (1989, 1992); Majd and Pindyck (1989); Myers and Majd</td>
</tr>
<tr>
<td>Right to Defer</td>
<td>The option to delay investment outlays until such time that the investment is more profitable.</td>
<td>Tourinho (1979); Titman (1985); McDonald and Siegel (1986); Majd and Pindyck (1987); Paddock, Siegel, and Smith (1988); Pindyck (1991, 1993); Ingersoll and Ross (1992); Quigg (1993); Østbye (1997)</td>
</tr>
<tr>
<td>Staged Investment</td>
<td>The option to make investment outlays in successive stages with the right to abandon the project as more information becomes available.</td>
<td>Roberts and Weitzman (1981); Majd and Pindyck (1987); Carr (1988); Trigeorgis (1993a); Grenadier (1996)</td>
</tr>
<tr>
<td>Growth</td>
<td>The option to capitalize on an earlier investment, such as one in research and development, to enter into related investment projects.</td>
<td>Myers (1977); Kester (1984, 1993); Trigeorgis (1988); Pindyck (1988); Chung and Charoenwong (1991); Kemna (1993); Brealey and Myers (1996); Grenadier and Weiss (1997); Chatwin, Bonduelle, Goodchild, Harmon, and Mazzuco (1999)</td>
</tr>
<tr>
<td>Interacting Options</td>
<td>Multiple options, including the option to defer, to expand, to switch.</td>
<td>Trigeorgis (1991, 1993a, 1993b); Childs, Ott, and Triantis (1998)</td>
</tr>
</tbody>
</table>


The term “Real Options” comes from Myers’ 1977 work that breaks down the value of an opportunity (e.g., the contractual opportunity to renew the contract) into two components: (1) the present value of the investment opportunity currently in place (e.g., the present value of the economic benefits to an existing contract) and (2) the present value of future growth opportunities (e.g., the present value of the economic benefits for a renewal period). Recently, more attention has been paid to applying the valuation methodology of option-pricing theory to Real Options, including the valuation of contract renewal.
options. The underlying value to Real Options in contractual arrangements is related to managerial flexibility. The basic idea of Real Option valuation is to consider that the value of an investment extends beyond its value as measured by traditional DCF or NPV methods. In other words, the value of a project (e.g., a contract) is supplemented by the value of its options.

**What Drives a Real Option's Value?**

Real Option valuation theory offers the only framework that measures the value of the flexibility to change a business decision over a defined period of time. A Real Option has value whenever three conditions that are common to almost all strategic and financial decisions exist:

1. **Flexibility**: the ability to change a business decision related to a project, investment or asset over a defined time period. By flexibility, the owner of the option can adjust the scale or scope of their business and make decisions that can expand, delay or abandon future investment or business opportunities rather than facing a “now or never” decision.

2. **Uncertainty**: the value of a project, investment or asset cannot be fully predicted. By uncertainty, the owner of the option cannot fully predict the future cash flows, investment costs, or any other relevant value driver associated with the project, investment or asset. There exists a probability that both systemic (i.e., market risk) and unsystemic (i.e., company specific) risks associated with the economy, business, project, investment or asset can change its value.

3. **Irreversibility**: irreversibility implies that sunk costs will exist in making a business decision or investment. For example, once a contract is signed or a decision is made to renew the contract, it will be impossible to terminate a contract without a penalty or to fully recover the investment or certain sunk costs associated with the renewal.

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Identifying the Option Opportunity & the Option Valuation Factors

Real Option Theory and Practice is Identical to Financial Option Theory and Practice

In applying Real Option theory and its valuation methodologies to existing contracts or licensing arrangements, the first challenge is recognizing the specific “options” that are embedded in the contract and/or licensing agreement itself. The second challenge is to value these options and incorporate them into the overall valuation process in measuring any alleged economic damages to an alleged breach of the agreement.

Almost any opportunity with a choice whose value depends on an underlying asset can be viewed as an option. A contract specifies the terms of the business opportunity, or outlines what financial economists call the option’s boundary conditions. Many opportunities have a sequential nature, where latter opportunities are available only if earlier opportunities are undertaken or certain conditions are achieved. Similar to the definition of a Real Option, a financial option is the right, without the obligation, to obtain something of value upon payment or the exchange of something else of value. The financial literature defines a financial option that gives its owner the right to buy an asset as a “call option.” Alternatively, a financial option that gives the owner the right to sell an asset as a “put option.”

Financial options generally have a contractually defined life that must be exercised prior to their maturity date. The financial literature and academic research on the valuation of financial options define two types of options: (1) the European style option and (2) the American style option. The exercise of a European option is permitted only upon its maturity date. As an alternative, an American option may be exercised at any time from its date of grant (or date of contractual creation) to its maturity date. All financial options are characterized by an underlying asset, such as a stock, foreign currency, real estate or intangible asset. In our discussion of a Real Options, a contract or licensing agreement is the underlying asset to the renewal option. The financial option right permits the right to buy (i.e., a call option) or sell (i.e., a put option) the underlying asset at a fixed price. That price is generally called the exercise price or the strike price.

Historical Methodologies and Practices to Lost Profits/Lost Value for Contract Renewal Options

In measuring the lost profits and/or lost value related to a breach of contract or licensing agreement, the length of the damage period will depend upon the underlying facts of the agreement.
litigation matter. Generally, the loss period will be projected over the remaining term of the contract. From a lost profits or lost value perspective, the challenge arises when the contract contains a renewal option(s). Many courts have taken a strict stance by limiting lost profits and lost value claims to the initial contract term and viewing lost profits or lost value in any renewal terms as too speculative. However, the specific case facts, contractual language defining the renewal option and the amount of time remaining in the initial term can support the measurement of the lost value of the renewal option as both foreseeable and reasonable to include as a subset of the overall economic damages' calculation to the breach of the contract and/or licensing agreement. Evidentiary support for claiming lost profits for a renewal period has historically included:

- The plaintiff has already notified defendant of its intent to renew the agreement.
- The plaintiff and defendant were in the process of negotiating a renewal of the agreement.
- The plaintiff has historically renewed contracts of the type at issue in the litigation.
- The remaining time period of the contract’s initial term is relatively short and other evidentiary support provides reasonable indicia that the contract would have been renewed.
- The remaining time period of the initial term of the contract is relatively short and contract terms state the contract would automatically renew and there are no other alleged contract performance breaches being claimed by plaintiff and defendant.

Historically plaintiff’s legal counsel may also simply request the damages expert to assume that the trier of fact will make a determination that lost profits during the renewal period are allowable. Under this circumstance, legal counsel is responsible for proving to the court that sufficient evidence exists for the assumption the expert was requested to make. However, there is an alternative methodology to measuring the plaintiff’s economic damages if the terms of the renewal option within a contract or licensing agreement meets the definition of a “Real Option.”

**The Purpose of Economic Damages in Breach of Contract and Licensing Agreements and the Factors Indicating a Renewal Option has Specific Economic Value**

The purpose of lost profit and lost value damages is to put the plaintiff in the same financial position it would have been in “but for” the alleged actions of the defendant. With regard to economic damages arising from a *breach of contract:*
“the measure of damages is the amount that will compensate the plaintiff for all the loss proximately caused thereby (i.e., the alleged breach), or that, in the ordinary course of things, would be likely to result from the breach of contract. The purpose of granting damages for breach of contract is to give the plaintiff the benefit of the bargain, and, insofar as possible, to place the plaintiff in the same position as the plaintiff would have been had the defendant performed the contract.”

[Emphasis Added]

With respect to the overall benefit of the bargain under a contract or license agreement, the terms for the right to renew is one of the elements (i.e., economic benefits) contained within the agreement. In contracts and licensing agreements that contain renewal options, there can be economic value to the “option” to renew itself. The renewal option is a “Real Option” in the sense that is a right but not the obligation to extend the terms of the contract into the future or to abandon the contract. The renewal option provides the contractual owner of it, the flexibility in making a managerial decision to adjust the scale or scope of their business to either continue to grow or to abandon its future investment or business opportunities. In effect, a renewal option is identical to a Real Option scenario for “Growth” or “Abandonment” as previously summarized in Table 1. The facts and circumstances that create value for a renewal option within a contract or licensing agreement include, but may not be limited to, the following factors:

(1) **Exclusivity:** Only one party to the contract or licensing agreement has been assigned ownership of the option to renew the agreement. If there is no exclusivity to who can exercise the right to renew, there can be no intrinsic value assignable to the option.

(2) **Certainty:** A specific date or specific time period must be defined within the contract or licensing agreement whereby the party assigned the exclusive right to exercise the renewal option must notify the other party to the agreement of its intent to exercise its right or abandon.

(3) **Valuable:** The contract or license agreement must provide objective economic conditions, factors and data to allow for the fair market value of the agreement to be measured at any point in time from the agreement’s effective date to the date when the renewal option must be exercised. For example, the contract or license agreement contains specified sales level data and/or there is sufficient historical sales data or reasonable financial projections to measure the expected economic benefits of the agreement.

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(4) **Determinable**: The price or sunk cost to be incurred by the party owning the exclusive right to exercise the renewal option must be determinable. For example, a license agreement may contain minimum royalty payments that are guaranteed during the renewal period regardless of sales level in the event that a renewal option is exercised. Likewise, additional costs (e.g., administrative, employee, working capital, capital investment) may need to be incurred by the option holder in the event that a renewal option is exercised to continue to meet expected sales levels during the renewal period. These costs can be best described as sunk costs that would be incurred and/or not recoverable if the renewal option is exercised.

A detail review of the contract and licensing agreement terms is required to identify the specific factors that may indicate that a renewal option may have specific value and represent a separate intangible asset within the agreement.

**Contracts and Licensing Agreements are Assets**

Accounting theory has long defined intangibles as assets that do not have physical substance, that grant rights and privileges to a business or entity and are inseparable from the business enterprise. Under both generally accepted accounting principles ("GAAP") , as promulgated by the Financial Accounting Standards Board ("FASB"), and the Internal Revenue Code ("IRC"), contractual relationships are considered intangible assets and must be independently valued when acquired either individually, or within a group, within the context of a business combination. GAAP defines an intangible asset as:

“A assets (not including financial assets) that lack physical substance.”

In many instances, a contractual relationship may exist whereby its value is not recorded on the balance sheet of the company. This is because an accounting transaction or measurement event has not occurred under either GAAP or IRC guidelines to trigger its measurement and subsequent recording of the intangible asset on the balance sheet. The lack of one or more of these events occurring does not preclude identifying the contract itself as an intangible asset to the company and valuing it for either financial, accounting or litigation purposes. Likewise, a grant of a renewal option within a contract or licensing agreement is

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10 See Accounting Standard Codification (ASC) 350-30-05, “[i]ntangible assets acquired individually or within a group of other assets should be recognized as assets in accordance with Section 350-20-25. . . . The accounting for an intangible asset after acquisition depends on its useful life. . . If the life is finite, the intangible asset should be amortized in accordance with paragraphs 350-30-35-6 through 35-13 and tested for impairment under the guidance for long-lived assets. . .

11 See ASC 350-10-10.
likewise a distinct intangible asset, separate and apart from the contract itself. This is identical to the situation where a financial asset (e.g., a publicly-traded stock) contains an option feature granting the right but not the obligation to purchase additional shares of stock in the future at a predetermined price over a defined period of time. Under this latter scenario, both the “stock” and the “option” would be considered two different assets with two different values. In fact, under GAAP accounting protocols, both the stock and option are required to be assigned separate values in the balance sheet.\textsuperscript{12}

Value and economic life have a very close relationship, especially in the context of applying the income approach to valuation for an intangible asset. The ultimate economic life of a contract or licensing agreement is generally defined as that period of time that the intangible asset is profitable.\textsuperscript{13} Economic life ends when (1) it is no longer profitable to use an asset (the future benefits are used up) or (2) when it is more profitable to use another asset.\textsuperscript{14} Accordingly, the economic life of a contract or licensing agreement may be longer than the contract (i.e., legal) life if there is an expectation and/or historical experience of renewals.

**The Lost Value of a Renewal Option is an Economic Damage Under the Initial/Existing Term of a Contract or License Agreement**

To avoid the potential legal challenges to measuring lost profits or lost value damages during the renewal period(s), an alternative methodology is to measure the lost value of the renewal option itself. As previously discussed, this methodology is only available if the contract or licensing agreement meets, at a minimum, the four criteria of (1) Exclusivity, (2) Certainty, (3) Valuable and (4) Determinable. Paramount among these criteria is the plaintiff seeking damages for the lost value of the renewal option must be assigned the exclusive right to exercise the option, or the contract contains an automatic renewal clause, whereby the plaintiff has the sole right to terminate the contract and make the decision to abandon.

**Binomial Models to Valuing Real Options**

Binomial option pricing models (BOPM) provide a generalizable numerical method for the valuation of options. The binomial model was first proposed by Cox, Ross and Rubenstein in 1979.\textsuperscript{15} Essentially, the model uses a “discrete-time” (lattice and/or

\textsuperscript{12} GAAP accounting also requires the same separate allocation of value between a debt instrument issued and any detachable warrants or options to purchase additional equity.


\textsuperscript{14} Ibid.

decision-tree based) model of the varying price over time of the underlying financial instrument (e.g., the price of a stock). Binomial option pricing is a simple but powerful technique that can be used to solve many complex option-pricing problems. The BOPM approach is widely used as it is able to handle a variety of conditions for which other models cannot easily be applied. This is largely because the BOPM is based on the description of an underlying instrument over a period of time rather than a single point. As a consequence, it is used to value American options that are exercisable at any time in a given interval as well as Bermudan options that are exercisable at specific instances of time.

Graph 1
Binomial Option Pricing Model Framework

3.2. Binomial option pricing model
(1979) J.C. Cox, S.A. Ross and M. Rubinstein, Option pricing: A simplified approach

First proposed by Cox, Ross and Rubinstein in 1979, the binomial options pricing model (BOPM) uses a ‘discrete-time’ (lattice) model to value both European and American option.

\[ u = e^{\sigma \sqrt{t}} \; ; \; \; d = e^{-\sigma \sqrt{t}} = \frac{1}{u} \]
\[ p = \frac{e^{(r-q)\Delta t} - d}{u - d} \]

Estimating the volatility is the key part of constructing the tree.

\[ C_{t-\Delta t, i} = (p \times C_{t, i} - (1-p) \times C_{t, i-1}) \times e^{-r\Delta t} \]


Most practitioners who use option pricing models to value real options argue for the binomial model over the Black-Scholes Model and justify this choice by noting that (1) early exercise is the rule rather than the exception with real options and (2) underlying
asset values are generally discontinuous.\textsuperscript{16} If you can develop a binomial tree with outcomes at each node, it looks a great deal like a decision tree from capital budgeting and the decision trees could yield the same values as option pricing models like the Black-Scholes model.\textsuperscript{17}

**The Black-Scholes Option Valuation Model**

One of the most widely applied option valuation models for both financial options and Real Options is the Black-Scholes Model. Based on the pivotal and Nobel Prize winning economic research by Fischer Black, Myron Scholes and Robert C. Merton, the Black-Scholes Model ("BSM") identifies five primary factors to valuing an option:

\begin{align*}
P & = \text{the underlying asset’s price}, \\
X & = \text{the strike (exercise) price of the option}, \\
r & = \text{the continuously compounded risk-free rate of interest}, \\
\sigma & = \text{volatility (i.e., standard deviation) of the asset’s return, and} \\
T & = \text{the time to expiration in years}.
\end{align*}

The use of the Black-Scholes Model is widely recognized and accepted for valuation, accounting and tax purposes. GAAP accepts the use of the Black-Scholes Model in accounting for stock-based compensation and fair value accounting purposes. Likewise, the Internal Revenue Service ("IRS") also recognizes the use of the Black-Scholes Model in the valuation of stock options for transfer tax purposes. Finally, the Black-Scholes Model is the most widely recognized option pricing models among the business valuation community.\textsuperscript{18}

In comparing the factors that drive the value of a financial option (as originally envisioned by the BSM) there is almost an identical similarity when applying the Black-Scholes Model to the valuation of Real Options. **Table 2** summarizes the close similarities among the Black-Scholes Model factors when applied to both financial options and Real Options.

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Table 2
Comparison of the Black-Scholes Model Option Value Factors to Financial & Real Options

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Valuation of a Financial Option</th>
<th>Valuation of a Real Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P$</td>
<td>The stock’s price</td>
<td>The present value of the net cash flows from the investment opportunity</td>
</tr>
<tr>
<td>$X$</td>
<td>The strike (exercise) price of the option</td>
<td>The present value of the delayed capital expenditure or future cost savings</td>
</tr>
<tr>
<td>$r$</td>
<td>The risk-free rate of interest</td>
<td>The continuously compounded risk-free rate of interest</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Volatility of the stock’s return</td>
<td>The volatility (i.e., standard deviation of the project’s relative value</td>
</tr>
<tr>
<td>$T$</td>
<td>The time to expiration in years</td>
<td>The option’s life in years</td>
</tr>
</tbody>
</table>


Case Study in the Valuation of a Licensing Renewal Option

To demonstrate the methodology and the process of valuing a renewal option, we will assume the following terms of a hypothetical trademark licensing agreement between a Licensor and Licensee for branded apparel.

The Hypothetical Licensing & Renewal Option Terms Subject to Analysis & Valuation

Section 3. Grant of License.

(a) (i) Subject to the terms and conditions set forth herein, Licensor hereby grants to Licensee, and Licensee hereby accepts from Licensor, an exclusive, nontransferable license to: (A) utilize the Trademarks solely in the Territory described herein during the Term of this Agreement, and solely in connection with the manufacture, distribution, importation, advertising, promotion, marketing and sale of the articles and merchandise described herein as Licensed Products and solely for sale at retail through the Licensed Channels of Distribution.

Section 4. Term.

(a) This Agreement shall commence on January 1, 2017 and shall continue until December 31, 2019, unless sooner terminated in accordance with the terms of this Agreement (the "Initial Term").
(b) **Licensee shall, subject to the terms and conditions herein, have the right to renew this Agreement for one additional term of five (5) years, from January 1, 2020 to December 31, 2024 (the "Renewal Term") upon written notice to Licensor which must be given not sooner than 60 days prior to expiration of the Initial Term (the "Renewal Notice") and if not, Licensee’s right to sell Licensed Products during the Renewal Term shall thereupon be terminated for all purposes, unless such right is reinstated by written agreement of Licensor in its sole and absolute discretion.

Section 5. **Royalty Rate and Minimum Royalties.**

(a) The Licensee agrees to pay to the Licensor a Royalty payment equal to five percent (5%) of all Net Sales of all Licensed Products during the Term and any Renewal Term.

(b) During the Term, Licensee must pay Guaranteed Minimum Royalties, equal to or in excess of $120,000 per year. During any Renewal Term, Licensee must pay Guaranteed Minimum Royalties, equal to or in excess of $150,000 per year.

[Emphasis Added]

**Summary of the Basic Assumptions for Measuring Lost Profits & the Lost Value of the Renewal Option**

For purposes of our analysis, we will assume the that the Licensor to the agreement breaches the agreement at the end of the first year. Section 4(b) of the License Agreement grants the Licensee the sole option to renew the agreement, which is a prerequisite to valuing the renewal option from the perspective of the Licensee. An alternative analysis could also be performed if the sole right to exercise the renewal option was granted to the Licensor and the alleged breach was caused by the Licensee. The methodology and approach to be discussed would be identical if the renewal option was being valued from the perspective of the Licensor. The only difference is the lost profits and valuation of the renewal option would be based on the future economic benefits from the royalty stream being paid to the Licensor by the Licensee during the Initial Term of the agreement.

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Under the hypothetical License Agreement, the Licensee manufactured and sold branded merchandise during the first year of the agreement before the alleged breach by the Licensor on December 31, 2017. As part of the negotiations between the Licensor and Licensee, the Licensee prepared a set of projections of estimated sales volume during
the Initial Term of the agreement prior to entering into the Licensing Agreement (i.e., the Pre-Litigation Projections).

**The Pre-Litigation Projections**

**Table 3** represents the sales projections for the number of units of merchandise to be sold.

**Table 3**  
Licensee Pre-Litigation Sales Projections (in Units)  
For the Years 2017 to 2019 (The Initial Term)

<table>
<thead>
<tr>
<th></th>
<th>Actual 2017</th>
<th>Projected 2018</th>
<th>Projected 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Units Sold</td>
<td></td>
<td>300,000</td>
<td>350,000</td>
</tr>
<tr>
<td>Actual Units Sold</td>
<td></td>
<td>311,000</td>
<td>-</td>
</tr>
</tbody>
</table>

During the first year of the License Agreement, the actual unit sales exceeded the projected unit sales by 11,000 units. As of the date of the alleged breach of the License Agreement on December 31, 2017, management of the Licensee confirmed that the Pre-Litigation Projections for 2018 and 2019 continued to represent its best estimate of sales under the agreement based on existing and unfulfilled orders that had been received. Based on a planned geographic expansion of sales for the merchandise, management for the Licensee projected that annual unit sales would increase to 500,000 units per year, starting in 2020 if the License Agreement had not been terminated on December 31, 2017 and it maintained its right to exercise the renewal option for another five-year period.

**The Lost Profits Calculation – Initial Term and Renewal Term**

Based on the assumptions set forth above, **Table 4** represents the calculation of the estimated lost profits incurred by the Licensee for the remainder of the Initial Term and the Renewal Term if a determination is made by the court that the Licensee is entitled to lost profits during the Renewal Term. The estimated present value of the lost profits for the remainder of the initial term is $5.29 million.\(^\text{19}\) The estimated present value of the lost profits for the renewal term is $8.99 million.

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\(^\text{19}\) An alternative and more conservative estimate of the lost profits during the Initial Term is $4.16 million based on a “Before and After” Methodology whereby the actual $2.48 million of profits realized by the
Table 4
Calculation of Lost Profits for Initial Term and Renewal Term
Measured as of December 31, 2017 Date of Breach

<table>
<thead>
<tr>
<th>Discount Period (Using Mid-Year Convention)</th>
<th>0.5</th>
<th>1.5</th>
<th>2.5</th>
<th>3.5</th>
<th>4.5</th>
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<tr>
<td>Actual 2017</td>
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<td>Projected 2018</td>
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<td>Projected 2019</td>
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<td>Projected 2020</td>
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<td>Projected 2021</td>
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<td>Projected 2022</td>
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<tr>
<td>Projected 2023</td>
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<tr>
<td>Projected 2024</td>
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</tr>
</tbody>
</table>

| Projected Units Sold                        | 300,000 | 350,000 | 450,000 | 500,000 | 500,000 | 500,000 | 500,000 |
| Actual Units Sold                           | 311,000 |     |     |     |     |     |     |

| Net Sales                                   | $6,220,000 | $7,000,000 | $9,000,000 | $11,000,000 | $11,000,000 | $11,000,000 | $11,000,000 |
| Variable Costs (Including Cost to Manufacture, Distribute, Marketing, Promotion, etc.) | 3,421,000 | 3,850,000 | 4,950,000 | 6,500,000 | 6,500,000 | 6,500,000 | 6,500,000 |
| Royalty Due to Licensor                     | 311,000 | 350,000 | 450,000 | 550,000 | 550,000 | 550,000 | 550,000 |
| Estimated Lost Profits                      | $2,488,000 | $2,800,000 | $3,600,000 | $3,950,000 | $3,950,000 | $3,950,000 | $3,950,000 |

| Estimated Cost of Capital                   | 20.00% |
| Discount Rate Factor                        | 1.00 | 1.10 | 1.31 | 1.58 | 1.89 | 2.27 | 2.73 | 3.27 |
| Present Value of Lost Profits Measured as of December 31, 2017 (Excludes Income Taxes) | $2,556,039 | $2,738,613 | $2,504,056 | $2,086,713 | $1,738,928 | $1,449,106 | $1,207,589 |

| Present Value of Lost Profits for Initial Term Ending December 31, 2019 | $5,294,651 |
| Present Value of Lost Profits for Renewal Term Ending December 31, 2024 | $8,986,391 |

The Valuation of the Licensee Renewal Option as Alternative to Renewal Period Lost Profits

An alternative damage theory to a breach of contract claim is to value the lost renewal option itself by applying Real Option theory as previously discussed. This lost value methodology can rely upon both a Binomial Option Pricing Model and the Black-Scholes Model to estimate the value of the renewal option.

Licensee during 2017 is projected forward for 2018 and 2019 and discounted back to December 31, 2017.
The Fair Market Value of the Contract or Licensing Agreement

The fair market value of a contract or licensing agreement can be measured by the present value of its future economic benefits over the remaining life of the agreement. This application of the Income Approach to value an intangible asset is a commonly used approach.\(^{20}\) The general economic inputs to apply the Income Approach to estimate the fair market value of the agreement are:

1. the estimated cash flow stream to be received under the agreement (revenues minus all variable costs associated with performing under the agreement);
2. the remaining time period under the agreement; and
3. the estimated weighted average cost of capital associated with entity owning the agreement.

The Exercise Price of the Renewal Option or the Sunk Costs to be Incurred for Renewal

The exercise price in a Real Options analysis is the amount that would be paid . . . if a real option is exercised.\(^{21}\) One of the more challenging inputs to either the Binomial Option Pricing Model and the Black-Scholes Model is the "price" to exercise or "costs to be incurred" upon renewal. Unlike a financial option whereby an exercise price is stated within the option agreement, the determination of the exercise price for a Real Option requires an analytical approach to estimating the cost to exercise. The analysis starts by asking the questions: What sunk costs or additional investment will be incurred by the owner of the option to exercise the renewal option? The answer may not be so straightforward. Following are examples of sunk costs and possible additional investments or capital outlays that the owner of a renewal option may need to incur if the option is exercised:

- Legal costs;
- Additional capital investment in plant and facilities to meet expected demand during the renewal period;


Guaranteed payments required under the contract or licensing agreement during the renewal period that are mandatory if the option is exercised;

Additional working capital requirements to meet expected demand during the renewal period;

Product development and redesign costs that are separate from product or manufacturing costs; and

Additional employee costs or ramp-up costs to support operations during the renewal period.

In certain instances, the cost to exercise the renewal option may be minimal due to the nature of the contract or licensing agreement. For example, the cost to exercise a renewal option may just be the cost of notification to the other party to the agreement of the intent to renew.

The Risk-Free Rate of Return

The estimated risk-free rate of return to apply in either the Binomial Option Pricing Model or the Black-Scholes Model is the easiest to determine among the five factors. It is generally recognized that the risk-free rate of return is a U.S. Treasury yield for a note or bond with the same approximate maturity term as the remaining life of the renewal option itself. The U.S. Treasury yield curve for the source of the risk-free rate can be found at the U.S. Treasury Department website.22

Expected Future Annual Volatility of the Fair Market Value of the Contract or Licensing Agreement

The annual volatility in an option-pricing model is one of the most critical variables. In financial option-pricing applications, it is generally the only unobservable variable. That being the case, a major reason why misestimation of a financial option value occurs is because of a difference of opinion on the volatility.23 With regard to Real Options, the estimate of future volatility becomes more challenging. Volatility is generally measured by analyzing the change in the historical price/value of the underlying asset to the option or making an estimate of the implied volatility by looking at the current pricing of option futures. Volatility is measured by calculating the standard deviation of historical changes in the underlying price/value of an asset. The pricing data may be available in either daily, monthly or quarterly basis, which will require converting the standard deviation calculated from a daily, monthly or quarterly basis to an annualized standard deviation. Tables 5

---


and 6 provides an example of the calculations and the excel formulae to calculate volatility on a daily, monthly and quarterly basis and convert the data to an annualized volatility.

<table>
<thead>
<tr>
<th>Date</th>
<th>Price</th>
<th>Change in Price</th>
<th>Daily Standard Deviation (i.e., Volatility)</th>
<th>Date</th>
<th>Price</th>
<th>Change in Price</th>
<th>Weekly Standard Deviation (i.e., Volatility)</th>
<th>Date</th>
<th>Price</th>
<th>Change in Price</th>
<th>Monthly Standard Deviation (i.e., Volatility)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/30/18</td>
<td>2,648.05</td>
<td>-0.82%</td>
<td>0.98%</td>
<td>15.60%</td>
<td>4/30/18</td>
<td>2,648.05</td>
<td>-0.82%</td>
<td>0.98%</td>
<td>7.09%</td>
<td>4/30/18</td>
<td>2,648.05</td>
</tr>
<tr>
<td>4/27/18</td>
<td>2,669.91</td>
<td>0.11%</td>
<td></td>
<td></td>
<td>4/23/18</td>
<td>2,669.91</td>
<td>0.11%</td>
<td></td>
<td></td>
<td>4/31/18</td>
<td>2,669.91</td>
</tr>
<tr>
<td>4/2/18</td>
<td>2,666.94</td>
<td>1.04%</td>
<td></td>
<td></td>
<td>4/16/18</td>
<td>2,666.94</td>
<td>1.04%</td>
<td></td>
<td></td>
<td>2/28/18</td>
<td>2,666.94</td>
</tr>
<tr>
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<td>0.18%</td>
<td></td>
<td></td>
<td>4/8/18</td>
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<td>0.18%</td>
<td></td>
<td></td>
<td>1/31/18</td>
<td>2,639.40</td>
</tr>
<tr>
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<td>-1.35%</td>
<td></td>
<td></td>
<td>4/2/18</td>
<td>2,634.56</td>
<td>-1.35%</td>
<td></td>
<td></td>
<td>12/31/17</td>
<td>2,634.56</td>
</tr>
<tr>
<td>4/23/18</td>
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<td>0.01%</td>
<td></td>
<td></td>
<td>3/26/18</td>
<td>2,670.29</td>
<td>0.01%</td>
<td></td>
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<td>1/30/17</td>
<td>2,670.29</td>
</tr>
<tr>
<td>4/19/18</td>
<td>2,670.14</td>
<td>-0.86%</td>
<td></td>
<td></td>
<td>3/19/18</td>
<td>2,670.14</td>
<td>-0.86%</td>
<td></td>
<td></td>
<td>10/31/16</td>
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</tr>
<tr>
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<td>-0.57%</td>
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<td></td>
<td>9/30/16</td>
<td>2,693.13</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
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<td>0.81%</td>
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<tr>
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<td></td>
<td></td>
<td>2/19/18</td>
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<td>-0.29%</td>
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<td>2,656.30</td>
</tr>
<tr>
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<td>0.82%</td>
<td></td>
<td></td>
<td>2/12/18</td>
<td>2,663.99</td>
<td>0.82%</td>
<td></td>
<td></td>
<td>5/31/16</td>
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<td>-0.55%</td>
<td></td>
<td></td>
<td>2/5/18</td>
<td>2,642.19</td>
<td>-0.55%</td>
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<td>4/30/16</td>
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</tr>
<tr>
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<td>1.66%</td>
<td></td>
<td></td>
<td>1/29/18</td>
<td>2,656.87</td>
<td>1.66%</td>
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<td></td>
<td>3/31/16</td>
<td>2,656.87</td>
</tr>
<tr>
<td>4/9/18</td>
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<td>0.33%</td>
<td></td>
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<td>1/22/18</td>
<td>2,613.16</td>
<td>0.33%</td>
<td></td>
<td></td>
<td>2/28/16</td>
<td>2,613.16</td>
</tr>
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<td>4/8/18</td>
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<td>-2.22%</td>
<td></td>
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<td>1/18/18</td>
<td>2,604.47</td>
<td>-2.22%</td>
<td></td>
<td></td>
<td>12/31/15</td>
<td>2,604.47</td>
</tr>
<tr>
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<td>0.68%</td>
<td></td>
<td></td>
<td>1/11/18</td>
<td>2,662.84</td>
<td>0.68%</td>
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<td></td>
<td>11/30/15</td>
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</tr>
<tr>
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<td>1.15%</td>
<td></td>
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<td>12/25/17</td>
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<td>1.15%</td>
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<td></td>
<td>10/31/15</td>
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</tr>
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<td></td>
<td></td>
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<td>12/11/17</td>
<td>2,581.88</td>
<td></td>
<td></td>
<td></td>
<td>8/31/15</td>
<td>2,581.88</td>
</tr>
</tbody>
</table>

Table 5
Sample Calculations of Annualized Volatility on a Daily, Weekly & Monthly Basis

In the calculation of historical volatility, the number of data points used does not impact the methodology of converting a standard deviation calculated on a daily, weekly, monthly or quarterly basis to an annualized volatility. For example, annualized volatility can be calculated on a daily basis using the last 30, 60 or 1,000 trading dates of an individual stock or index. Depending upon the time horizon that historical volatility is being used as a projection of future volatility, the more data points within the calculation may better refine the overall estimate of annual volatility. The amount of data used on a daily, weekly, monthly or quarterly basis is up to the judgement of the expert.

The starting point of the annualized volatility calculation is to calculate the percentage change in the price of the individual stock or index from the previous period. For example, if daily data is being used, the percentage change can be calculated as the current day price minus the previous day price divided by the previous day price. Alternatively, the natural logarithm formula in excel can be used where the formula \(\text{Price of the Individual Stock or Index} = 2,581.88\).
price/previous day price) is applied. The mathematical results will be almost identical from either calculation methodology.

Once the percentage change in the price has been calculated for each period (i.e., daily, weekly, monthly, etc.), the standard deviation is calculated for the length of time included in the data set. For example, if daily data is being used, a standard deviation may be calculated over a 30, 60 or 1,000 days period. In this example, the calculation is a "daily standard deviation." To convert that daily deviation to an annualized volatility (i.e., annualized standard deviation), we must multiply the daily standard deviation by the square root of 252 days. The adjustment required for each possible time period of data is shown as follows:

- Annualized Volatility = (Daily Standard Deviation) x Square Root of 252
- Annualized Volatility = (Weekly Standard Deviation) x Square Root of 52
- Annualized Volatility = (Monthly Standard Deviation) x Square Root of 12
- Annualized Volatility = (Quarterly Standard Deviation) x Square Root of 4

For the sample calculations shown in Table 5, Table 6 shows the excel formulas to calculate the (1) percentage price change using the excel natural logarithm formula, (2) the calculation of the daily, weekly and monthly standard deviation and (3) the calculation to convert daily, weekly and monthly standard deviations to annualized standard deviations (i.e. volatility).

[Remainder of Page Intentionally Left Blank]

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24 If daily publicly-traded stock prices or indexes are being used, the square root of 252 days is used rather than 365 days. This modification is used to account for, on average, that there are 252 trading days in a calendar year. This approach adjusts the annualized volatility calculation to exclude weekends and holidays when the markets are closed over the course of a 365-day year. *Ibid.*

### Table 6
Excel Formulae For Calculation of Annualized Volatility on a Daily, Weekly & Monthly Basis

<table>
<thead>
<tr>
<th>T</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
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<td>18</td>
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<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>9</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>S&amp;P 500 or Individual Stock Price</td>
<td>S&amp;P 500 or Individual Stock Price</td>
<td>S&amp;P 500 or Individual Stock Price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Date</td>
<td>Price</td>
<td>in Price</td>
<td>Deviation</td>
<td>Deviation/Volatility</td>
<td>Date</td>
<td>Price</td>
<td>in Price</td>
<td>Deviation</td>
<td>Deviation/Volatility</td>
<td>Date</td>
<td>Price</td>
<td>in Price</td>
<td>Deviation</td>
<td>Deviation/Volatility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With regard to the changing value of a contract or licensing agreement, the analytical process is more involved. One methodology to estimate the expected future volatility of the fair market value of the contract or licensing agreement is to build a value curve over the remaining life of the agreement on a monthly or daily basis and calculate the annualized volatility (i.e., the standard deviation) over that period of time. An alternative methodology is to identify a reasonable proxy situation, company or index that will provide an estimate of the future volatility of the value of the contract or license agreement. There are several options available for consideration:

1. The historical volatility of the stock price of the entity owning the renewal right in the contract or licensing agreement (if publicly traded or if stock options and the company is valued on an annual or interim basis as a privately-held company).
2. The use of a proxy index such as the S&P 500 index or Russell 2000 index (or similar index) to estimated historical volatility to apply to the expected future volatility of the changing value of the contract or licensing agreement.

3. The use of one of the Chicago Board Option Exchange ("CBOE") Volatility Indices ("VIX") as a proxy for estimated future volatility.

4. The use of the historical volatility of the stock prices of a portfolio of proxy companies that are publicly traded and similar to the entity owning the renewal option in the contract or licensing agreement.

Considering the sensitivity of the Binomial Option Pricing Model and the Black-Scholes Model to the estimate of volatility and to the remaining life of the renewal option, the application of more than one methodology to estimating volatility may be appropriate to identify the value changes in the renewal option due to changes in the estimated future volatility.

Remaining Time to Exercise the Renewal Option

The remaining life of the renewal option is generally defined within the contract or licensing agreement itself and should be is easily identifiable.

The Valuation of the Hypothetical Licensee Renewal Option

Option Valuation Input 1 - The Fair Market Value of the License Agreement

The starting point in measuring the lost value of the renewal option in our hypothetical License Agreement is to estimate the fair market value of the License Agreement at the date of its termination and/or breach. We have applied an Income Approach to estimate the fair market value of the License Agreement at the December 31, 2017 termination date. Based on the same assumptions used in Table 4 to calculate the estimated lost profits during the Initial Term of the agreement, we have used the same estimate of the future economic benefits to be derived. Also, our valuation analysis as of December 31, 2017 has assumed a zero probability of the renewal option being exercised.

For purposes of the analysis, we have applied the fair market value standard of value in estimating the value of the License Agreement from the perspective of the Licensee. Fair market value is defined as:

“the price, expressed in terms of cash equivalents, at which property would change hands between a hypothetical willing and able buyer and a hypothetical willing and able seller, acting at arms length in an open
and unrestricted market, when neither is under compulsion to buy or sell and when both have reasonable knowledge of the relevant facts."\(^{26}\)

In applying the Income Approach, we have valued the income stream (i.e., the future economic benefits) that would be available to the Licensee’s equity holders. Accordingly, we have made certain assumptions about income taxes\(^ {27}\) that would be applicable, and for ease for demonstration purposes, have also assumed that no additional capital expenditures, working capital or other costs would need to be incurred by the Licensee to perform under the License Agreement during the duration of the Initial Term. Based on the Income Approach, we estimate the fair market value of the License Agreement at December 31, 2017 is $4.18 million.

### Table 7
Calculation of the Fair Market Value of the License Agreement Based on Initial Term Measured as of December 31, 2017 Date of Breach

<table>
<thead>
<tr>
<th>Discount Period (Using Mid-Year Convention)</th>
<th>-</th>
<th>0.5</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actual Term</strong></td>
<td><strong>Projected Term</strong></td>
<td><strong>Projected Term</strong></td>
<td></td>
</tr>
<tr>
<td>Projected Units Sold</td>
<td>300,000</td>
<td>350,000</td>
<td>450,000</td>
</tr>
<tr>
<td>Actual Units Sold</td>
<td>311,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Net Sales</td>
<td>$6,220,000</td>
<td>$7,000,000</td>
<td>$9,000,000</td>
</tr>
<tr>
<td>Variable Costs (Including Cost to Manufacture, Distribute, Marketing, Promotion, etc.)</td>
<td>3,421,000</td>
<td>3,850,000</td>
<td>4,950,000</td>
</tr>
<tr>
<td>Royalty Due to Licensor</td>
<td>311,000</td>
<td>350,000</td>
<td>450,000</td>
</tr>
<tr>
<td>Estimated Lost Profits</td>
<td>$2,488,000</td>
<td>$2,800,000</td>
<td>$3,600,000</td>
</tr>
<tr>
<td>Estimated Income Taxes @ 21%</td>
<td>(522,480)</td>
<td>(588,000)</td>
<td>(756,000)</td>
</tr>
<tr>
<td>Estimated Unlevered Cash Flow to Equity Owners (1)</td>
<td>$1,965,520</td>
<td>$2,212,000</td>
<td>$2,844,000</td>
</tr>
<tr>
<td>Estimated Cost of Capital</td>
<td>20.00%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount Rate Factor</td>
<td>1.10</td>
<td>1.31</td>
<td></td>
</tr>
<tr>
<td>Present Value of Unlevered Cash Flow to Equity Owners as of December 31, 2017</td>
<td></td>
<td></td>
<td>$2,019,270</td>
</tr>
</tbody>
</table>

**Estimated FMV of Licensing Agreement at 12.31.17**

Based on Economics of Initial Term (Includes Effect of Income Taxes)

$4,182,775

\(^{(1)}\) Our example has applied an income approach to the valuation of the License Agreement (i.e., intangible asset). We have assumed that no additional changes in capital expenditures, working capital or costs would be required to perform under the agreement over the remaining period of the Initial Term.

---

\(^{26}\) AICPA Statement on Standards for Valuation Services No. 1, *Valuation of a Business, Business Ownership Interest, Security, or Intangible Asset*

\(^{27}\) We have assumed corporate taxes at 21% based on the new corporate tax law changes that became effective on January 1, 2018.
Option Valuation Input 2 - Estimated Volatility of the Value of the License Agreement

For purposes of applying both the Binomial Option Pricing Model and the Black-Scholes Model, we have estimated the annualized future volatility for the hypothetical License Agreement using three approaches:

1. The volatility of the License Agreement for its declining value over the remainder of the Initial Term from December 31, 2017 to December 31, 2019.


3. A proxy volatility represented by the historical volatility in the stock prices of a portfolio of publicly-traded companies similar to the Licensee.

Volatility in the License Agreements Declining Value Curve

Under GAAP accounting, the fair value assigned to acquired intangible assets such as contracts and licensing agreements are amortized over the remaining life of each agreement. Accordingly, GAAP accounting is attempting to match the expected declining value of the intangible asset with the economic benefits received under the agreement. The estimated value of a contract or license agreement can be measured at any point in the future based on the continuing economic benefits to be received at any future date through the end of the life of the agreement. Based on the projections set forth in Table 7, we have assumed that the projected unit sales of 350,000 and 450,000 in 2018 and 2019 are spread evenly over each of the 12-month periods (i.e., 29,166 per month in 2018 and 37,500 per month in 2019). Based on the same economic assumptions, a declining value curve as set forth in Table 8 is calculated.
Based on this methodology, the estimated annualized volatility of the future value of the License Agreement, assuming zero probability of the renewal option being exercised, is 54.00%.

Proxy Volatility Based on S&P 500, Russell 2000 and DOW Indices

Using five years of daily index values for the period from 2013 to 2018 for the S&P 500, Russell 2000 and Dow Jones Industrial indices, we estimated annualized volatility at 12.50% based on the narrow range of volatility per the three indices of 12.45% to 15.92%. The annualized volatility since the December 31, 2017 termination date for the three indices was slightly higher at 17.35% to 20.06% compared to historical volatility over the prior five-year period. Table 9 summarized the calculation.
Proxy Volatility Based on Portfolio of Publicly-Traded Companies Similar to Licensee

As a third approach to estimate the annualized volatility of the License Agreement, a portfolio of similar publicly-traded companies in the same industry as the Licensee was developed. The scope of how to select benchmark (i.e., “yardstick”) companies will be addressed in another chapter. For purposes of our proxy portfolio, we have evenly weighted each company within the portfolio. Likewise, we have analyzed the volatility of the proxy portfolio using both one, four and five years of historical stock price data to identify any volatility anomalies. Based on the proxy portfolio analysis, the estimated volatility of the value of the License Agreement was estimated at 50.00%. Table 10 summarizes the outcome of the data analysis. The process of the calculation was identical to the format presented in Table 9.
Table 10
Calculation of Volatility from a Proxy Portfolio of Publicly-Traded Companies
For the Period of May 2013 to May 2018

<table>
<thead>
<tr>
<th></th>
<th>GIII</th>
<th>VFC</th>
<th>PVH</th>
<th>RL</th>
<th>ICON</th>
<th>SQBG</th>
<th>DFBG</th>
<th>HBI</th>
<th>Average of All Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Year</td>
<td>44.34%</td>
<td>22.07%</td>
<td>28.14%</td>
<td>30.00%</td>
<td>83.07%</td>
<td>62.08%</td>
<td>102.61%</td>
<td>30.12%</td>
<td>50.30% Say 50.00%</td>
</tr>
<tr>
<td>1-Year</td>
<td>45.38%</td>
<td>21.47%</td>
<td>20.65%</td>
<td>27.96%</td>
<td>136.64%</td>
<td>78.46%</td>
<td>85.69%</td>
<td>29.82%</td>
<td>55.76%</td>
</tr>
<tr>
<td>4-Year</td>
<td>45.32%</td>
<td>22.87%</td>
<td>29.06%</td>
<td>31.86%</td>
<td>92.07%</td>
<td>66.60%</td>
<td>111.72%</td>
<td>31.09%</td>
<td>53.82%</td>
</tr>
</tbody>
</table>

Option Valuation Input 3 – The Remaining Life of the Renewal Option

Based on the terms of the License Agreement, notice of the exercise of the renewal option had to be no sooner than 60-days before the expiration of the agreement on December 31, 2019. Accordingly, the earliest exercise date for the option would be November 1, 2019. Accordingly, the remaining life of the renewal option has been calculated as 669 days or 1.83 years.

Option Valuation Input 4 – The Risk-Free Rate

Based on the remaining useful life of the option of 1.83 years, a risk-free rate of 2.50% has been used based on the one-year and two-year US Treasuries yields as of December 31, 2017 was 2.32% and 2.52% respectively.

Option Valuation Input 5 – Estimated Cost to Exercise the Renewal Option

The exercise price in the renewal option is the amount that would be paid, or the sunk costs incurred if the option is exercised. Based on the hypothetical License Agreement, the Licensee would be required to pay guaranteed minimum royalties equal to $150,000.
per year upon the exercise of the renewal option. Accordingly, the financial risk (i.e., sunk cost to exercise) to the Licensee is the commitment to pay $750,000 ($150,000 x 5 years = $750,000) in royalties. This financial cost would be incurred in the event that sales failed to meet expectation, or the Licensee decided to terminate the agreement after the date of exercise. For purposes of our hypothetical License Agreement, we have assumed that the cost of notification of the intent to exercise the renewal option is nominal and that the Licensee would not be required to incur additional capital expenditures, working capital commitments or increase other sunk costs such as adding additional employees to perform under License Agreement during the renewal period. A detail analysis should be performed to take into account all such costs in the real world.

The Estimated Value of the Renewal Option Using the Binomial Option Pricing Model (BOPM)

Under the terms of our hypothetical License Agreement, we have estimated the fair market value of the license as of the date of its termination and/or breach at $4.18 million (See Table 7). Likewise, we have estimated the future volatility of the value of the license agreement at 50% based on a proxy-portfolio of publicly traded companies. Accordingly, we estimate that the value of the license during the remaining term of the agreement may increase by 50% or decline by 50% during each year. Inherent in the assumption of future volatility of the License Agreement is that its value is continuous under certain derived probabilities (as discussed later) and with an underlying discreet upside probability the agreement continues into the renewal period so that value exists for the License Agreement at the date of exercise. The continuous existence of a market is an underlying assumption in all option pricing models.

In applying a BOPM, we can develop a lattice of expected future values over the remaining term of the License Agreement. Graph 2 summarizes the expected future value outcomes based on our input assumptions. To demonstrate the process, the estimated value of the License Agreement is expected to increase 50% by December 31, 2018 to $6.27 million [$4.18 million x 1.50 = $6.27 million] or decline in value by 50% to $2.79 million [$4.18 million ÷ 1.50 = $2.79 million]. For 2019, we have estimated the value of the License Agreement as November 1, 2019, which is the earliest date the renewal option could be exercised under the terms of the License Agreement. Accordingly, the first estimated upside value of the License Agreement at November 1, 2019 by applying the 50% volatility is $8.80 million [$6.27 million x (1.50)^0.83 = $8.80 million]. The first downside value of the license at November 1, 2019 is $4.48 million [$6.27 million ÷ (1.50)^0.83 = $4.48 million]. Graph 2 summarizes the calculations for the Year 3 estimated values for both the Upside Scenario 1 and Downside Scenario 1.

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28 We have also applied alternative valuations of the renewal option assuming a 12.50% future volatility based on the historical S&P 500, Russell 2000 and DOW Indices volatility and a 54% volatility based on the volatility of the License Agreement's declining value curve.
Graph 2
Binomial Option Pricing Model of Expected Values of License Agreement
For Period from December 31, 2017 to December

Assumptions:
Estimated Volatility (V) 50.00% Based on Volatility of Similar Public Company Stock Price Volatility
Risk Free Rate (RF) 2.50% US Treasury Rate with Approximately 1.83 Year Maturity
Investment to Renew License (I) $ (750,000) Minimum Royalty Payments for Renewal Period ($150,000 x 5 Years = $750,000)

Table: Initial Term of License

Option Value at Date of Termination and/or Breach $3,419,781

Discount Period = 0.83
Year 3 11.01.19
Upside Scenario 1
$8,796,149
[$6,274,162 x (1+50%)^0.83 = $8,796,149]

Discount Period = 1.0
Year 2 12.31.18
Upside Scenario 1
$6,274,162

Discount Period = 0.83
Year 3 11.01.19
Downside Scenario 1
$3,909,399
[$2,788,516 x (1+50%)^0.83 = $3,909,399]

Discount Period = 1.0
Year 2 12.31.18
Downside Scenario 1
$2,788,516

Discount Period = 0.83
Year 3 11.01.19

Early Renewal Option Exercise Date
Upside Scenario 1
$8,796,149
[$6,274,162 x (1+50%)^0.83 = $8,796,149]

Discount Period = 1.0
Year 2 12.31.18

Early Renewal Option Exercise Date
Downside Scenario 1
$1,989,007
[$2,788,516 x (1+50%)^0.83 = $1,989,007]
The application of the BOPM requires the determination of the estimated probability that the value of the License Agreement will increase (i.e., $P^+$), and likewise, the estimated probability that the value of the License Agreement will decline (i.e. $P^- = (1 - P^+)$). The starting point of our analysis is represented by the following mathematical formula that calculates the current value of License Agreement based on the expected values set forth in the decision tree and applying the probability that the value of the License Agreement will increase by $P^+$:

$$S = [(S^+ x P^+) + (S^- x (1 - P^+))] x e^{(RF x T)}$$

$4.18 million = [($6.27 million x P^+) + ($2.79 million x (1 – P^+))] x 2.71828^{0.025}$

Where:

- $S =$ Current Value of the License Agreement ($4.18 million)
- $S^+ =$ Estimated Future Upside Value of License Agreement for Next Period ($6.27 million)
- $S^- =$ Estimated Future Downside Value of License Agreement for Next Period ($2.79 million)
- $e =$ 2.71828 (mathematical constant)
- $RF =$ Risk Free Rate (2.50%)
- $T =$ Time Period to Future Valuation Date (1 year)

In applying the BOPM, many practitioners and academics assume a risk neutral approach. The basic argument in the risk neutral approach is that since the valuation of options is based on arbitrage and is therefore independent of risk preferences; one should be able to value options assuming any set of risk preferences and get the same answer. As such, the easiest model is the risk neutral model. In a risk neutral approach, given a decision tree of likely future value outcomes, we can estimate the probabilities of the outcomes for purposes to price the call option by solving for ($P^+$) in the previous formula as follows:

$$\text{Probability of Value Increase (P+) } = \frac{S x e^{(RF x T)}}{S^+} - S^-$$

Where:

- $S =$ Current Value of the License Agreement ($4.18 million)
- $e =$ 2.71828 (mathematical constant)
- $T =$ Time Period to Future Valuation Date (1 year)
- $RF =$ Risk Free Rate (2.50%)
- $S^+ =$ Estimated Future Upside Value of License Agreement for Next Period ($6.27 million)

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29 Binomial Option Pricing, Robert M. Conroy, Darden Graduate School of Business Administration, University of Virginia, 2003, p. 9.
\[ S^- = \text{Estimated Future Downside Value of License Agreement for Next Period} \]  
\[ \text{($2.79 million)} \]

\[ P^+ = \frac{[$4.18 \text{ million} \times (2.71828^{0.25 \times 1})] - $2.79 \text{ million}}{$6.27 \text{ million} - $2.79 \text{ million}} \]

\[ P^+ = 43.04\% \]

\[ P^- = 1 - P^+ \]

\[ P^- = 1 - 43.04\% = 56.96\% \]

*Calculate the Current Value of The Renewal Option by Working Backwards from Year 3 Estimated Value Scenarios*

For simplicity purposes, we will demonstrate the step by step valuation process to calculate the current value of the renewal option as of the date of termination and/or the date of the breach. The first step in the process is to start with the Year 3 projected valuation scenarios and work backwards to Year 2 and then to the date of the termination and/or breach of the License Agreement to calculate the value of the renewal option. The binomial decision tree presents three distinct valuation scenarios for the License Agreement based upon the assumption of a 50% future volatility. One scenario exists for Year 2 (i.e., year ending December 31, 2018) and two scenarios exist for Year 3 (i.e., period ending November 1, 2019) for the date the renewal option can first be exercised. Our previous calculation determined that the probability of the value of the License Agreement will increase from its current value of $4.18 million to $6.27 million in Year 2 is 43.04%. Likewise, the probability of the value will decline from $4.18 million to $2.79 million is 56.96%. These same probabilities will apply for each of the two valuation scenarios attributable for Year 3.

Working backwards, the two valuation scenarios in Year 3 estimate that the renewal option at the end of Year 2 for the upside scenario is $5.70 million and $2.02 million for the downside scenario. Table 11 summarizes the specific calculation for this step of the process.
# Table 11
## Calculation of Renewal Option Value as of the End of Year 2

<table>
<thead>
<tr>
<th>Year 3 Estimated Future License Value</th>
<th>Year 3 Option Exercise Cost</th>
<th>Year 3 Estimated Option Payoff</th>
<th>Year 3 Probability of Payoff</th>
<th>Year 3 Adjusted Payoff Value</th>
<th>Discount Factor</th>
<th>Value of Renewal Option at End of Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payoff Option 1 - Year 3 Upside Scenario 1</td>
<td>$8,796,149</td>
<td>(750,000)</td>
<td>$8,046,149</td>
<td>43.04%</td>
<td>$3,462,886</td>
<td>0.97938</td>
</tr>
<tr>
<td>Payoff Option 2 - Year 3 Upside Scenario 1</td>
<td>$4,475,266</td>
<td>(750,000)</td>
<td>$3,725,266</td>
<td>56.96%</td>
<td>$2,121,993</td>
<td>0.97938</td>
</tr>
<tr>
<td>Payoff Option 1 - Year 3 Downside Scenario 1</td>
<td>$3,909,399</td>
<td>(750,000)</td>
<td>$3,159,399</td>
<td>43.04%</td>
<td>$1,359,736</td>
<td>0.97938</td>
</tr>
<tr>
<td>Payoff Option 2 - Year 3 Downside Scenario 1</td>
<td>$1,989,007</td>
<td>(750,000)</td>
<td>$1,239,007</td>
<td>56.96%</td>
<td>$705,766</td>
<td>0.97938</td>
</tr>
</tbody>
</table>

Discount Factor = $e^{-\left(\frac{RF \times T}{2}\right)}$

Discount Factor = $2.71828^{(2.50\% \times 0.83)}$

Discount Factor = 0.97938
The binomial decision tree effectively identifies the economic possibilities for the value of the License Agreement as of the date the option can be exercised, when compared to the cost to exercise the option. Based on the expected future values for the License Agreement as of the date the renewal option could be exercised, the binomial model estimates that the renewal option would be “in the money” under both possible scenarios in Year 3. Under both the upside and downside scenarios, the expected value of the License Agreement exceeds the $750,000 cost to exercise the option by continuing to pay the guaranteed royalties during the renewal period. Accordingly, the economically rational decision would be to exercise the option to continue to realize the value of the License Agreement during the renewal period.

Continuing the process of working backwards in the calculation process, the next step is to calculate the value of the renewal option as of the date of the termination and/or breach of the License Agreement by probability adjusting and discounting to December 31, 2017 the two expected valuation options at the end of Year 2 (i.e., December 31, 2018). Table 12 summarizes this calculation process.

<table>
<thead>
<tr>
<th>Table 12</th>
<th>Calculation of Renewal Option Value as of the End of Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 2 Estimated Probability of Payoff</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Value of Renewal Option at End of Year 2 - Upside Scenario 1</td>
<td>$5,469,736</td>
</tr>
<tr>
<td>Value of Renewal Option at End of Year 2 - Downside Scenario 1</td>
<td>$2,022,918</td>
</tr>
</tbody>
</table>

Discount Factor = $e^{-(RF \times T)}$

Discount Factor = 2.71828 $^{-2.50\% \times 1.00}$

Discount Factor = 0.97531

The BOPM calculates the lost value of the renewal option as of the date of termination and/or breach of the License Agreement at $3.4 million. This compares to the alternative economic damage methodology of estimating the future lost profits associated with the renewal period set forth in Table 4 of $8.99 million. To reconcile these two different methodologies, the lost value of the renewal option represents the lost value associated with the Licensee management’s flexibility to extend the License Agreement as of the date of termination and/or breach when the option was expected to be “in the

\[30\] The value of the renewal option calculated applying a 12.50% and 54.00% annual volatility using the BOPM was $3.46 million and $3.41 million respectively.
“money” based on the historical performance of sales and the projected sales during the remainder of the Initial Term. The estimated future lost profits of $8.99 million is the present value of future earnings expected during the five-year renewal period of the License Agreement, if a renewal took place.

Returning to the binomial decision tree graphic, **Graph 3** summarize the calculation process to determine the value of the renewal option as of the date of the termination and/or breach of the License Agreement.

**Graph 3**

**Summary of Binomial Option Pricing Model of Expected Values of License Agreement & Value of the Renewal Option**

The benefits of the use of the BOPM is its simplicity and its graphic presentation to the process of valuing the option. The mathematical process of the valuation of multi-period binomial option models beyond the scope of this chapter.
The Estimated Value of the Renewal Option Using the Black-Scholes Model

Based on the five basic option valuation inputs previously discussed, the Black-Scholes Model estimates the lost value to the Licensee of the renewal option at the December 31, 2017 date of termination and/or breach at $3.46 million. Table 13 summarizes the results of the BSM analysis. To test the sensitivity of the analysis, the renewal option was valued using all three methodologies to estimate volatility. Under all three estimates of volatility under the BSM, the estimated value of the renewal option was approximately $3.46 million. This particular outcome was influenced by the fact that the renewal option would be viewed as well “in the money” considering the estimated exercise price of $750,000 with 1.83 years remaining to exercise the option. This estimated value of the renewal option was also confirmed by the application of the BOPM, which estimated the lost value of the renewal option under all three assumptions of volatility at approximately $3.46 million as well. This is precisely the expected outcome as both the BSM and BOPM approaches should yield the same result.

A detail discussion of the mathematical assumptions and properties of the Black-Scholes Model is beyond the scope of this chapter; however, the results are based on a significant amount of academic and financial research, peer review and testing. The $3.46 million value associated with the renewal option represents both the combined values of flexibility to continue the Licensing Agreement and the growth opportunity realized by achieving profitability during the Initial Term of the agreement. The actual 2017 financial results provide indicia that the Pre-Litigation Projections were reasonable to allow for the valuation of the License Agreement for the remainder of the Initial Term. The results indicate there is substantial value to the renewal option attributable to the Initial Term of the License Agreement without specifically measuring the lost profits or the lost value of the License Agreement in the renewal period itself.

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 Returning to the economic damages incurred by the Licensee by the alleged breach of the License Agreement on December 31, 2017, the two components of the economic damages related to the Initial Term of the agreement are:

1. The lost profits attributable to the remainder of the Initial Term of $5.29 million as set forth in Table 4; and

2. The lost value the renewal option itself of approximately $3.46 million summarized in both Tables 12 and 13.

The total economic damages associated with the Initial Term is $8.75 million ($5.29 + $3.46). This damage calculation and theory is based on the assumption that the lost profits associated with the renewal period are not allowable by the court. In Table 4, the estimated lost profits associated with the renewal period are $8.99 million compared to the value of the renewal option that existed at the date of the alleged termination of December 31, 2017 of $3.46 million. The renewal option is clearly a Real Option by definition and a separate asset that was contained within the Licensing Agreement and existed at the date of termination and attributable to the Initial Term of the agreement.
Considerations and Problems in Applying the Black-Scholes Model to Real Options

The Black-Scholes Model was originally developed in valuing financial options rather than Real Options. Accordingly, many practitioners and academics argue for the use of the Binomial Option Pricing Model to value Real Options. Special considerations and problems in the difference between Real Options and financial options must be addressed in how the parameters of the Black-Scholes Model estimate the value of Real Options. Some of the considerations to be addressed include the following:

1. The underlying asset subject to the Real Option may not be traded, which makes it difficult to estimate value and variance for the underlying asset.

2. The price of the asset may not follow a continuous process as required in the Black-Scholes formula, which makes it difficult to apply option pricing models that use this assumption.

3. The volatility may not be known or measurable and may change over the life of the option, which can make the option valuation more complex.

4. The exercise of the Real Option may not be instantaneous, which will affect the value of the option.

The Underlying Asset May Not be Traded

With regard to renewal options included in a contract or licensing agreement, the underlying asset is the contract or license agreement itself. The general assumption is the contract or license agreement is part of the normal business operations of the parties to the agreement. Although individual contracts and licensing agreements may not be traded in an open and unrestricted marketplace, the entities owning such contracts and licensing agreements are bought and sold in an open and unrestricted marketplace providing for the opportunity to identify a proxy or yardstick opportunity. Likewise, standard business valuation methodologies such as the income approach are also applicable in valuing contract and licensing agreements to overcome any perceived lack of a market for the trading of the specific contract or licensing agreement itself.31

The Price of the Asset May not Follow a Continuous Process

One of the assumptions underlying the Black-Scholes formula is the underlying asset is continuously traded and the value of the asset evolves via a specific “process” through time. Similar to the issue of whether a contract or licensing may be traded in an open and unrestricted market, the underlying issue of a continuous time option pricing model

31 Depending upon the specific contract or licensing agreement, the market approach to valuing the intangible asset may also be available as an alternative and, in addition to, the income approach.
such as the Black-Scholes Model can be addressed by the fact that entities owning such contract and licensing agreements are continuously bought and sold and stock options for such entities can and are valued using the Black-Scholes Model. Likewise, a contract and licensing agreement can be continuously valued using standard business valuation methodologies.

**Volatility of the Asset May not be Known or Measurable**

Option-pricing models such as the Black-Scholes and the Binomial Option Pricing Model require as an input the estimated future volatility over the remaining life of the option. A starting point to assessing the estimated future volatility is to consider historical volatility. In considering past volatility, the underlying assumption is that the past volatility can be extrapolated directly to the future volatility. In applying the Black-Scholes option pricing model to Real Options associated with a contract or licensing agreement, the use of historical volatility can be a problem. Depending upon the specific facts, there may be no past since the contract or licensing arrangement may relate to a new product, entity, product market or technology. In some cases, a proxy variable can be used to estimate past volatility, such as the price of a gold mining stock or the price of gold if one is valuing a Real Option to abandon or expand a gold mine. With respect to a Real Option such as a renewal option in a contract or licensing agreement, the volatility associated with the entity owning the agreement can be used as a proxy. For privately-held entities, other potential proxies for volatility can include a single or portfolio of similar companies to the subject entity to measure volatility for purposes of pricing the renewal option under the Black-Scholes Model. The proxy selected should indicate expected volatility associated with value of the specific contract or licensing agreement. Any special circumstances or facts the specific agreement that may indicate that volatility would be expected to deviate from the proxy selected should be addressed.

**Exercise of the Real Option May not be Instantaneous**

In certain circumstances dealing with Real Options associated with other assets and projects, the ability to exercise the option immediately may be an issue; however, this is not generally the case with renewal options within a contract or licensing agreement. Accordingly, this issue should not impact the valuation of the renewal option.

**Conclusion**

Real Option theory is a valid methodology to consider and apply depending upon the circumstances and specific facts. Possessing the exclusive right to renew a contract or licensing agreement in itself has value, just like a financial option associated with a stock or other underlying financial asset. Real Option theory has been applied in valuing real estate lease renewals and other projects where there is value in possessing the flexibility to make a "growth" or “abandonment” management decision at a future date. Renewal options are included in contracts and licensing agreements for the same specific reason to provide either party to the agreement with the flexibility to learn and obtain experience under the terms of the agreement to make an economic decision at a later date to extend
and continue the relationship under the renewal right provided or to abandon the agreement if the economics at the end of the initial term indicate that there is no profitability to renew.

Our review of the case law has not identified a contract or licensing agreement situation where the application of Real Option theory to the value of a renewal option has been addressed by the courts. Considering historical practice in many cases where a damage expert is requested to “assume” that economic damages attributable to a renewal period are allowable subject to a final ruling by the court, the application of Real Option theory to value the renewal option itself is based on **objective facts, figures and data** that provide a more defensible position to measure the value of an intangible asset (i.e., the renewal option) that was specifically created by the contract or licensing agreement and is exclusively owned by one of the parties to the agreement.

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