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# How Risky Are Your Lease vs. Buy Decisions?

**By Thomas L. Zeller, CPA, Ph.D.; Brian B. Stanko, CPA, Ph.D.; and Andrew D. Tressler, CPA**

**EXECUTIVE SUMMARY**

Adding risk analysis to your lease vs. buy analytics can make the decision process more involved, but it is worth the effort strategically. To accomplish this, you need to create a comparable analysis that estimates the risk in a lease vs. buy decision. With a few additional steps in the present value analytics, you can develop comparable information to capture the risk of one option over another and manage expectations.

Present value analysis and Monte Carlo simulation make it possible to add risk analysis to your lease vs. buy decisions. Because of the strength of Monte Carlo simulation to model different outcomes, it has the ability to make the risk in a lease vs. buy decision explicit. The results are an effective way for management accountants to add value to the decision process and manage constituents' expectations.

The lease vs. buy decision is a financing decision with an effort to manage an asset's cost volatility (that is, risk) and still support the company's strategic focus.[1] The routine task of a lease vs. buy present value analysis does indeed prescribe a decision. That is, select the lowest present value cost alternative along with other strategic considerations. Strategic considerations may include brand image, how fast technology is changing, or the asset's appearance over time.

A challenge surfaces when trying to estimate the risk associated with a lease vs. buy decision. While the discount rate captures risk in a traditional present value analysis, is it reasonable to assume one discount rate captures the risk of the many different cash flows? Are your lease analytics and your buy analytics comparable? Do you see the risk of leasing over buying from routine present value analysis? And how variable is the range in cost of leasing over buying?

For better lease vs. buy decisions, create a comparable

analysis, and estimate the risk in the decision. By incorporating risk into the analytics, you may find a wide disparity between the cost of leasing over owning or vice versa. With a few additional steps in the present value analysis, you can develop comparable information and capture the risk of one option over another. If you understand how to run Excel, you can use add-in software that captures the risk.

**Nonquantifiable and Quantifiable Risk**

Because of its very nature, some risk is quantifiable and some is not. Risk varies among lease vs. buy options, and it is unreasonable to assign a value to all the risks that come into play in a lease vs. buy decision. Table 1 shows an illustrative list of nonquantifiable risk factors.

Estimating quantifiable risk means providing management with a range of possible present value cost outcomes along with the likelihood of one cost outcome over another.[2] A routine present value analysis provides a single present value estimate regarding the cost of leasing compared to buying. A routine present value analysis extended with Monte Carlo simulation provides a more comprehensive range of possible present value cost outcomes, thus managing expectations and communicating the risk of one option over another.

Monte Carlo simulation weaved into the lease vs. buy decision offers real benefits. Management accountants can readily comprehend and communicate the risk

**Table 1: Nonquantifiable Risk and Acquisition Options**

| Nonquantifiable Risk | Purchase option | Capital lease option | Operating lease option |
|---|---|---|---|
| Vendor (lessor) goes out of business and is not able to support necessary maintenance and updates. This is called a counterparty risk. | X | X | X |
| There is no reasonable alternative supplier for the necessary equipment if the current supplier leaves the market. | X | X | X |
| There is a value-chain problem causing injury to personnel, resulting in a court order to stop manufacturing a product or delivering a service, thus rendering the equipment useless. | X | X | Assume a contract written to include the lessee's right to return with short-term notice and without penalty. |
| A change in technology makes the equipment obsolete sooner than expected. | X | X | Assume a contract written to include the lessee's right to return with short-term notice and without penalty. |
| There is a shortage of workers who know how to use and/or maintain the equipment. | X | X | X |
| Management accountants apply a changing discount rate in the analysis. | X | X | X |
| There is political risk because the company operates in foreign countries. | X | X | X |

associated with the lease vs. buy decision. They may find that the lease option in support of a particular strategic objective is very expensive compared to a buy option. Or they may find that the cost of leasing—and not carrying the risk of ownership—is very similar to owning the asset itself. With Monte Carlo simulation, the analytics provide an estimate of the risk to support the decision to lease vs. buy, thus managing expectation well beyond selecting the lowest-cost present value amount (a single cost estimate) alternative.

We will now briefly examine how to interpret the output of a Monte Carlo simulation used in a lease vs. buy decision.

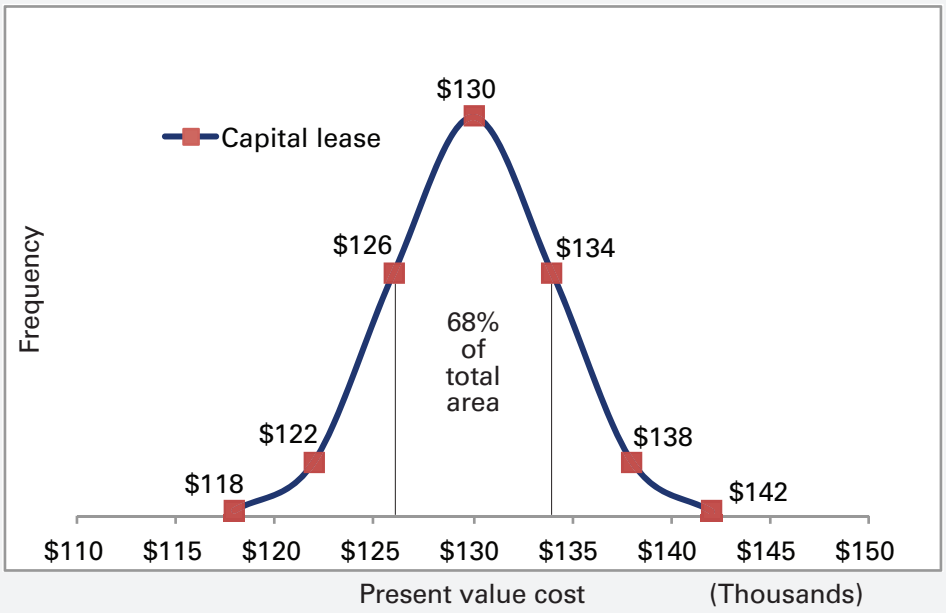
***Interpreting Monte Carlo Simulation Output***

Distribution theory directs the interpretation of Monte Carlo simulation output. The height of the distribution in Figure 1 represents a frequency count (histogram). The value with the greatest frequency is the most likely outcome in Figure 1. This value, $130, represents the single estimated cost from a traditional present value analysis.

Think of the space under the curve in Figure 1 as an area. The entire area is equal to 100%. Distribution theory tells us the area can be broken into six zones (standard deviations), three on each side of $130. Each value in Figure 1 marks off one, two, and three standard deviations from each side of $130.

Insight comes from reading the values immediately to the left and right side of $130. Notice the value of $126 to the left of $130 and $134 to the right of $130. These are the present values at one standard deviation from $130, labeled one standard deviation left of the mean and one standard deviation right of the mean. Distribution theory tells us that the area under the curve at one standard deviation from the most likely value ($130) is 68% of the total area under the curve. The interpretation is that there is a 68% chance the capital-lease contract present value cost will fall between $126 and $134.

**Figure 1: Monte Carlo Simulation: Capital Lease Distribution**



Notice the value of $122 to the left of $130 and $138 to the right of $130. These are the present values at two standard deviations from $130. Distribution theory tells us that the area under the curve at two standard deviations from the most likely value ($130) is 95% of the total area under the curve. The interpretation is that there is a 95% chance the capital-lease contract present value cost will fall between $122 and $138.

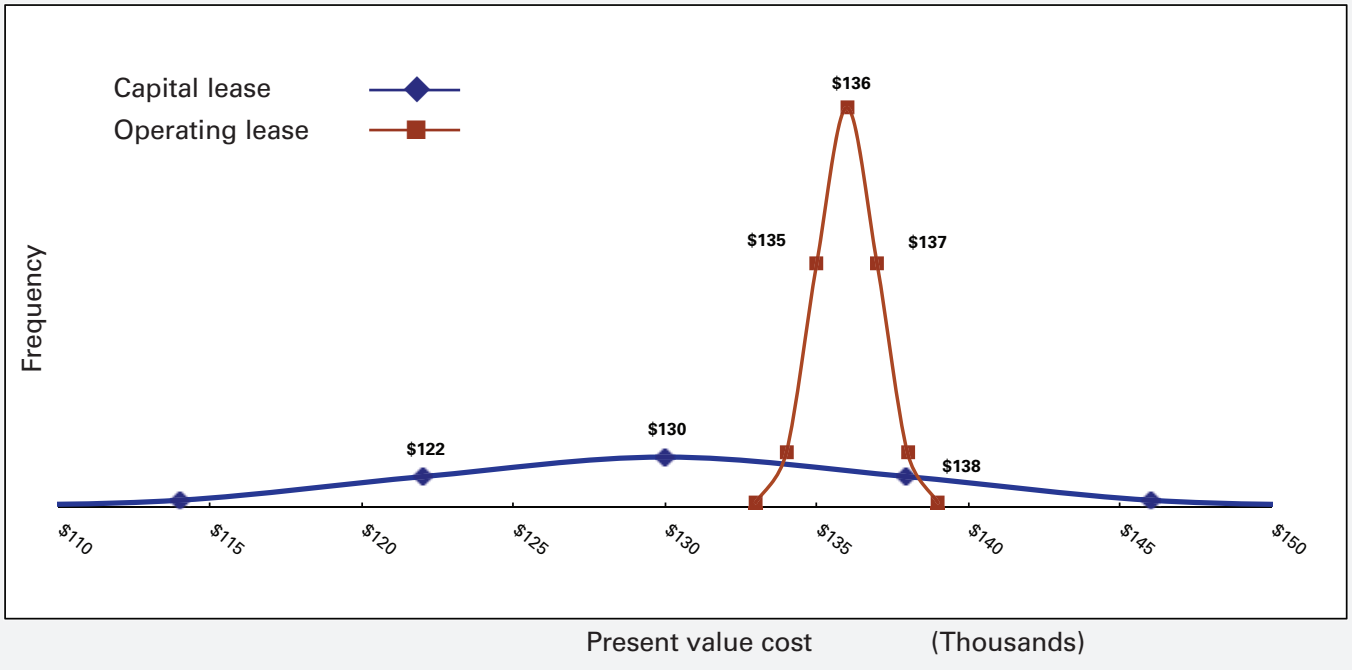
Notice the value of $118 to the left of $130 and $142 to the right of $130. These are the present values at three standard deviations from $130. Distribution theory tells us that the area under the curve at three standard deviations from the most likely value ($130) is 99% of the total area under the curve. The interpretation is that there is a 99% chance the capital-lease contract present value cost will fall between $118 and $142.

Now you can define and evaluate risk in the context of a Monte Carlo simulation. Figure 1 shows present value outcomes at one, two, and three standard deviations from the mean. The greater the range in each cash flow estimate used in the model, the greater the distribution in present value outcomes at one, two, and three standard deviations overall. The wider the distribution at one, two, and three standard deviations, the greater the risk associated with a lease vs. buy decision. The risk described by Monte Carlo simulation output is explicit.

In application, it is subjective yet reasonable to evaluate the risk at one standard deviation from the most likely value. Some cash flow costs are likely to be higher and others lower. Overall, the costs should balance out within one standard deviation.

Figure 2 shows an overlay of two lease options. In this illustration, the most likely costs for the respective leases are $130 and $136. But looking at this with a critical eye captures further insight. The capital lease cost is likely to range between $122 and $138 at one standard deviation from $130. The operating lease cost is likely to range between $135 and $137. This means that if the actual cash flows for the capital lease and operating lease are more than expected, the capital lease will cost approximately $138 compared to approximately

**Figure 2: Overlay of Options: Capital Lease and Operating Lease Distributions**



$137 for the operating lease. Why would a company take on the risk of a capital lease when it can retain the flexibility of an operating lease for approximately the same cost? At this point, strategic factors need to be taken into consideration, such as the intent to own, brand image, and/or technology concerns.

Each lease vs. buy decision is made on its own merit. A routine present value cost estimate provides necessary but insufficient information. Adding a Monte Carlo simulation to this effort shows that each option carries risk. The more difficult the cash flow estimate, the more useful it is to describe the risk of each option. The constituent should know there is a range of possible outcomes in the lease vs. buy decision.

### Managing Cash Flow Estimates

Authoritative accounting literature explains how to manage cash flow estimates in financial analysis modeling. Statement of Financial Accounting Concept Number 7 (CON 7), *Using Cash Flow Information and Present Value in Accounting Measurements*, "provides a framework for using future cash flows as the basis for accounting measurement….It provides general principles that govern the use of present value, especially when the amount of future cash flows, their timing, or both are uncertain," and CON 7 further articulates why cash flow estimates necessitate careful consideration: "An accounting measurement that uses present value should reflect the uncertainties inherent in the estimated cash flows; otherwise, items with different risks may appear similar."[3] CON 7 suggests incorporating a range of cash flows into a present value analysis because it captures the risk that is associated with the cash flow uncertainties.

### Present Value Analysis with Monte Carlo Simulation

Monte Carlo simulation can be used to incorporate a range of cash flows into the present value analysis to get a better estimate of the risk of cash flow uncertainties. But a Monte Carlo simulation involves several critical variables, including time, discount rate, cash flow amounts, and risk. Here is an explanation of how to apply each one in the context of the present value analysis.

#### *Time*

A careful question about a company's strategic objective guides the application of time in present value analysis. Strategically, does the company want to own the asset at the end of a specified period? The answer establishes the time assumption for the present value analysis.

Protecting brand image is a common strategic objective. Management must ask a key question: What business factors need vigilant consideration in protecting the company's brand image? For example, consider a restaurant food supplier with daily distribution. The supplier would want the truck delivery fleet to be very reliable and look relatively new and clean. The failure to deliver because of a breakdown would certainly be a concern. It is also important that the supplier's fleet of trucks carries the company's brand image and affects how the restaurant customers perceive the supplier's quality. Old, dirty, rusted trucks delivering food supplies to a restaurant do little to enhance the supplier's brand image. The answer is to carefully control the quality and appearance of the trucks as one component of brand image management. In doing so, the company may have a policy of leasing new trucks every five years to maintain a high level of brand image. The leasing contract forces management to place new trucks into service every five years when in fact the trucks may offer a seven-year life. Without the contract, it is too easy to push back the fleet replacement, losing sight of the fleet's role in brand image management as a strategic objective.

Ownership is another strategic objective consideration. What is management's plan for the asset at the end of its useful life? For example, consider office furniture and fixtures. Desks, lamps, and other furniture and fixtures last well beyond their depreciable life. Management may elect to own the assets after lease completion or simply purchase the assets outright. Warehouse shelving is another example of an asset the company may want to own. Generally, the useful life extends well beyond the depreciation window. Although shelving is not a permanent structure, it may take substantial effort to replace when the lease terminates. Therefore, management may elect to own that asset upon completing the lease contract.

As the previous examples suggest, the time built into

a present value analysis should be the asset's estimated useful life, with ownership transferring to the lessee at the end of the lease when management elects to own the asset. Thus, a strategic view of each asset plays a substantial role in setting the time attribute in a present value analysis.

### *Discount Rate*

Technical literature guides the discount rate to apply in a lease vs. buy present value analysis.[4] Essentially, the lease vs. buy is a financing decision. The lease displaces debt and can be considered a loan equivalent. It is assumed that the lease payments carry risk similar to bank debt payments. Therefore, to establish comparability, the lessee should use a bank loan rate (loan equivalent) to discount the future cash flows in the lease present value analysis.

### *Cash Flow Amounts and Risk*

Cash flow estimates bring risk to the forefront in a lease vs. buy present value analysis. The lease and the buy present value models require several different cash flow estimates. The model requires estimates at the point of initial acquisition, throughout the lease period, and at the end of the lease term or life of the asset. Some of the cash flow estimates are easy to do and are very predictable, while others are difficult. The assumed tax rate also affects cash flow estimates.[5]

Risk requires a careful consideration at this point. The discount rate applied in a lease vs. buy present value model carries a loan equivalent perspective. Implicitly, this means the loan equivalent discount rate captures the risk of all cash flow estimates. For example, using a loan equivalent rate assumes that the risk in cash flows associated with maintaining the asset is the same as the risk in cash flows associated with the estimated residual value. The same assumption holds for the tax rate and all the different cash flows in a present value model. The concern, however, is that it is unreasonable to assume one discount rate captures the risk of the many different cash flows.[6] A further concern is that the risk associated with the range of possible cash flow estimates is not explicit with routine present value analysis alone. A description of the risk associated with a lease vs. buy decision is lacking, as is a mechanism to capture the risk with each cash flow estimate.

### *Illustrating Cash Flow in a Lease vs. Buy Decision*

In general, risk tied to cash flows in a lease vs. buy analysis falls into four areas:

- Initial acquisition/lease,
- Routine maintenance and updates,
- Residual value, and
- Tax rate.

Cash flows associated with an initial acquisition or a lease may or may not be difficult to estimate. A contract that specifies the initial acquisition/lease costs is easily managed in a present value model. A challenge surfaces when the acquisition/lease analysis includes training, installation, and/or other initial cash flow estimates. For example, the exact cash flow amounts may not be known until training and installation are complete. The initial cash flows may be more or less than estimated. This risk is not measured in a routine lease vs. buy present value analysis.

Cash flows throughout the life of an asset, such as routine maintenance and updates, may or may not be difficult to estimate. A lease contract may specify the amount of routine maintenance and update cost. Risk does not come into play in this situation, but it does come into play in a lease or buy when the lessee or owner is responsible for all maintenance and updates. For example, the accounting or finance professional may have difficulty estimating precise cash flows because of a change in technology (especially software), usage, and/or customer needs. The variability in cash flows contributes to the risk and thus a range of possible present value outcomes.

Cash flows associated with residual value require careful scrutiny. In a buy situation, risk emerges when estimating cash flows at the time of disposal. In a lease situation, risk emerges in the structure of the contract. The contract may specify fair market value or a guaranteed amount for the asset at the end of the lease term. Regardless, certain end-of-lease contract term specifications introduce variability into the lease vs. buy analysis.

The assumed tax rate built into the lease vs. buy analysis adds further to cash flow variability. Note the

compounding influence. Cash flow estimates of a particular expense (for example, software updates) may vary. The difference between the actual tax compared to the estimated tax rate adds further variability to the software cash flow estimate. Thus, changes in tax regulations and variability in performance introduce risk into the present value model.

***Lease vs. Buy Example***

Tables 2 through 4 summarize a medical practice's options for acquiring a new microscope by leasing or buying it. The equivalent loan rate applied in each option is 5%, and all variables were assumed to approximate a triangular distribution.[7]

Figure 3 shows the lease vs. buy present value output from a Monte Carlo simulation.[8] The operating lease is clearly the highest-cost option, yet it carries the least amount of risk. The terms of the lease are such that the lessee can return the microscope with one month's notice and walk away from the contract without further liability. Given the terms of the contract, the present value cost range at one standard deviation from the most likely cost estimate is approximately $140 to $144. This may be a reasonable choice depending on management's confidence in the service delivery associated with the new equipment. The management accountant can communicate the cost and risk associated with the flexibility offered with an operating lease.

The capital lease vs. buy option shown in Figure 3 offers further insight. The most likely present value cost estimate is approximately $127 to buy and $130 to lease, assuming the cash flow estimates prove to be accurate. This is rarely the case in real-world outcomes, however. The decision should not be based on an expectation that there is a $3 ($130 – $127) difference in present value cost. The management accountant must carefully manage constituent expectations and communicate that there is a range of possible present value cost outcomes.

Monte Carlo simulation offers further insight. There is a 68% chance the buy option will cost between $122 and $132. There is a 68% chance the capital lease option will cost between $126 and $134. Monte Carlo simulation depicts for the management accountant the risk of buying is greater than the risk of leasing. The buy risk range is $10 ($132 – $122), where the capital lease

## Table 2: Buying Medical Equipment

The buy will have a five-year life with a double declining balance.
Assume the company will sell the equipment at the end of Year 3.

| Description | Amount | Range and Additional Information |
|---|---|---|
| *Initial Acquisition* | | |
| Microscope | $100,000 | Minimum = $91,000, maximum = $109,000 |
| Install electrical components | 10,000 | Minimum = $7,000, maximum = $13,000<br>Expensed at end of year one |
| Install temperature control | 3,000 | Minimum = $2,400, maximum = $3,600<br>Expensed at end of year one |
| *Annual Actions* | | |
| Lens calibration and general maintenance | 20,000 | Minimum = $14,000, maximum = $26,000 |
| Software updates | 5,000 | Specified by contract |
| Training | 10,000 | Minimum = $7,000, maximum = $13,000 |
| Depreciation expense | | Estimated five-year life, double declining balance |
| Estimated resale value | 35,000 | Minimum = $29,000, maximum = $41,000 |
| Income tax rate | 30% | Minimum = 27%, maximum = 33% |

## Table 3: Capital Lease for Medical Equipment

The capital lease is not cancellable, and the lessee is liable for the three-year contract period.

| Description | Amount | Additional Data |
|---|---|---|
| *Initial Acquisition* | | |
| Install electrical components | $10,000 | $9,250 to $10,750, expensed at end of Year 1. |
| Install temperature control | 3,000 | $2,850 to $3,150, expensed at end of Year 1. |
| *Annual Actions* | | |
| Microscope lease | 58,000 | There is a three-year annual contract price. The estimated life of the microscope is five years. The company leasing the medical equipment will apply a double-digit depreciation rate for tax purposes. |
| Lens calibration and general maintenance | 15,000 | This is a contract price that applies regardless of the frequency of service. |
| Training | 10,000 | $9,250 to $10,750 |
| Guaranteed fair market value | 40,000 | |
| Actual fair market value | 40,000 | $37,000 to $43,000 |
| Income tax rate | 30% | 27% to 33% |

## Table 4: Operating Lease for Medical Equipment

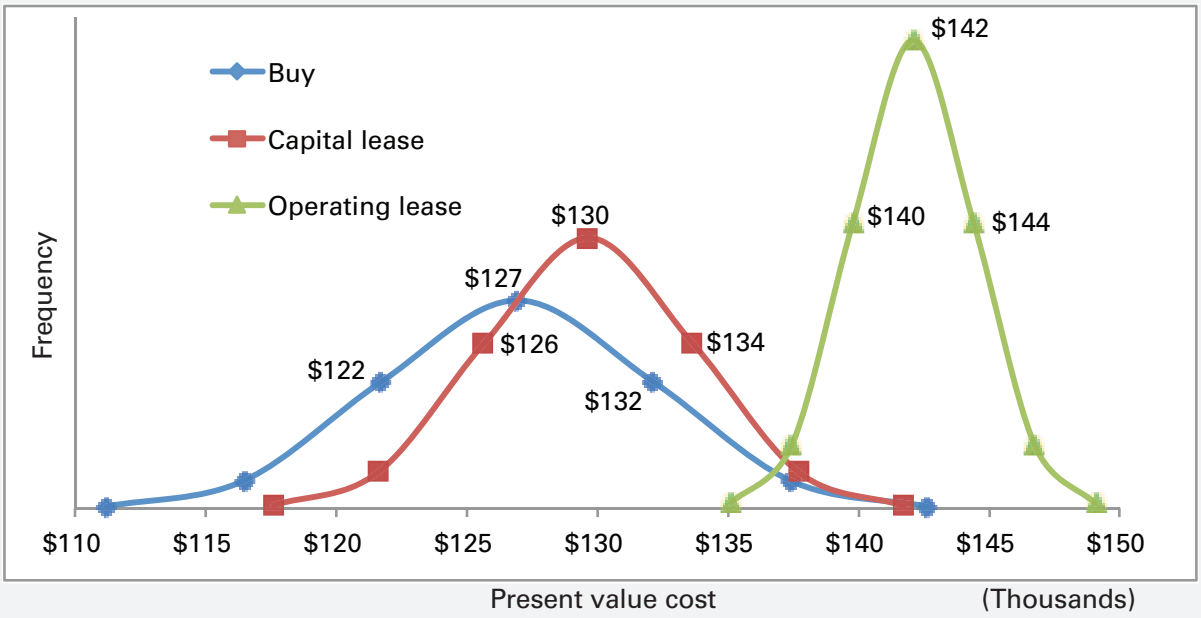
The lessee can cancel the operating lease with a 30-day notice without incurring further liability to the lessor.

| Description | Amount | Additional Data |
|---|---|---|
| *Initial Acquisition* | | |
| Install electrical | $10,000 | $8,000 to $12,000, expensed at end of Year 1. |
| Install temperature control | 3,000 | Contract price, no range |
| *Annual Actions* | | |
| Microscope lease | 70,000 | Contract price, no range |
| Training | 10,000 | $8,500 to $11,500 |
| Income tax rate | 30% | 27% to 33% |

risk range is $8 ($134 – $126). Further, the simulation shows that if costs are less than planned, the buy option present value cost is approximately $122, compared to the capital lease option at $126. The simulation shows the difference narrows if costs are more than planned to buy at $132, compared to the capital lease option at $134. The management accountant armed with Monte Carlo simulation data can manage expectations and say,

"I estimate the cost difference to acquire the microscope with a buy vs. capital lease is approximately $2 ($134 – $132) to $4 ($126 – $122). The chart shows an entire range of possible present value costs. Estimating a difference of $2 to $4 is

**Figure 3: Medical Equipment Acquisition Option with Respect to Risk**




reasonable assuming individual cash flow estimates move in approximately the same direction for the capital lease and buy option."

The microscope's strategic role guides the decision at this point. The microscope may last several years, but new equipment may be important to the practice's image and quality of care to patients. Monte Carlo simulation captures the additional cost of image and quality of care in this illustration. The difference in cost is estimated to be approximately $2 to $4.

The conclusion may be completely different with a different type of asset. Assume the illustration is built around snow-blowing blades attached to trucks to clear airport runways. In this case the company would likely want to own the blades. Certainly every analysis will be different, driven by time, discount rate, cash flow estimates, and asset strategic role.

### Making a More Informed Decision

The lease vs. buy decision is a recurring event in business. The complexity of the task adds a twist to the decision. Establishing a comparable evaluation and estimating the risk of each option allows for a more informed decision. Using a loan-equivalent discount rate establishes comparability. Monte Carlo simulation adds considerable insight to the decision-making process by approximating the risk of one option over another. Commercially available software running Monte Carlo is readily available and easy to run as an add-in to Excel. With additional insight about risk, management accountants are now able to further consider the qualitative issues surrounding a lease vs. buy decision. ■

*Thomas L. Zeller, CPA, Ph.D., is a professor of accounting at Loyola University Chicago and an IMA® Member-at-Large. He can be reached at tzeller@luc.edu.*

*Brian B. Stanko, CPA, Ph.D., is also a professor of accounting at Loyola University Chicago. He can be reached at bstanko@luc.edu.*

*Andrew D. Tressler, CPA, is vice president, finance at*

*Snap-On Credit, Libertyville, Ill. He is a member of IMA's Chicago Chapter. Andrew can be reached at andrew.tressler@snaponcredit.com.*

## Endnotes

1 Harold Bierman, Jr., and Seymour Smidt, *The Capital Budgeting Decision: Economic Analysis of Investment Projects*, 9th ed., Routledge, New York, N.Y., 2007, p. 304. The authors argue, based on literature from the 1960s and 1970s, that the lease vs. buy decision is misnamed. Technically, the lease vs. buy decision is a financing decision.

2 What-if analysis provides a range of possible present value amounts, but it does not provide insight regarding one outcome over another (percentage estimates associated with the range of possible present value amounts).

3 Statement of Financial Accounting Concepts Statement No. 7, *Using Cash Flow Information and Present Value in Accounting Measurements*, Financial Accounting Standards Board (FASB), Norwalk, Conn., February 2000, pp. 4-5.

4 Richard F. Vancil, "Lease or Borrow—New Method of Analysis," *Harvard Business Review*, September/October 1961, pp. 122-136. In particular, Vancil states, ". . . in order to compare acquisition alternatives, the lessee *should compare the cost of a leasing plan against the cost of raising the same amount of capital through debt financing, at the lowest possible rate available to him*" (emphasis added), p. 125; see also Stewart C. Myers, David A. Dill, and Alberto J. Bautista, "Valuation of Financial Lease Contracts," *Journal of Finance*, June 1976, pp. 799-819.

5 Wilbur Lewellen, Michael Long, and John McConnell, "Asset Leasing in Competitive Capital Markets," *Journal of Finance*, June 1976, pp. 787-798. The authors support the equivalent loan application and emphasize the need to take into consideration corporate tax rate fluctuation in the lease vs. buy decision.

6 Richard Brealey, Stewart Myers, and Franklin Allen, *Principles of Corporate Finance*, 9th edition, McGraw-Hill/Irwin, New York, N.Y., 2009, p. 709, suggest that different discount rates be used for different cash flow categories. This resolves the potential problem with discounting cash flows with a rate that does not match the risk. Yet the fundamental problem remains. The present value model output simply prescribes a point estimate for management, but a measure of risk and the information to manage the risk within a lease vs. buy decision is lacking. Also see Lewellen, Long, McConnell, 1976.

7 We used a triangular distribution because of the need for only three estimates and the many intervening external factors that play into the actual cash flows. The accounting professional needs to only estimate the best- and worst-case scenario cash flows along with the most likely cash flow.

8 The spreadsheet is available upon request from Thomas Zeller. The output is produced with Crystal Ball Monte Carlo simulation. The commercial software industry offers several Excel add-ins that run Monte Carlo simulation. The authors are not associated with any software company.