Total Cost of Ownership (TCO): A Brief Tutorial

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Introduction

Total Cost of Ownership (TCO, or total ownership cost TOC), is a concept that is increasingly used in business around the world. The essence of the concept is that the full costs of a decision should be evaluated, rather than focusing on the initial purchase price (of hardware and software for example). The term TCO is relatively new (probably popularized by the Gartner Group in the last 15 years), but the approach is similar to notions of life cycle costs and other valid economic criteria for properly evaluating business decisions.

The term TCO is sometimes used to describe the full costs of one choice. In other instances, the term TCO is used to describe the comparison of full costs of two competing alternatives. With either usage, the approach is the fundamentally the same - to calculate the full costs of a business alternative. The term, and the approach, is especially popular (and useful) in evaluating the possible deployment of a new technology, or the head-to-head comparison of two competing technology platforms.

When properly applied, TCO reflects the full opportunity cost of a decision (i.e., of taking one course of action rather than another). Therefore, TCO reflects not only the initial purchase price of assets, but also the less obvious initial costs of training personnel to use the new assets, the costs of upgrades over time, maintenance and operating expenses, and net salvage value (negative or positive) of the asset at the end of its life, and other costs.

Present Value

There are many different ways to consider organizing or categorizing the relevant costs. Some analysts recommend identifying direct costs (e.g., hardware and software purchase price) v. indirect costs (e.g., training and migration costs). I find it useful to also think about costs over time; that is the initial costs (both obvious direct as well as indirect costs). Part of the reason this distinction is important is that a decision should rest not on the nominal sum of the costs, but rather on the present value of the costs. A dollar today is worth more than a dollar one year from now; a dollar of cost (or revenue) today is more important than a dollar of cost (or revenue) one year from now. The relevant discount rate (interest rate) is the firms marginal cost of capital corresponding to a level of risk commensurate with the project.

Example

Consider a hypothetical example. ABC retail is contemplating implementing a new billing system. The major components of the system will be: hardware, software, initial training, other transition costs, subsequent software upgrades, subsequent training, ongoing maintenance and operations. Salvage is zero. For simplicity, the billing system is assumed to last 3 years. ABC's finance group informs us that the forward-looking cost of capital is 15%.

The calculations below implicitly assume initial purchase at time zero, and that other cash occur at the middle of the year. I.e., cash outlays for year 1 are assumed to occur 6 months after initial purchase, those for year 2 occur 18 months after initial purchase). In practice, this so-called "mid year" calculation is often a reasonable approximation if the initial purchase occurs at the very end of the prior year/start of year 1 and if subsequent cash outlays are fairly evenly spread over the year. Monthly calculations (using a mid-month convention) are more accurate.

Costs of New Billing System in $1,000					
Discount Factor	1.0000	0.9325	0.8109	0.7051	
	Year 0	Year 1	Year 2	Year 3	PV Costs
hardware	$1,000				$1,000
initial software	$2,000				$2,000
initial training	$800				$800
other transition costs	$800	$400			$1,173
subsequent software upgrades		$1,000	$1,000	$500	$2,096
subsequent training		$200	$200	$150	$454
maintenance & operations		$500	$600	$700	$1,446
Total Costs	$4,600	$2,100	$1,800	$1,350	**$8,970**

Note that the nominal (not present value) cost of the existing billing system is $9,850,000. The present value of the costs is $8,970,000 over the three years. The most obvious costs are the hardware and software initial purchases, but these items sum to only $3 million; not much more than a third of the total costs.

Is the new billing system a good decision? We are far short of the necessary information to make such an assessment.

Example: Cost Comparison

Part of the relevant information necessary to evaluate the new billing system are the costs of continuing operations with the old billing system.

Costs of Existing Billing System in $1,000					
Discount Factor	1.0000	0.9325	0.8109	0.7051	
	Time 0	Year 1	Year 2	Year 3	PV Costs
hardware upgrades	$200		$100		$281
initial software					
initial training					
other transition costs					
subsequent software upgrades		$100	$100	$150	$280
subsequent training		$40	$40	$40	$98
maintenance & operations		$2,000	$2,500	$3,000	$6,007
Total Costs	$200	$2,140	$2,740	$3,190	**$6,667**

Note that the nominal (not present value) cost of the existing billing system is 8,270,000. The present value of the costs is significantly smaller at $6,667,000 since the costs occur disproportionately towards the end of the period, while with the new billing system, the costs occur disproportionately towards the start of the period.

One of the more important costs of the existing billing system is the relatively high costs of operations and maintenance. The new billing system allows operations with a much smaller staff than the existing billing system.

Benefits?

Should the new billing system be implemented? The total cost of ownership (in present value) of the new system is $8,970,000 v $6,667,000. What we can say is that unless the new billing system allows new sources of contribution or net revenue (net of any other additional costs not identified in the analysis so far) greater than $2,303,000, then the new billing system is not a rational business decision.

In some instance, a new technology can be justified simply on the basis of the present value of a cost comparison; reductions in operating costs dominate (in PV) the cost comparision. Often, however, new technologies can only be justified (if at all) on the basis of cost comparisons as well as opportunities for additional revenues.

Risk, Sensitivity Analysis, and Real Options

A full evaluation of the present value of the costs and benefits of the two competing business choices is critical for making a sound decision. However, this is often not sufficient to make a rational choice. This primary analysis must be overlaid with assessment of the risks of each choice, and the level of flexibility each offers in a real world of variability and uncertainty.

Typically, cost and revenues are analyzed with point estimates. One method for expanding the analysis is the use of multiple scenarios (with associated probabilities). One method of display is the decision tree.

Another analytical tool is that of real options. This analytical tool helps one consider the degree to which each competing alternative expands (or contracts) managerial flexibility in dealing with likely real world results. For example, does one technology allow for greater ease (more rapid or lower cost) expansion or contraction of capacity? These topics are considered in more detail later.