

If You Don't Compute the Cost, You Pay the Price

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In his article, "Nickel and Dimed to Death," Malcolm Gladwell illustrated that when it comes to money "consumers consistently make decisions that defy common sense" (1991, p. 31). One consumer decision Gladwell described as defying common sense is the failure to recognize the difference between price and cost. Consumers tend to use these two terms interchangeably in everyday conversation. When someone asks, "Hey, what did that cost you?" he or she is probably quizzing about the dollar amount paid at the time of purchase. However, the terms *cost* and *price* have very different implications, especially with respect to the purchase of durable goods. Miller and Stafford (2001) suggest that all costs, that is, cost and price, need to be considered when purchasing durable goods. These purchased goods should be considered investments.

In our affluent society, status is often judged by the consumption of a large array of durable goods; thus Americans spend a lot on durables. Durable goods are defined in this paper and by the U. S. Bureau of Labor Statistics, as products with an expected lifetime of three years or greater (U. S. Bureau of Labor Statistics, 2003).¹

Determining the price of a durable good is usually straightforward since the price is simply what is paid to sellers when the durable is bought. The cost is more comprehensive and hence more difficult to identify. Costs include not only the

¹ Sources for information on the life expectancy and household saturation of specific household durables include: the U.S. Census Bureau (www.census.gov); the National Automobile Dealers Association (www.nada.org); and Appliance Magazine (www.appliancemagazine.com), which puts out an annual statistical report every year on the U.S. appliance industry.

purchase price but also an array of additional costs that are incurred during acquisition and operation. This makes computing the full cost an inherently difficult task. It is also time consuming due to such factors as: the need to predict future events; the lack of essential information concerning many aspects of the durable; and the required arithmetic computations. Additionally, the seller or manufacturer may deliberately withhold or distort critical price and quality information.

As consumer educators know, people tend to think of the "now" when it comes to spending rather than the future. Gladwell and others have pointed out that, when consumers do look to the future, many discount future dollars at a much higher rate than can be justified in terms of economic efficiency. This may be caused by a lack of information about future costs, or an inability to process that information, or both. For example, a consumer may decide to purchase a low-priced air conditioner that has relatively high energy costs. Consumers either cannot or prefer not to do the computations that might show that the higher-priced air conditioner is really a "better buy." The extra dollars spent on electricity in the future tend to have little impact on the calculus of the current decision.

If consumer educators could more effectively convey the message that significant dollar differences exist between the initial prices paid and the total cost of ownership, consumer decisions may become more efficient. This approach involves identifying and analyzing an array of costs, called life-cycle costs or LCC, which should be factored into the total cost of owning a durable good. This paper is a synthesis and bundling of ideas, many of which have been published elsewhere, in order to assist educators in their attempt to provide students and clients with guidelines for more efficient and satisfying purchases of durable goods (Hutton & Wilkie, 1980; Gladwell, 1991; Miller & Stafford, 2003). We take a broad overview that includes in one bundle cost factors that most other published materials have dealt with individually. This bundle consists of a comprehensive list of acquisition costs (including search costs) and operation costs

(including opportunity cost). This bundle also takes into account the concepts of present and future value. Social and psychological costs are excluded from our discussion.

If consumers are aware of most, if not all LCC, they will be in a better position to make decisions that are efficient in the long run. Note that this paper uses the purchase of a particular durable good (a desktop computer) to illustrate the concept of LCC. However, the process of determining LCC can be applied to nearly all durable purchases. In their research, Hutton and Wilkie (1980) argue that consumers can use the principle of LCC when deciding whether to purchase durable goods, because it is the organizing of information that provides a logical and common time frame for determining product costs. The military, government, and industry have used LCC for years to increase efficiency, yet consumers have not.

Calculation of Life-Cycle Costs

Life-cycle costs (LCC) consist of net acquisition costs and operation costs. The former are one-time expenditures incurred in the purchasing process, minus the present value of residual value at the end of the holding period. The latter are charges incurred subsequent to the purchase arising from ownership. When calculating LCC, it is important to convert all costs either to present or future values for comparison. A present value (PV) approach is used in this paper. For costs that occur only once (one-time costs), such as the residual value of the durable, the Present Value Factor (PVF) is used for the conversion:

$$PV = M * PVF = M * \left(\frac{1}{1+r}\right)^n,$$

where M is the cost before conversion, r is the discount rate, and n is the number of periods (years or months, for example).

For periodical costs, the Present Value Factor Sum (PVFS) is used for conversion:

$$PV = M_p * PVFS = M_p * \frac{1 - \left(\frac{1}{1+r}\right)^n}{r},$$

where M_p is the periodical cost, which is incurred every period (i.e., annual energy cost).

In the following discussion of the costs of durables, a notation of "(PV)" means this cost has to be converted to present value to be included in the computation of LCC.

Net Acquisition Costs

Net acquisition costs are the difference between the acquisition costs and the present value of the residual value. Depreciation, or loss of value of a good over time, is typically a function of wear and tear. However, depreciation may be caused by functional obsolescence (e.g., LCD flat screen monitors replacing old CRT technology) or fashion obsolescence (e.g., changes in the color of kitchen durables make appliances in out-of-fashion colors obsolete). If one were to compute the *annual* depreciation based on the market value of the durable, an accelerated method is appropriate since the good loses market value at a greater rate earlier in its life. However, households usually do not purchase durables for resale but for continuous use. Therefore, it may be assumed that the household receives a constant flow of services from the durable over its life. With this assumption, a straight-line method of depreciation is appropriate for most household durables.

Almost all acquisition costs are incurred at the time of purchase and thus are in present value form. Residual value is incurred when the durable is resold as a used good or is disposed of and thus has to be converted to present value.

1. Search Costs. Search costs are costs incurred by consumers gathering sufficient information to make intelligent decisions plus immediate costs incurred in acting upon the information obtained. Examples of search costs are: (a) travel costs associated with visiting different sellers, (b) the purchase of an informational

database, such as \$24.99 for CARFAX, and (c) the value of the time required to compile the appropriate information and negotiate the purchase.

2. Purchase Price. The purchase price is the money paid for the item. Although price is often the simplest component of cost, identifying the true price can be difficult because discounts, coupons, or rebates may camouflage the real purchase price.

3. Accessories. Sellers often make more money on the sale of accessories than on the basic product. Purchasing accessories to make the durable function in the manner desired can be one of the largest components of acquisition costs.

4. Sales Taxes. Many states impose sales taxes on the retail price of a product; good accounting procedures require that the sales tax be included as part of the price.

5. Shipping and Handling Charges. When charged separately, shipping and handling becomes part of the acquisition costs. With the growth of on-line shopping and mail-orders, these charges have become more significant.

6. Installation and Set-up Charges. For large appliances such as dishwashers or air conditioners, installation costs can amount to a substantial sum. Because of the complexity of computer installation and set up, some firms now offer services for a fee that will load software and provide initial instructions to the user.

7. Extended Warranties and Service Contracts. These are purchased at the time of sale by the buyer in an attempt to reduce repair costs. Consumer advocates consistently report that service contracts and extended warranties are a poor investment, and consumers are better off setting aside money in a savings account to be used for repairs.

8. Additional Equipment. Sometimes the consumer has to buy additional equipment in order to use the durable purchased. For example, one may need to purchase a computer desk for the computer to sit on.

9. Education Costs. With many newer and more sophisticated technologies, some type of training may be necessary to enable the

user to operate the durable good effectively. An example would be taking a course to learn to use specialized software.

10. Environment Changes. Sometimes alterations in the durable good's environment are needed to get the most efficient use from the good. For example, electrical or plumbing adaptations may need to be made.

11. Residual Value (PV). The value of the durable at the time of disposal, known as the residual value, must be factored into the final LCC computation as a reduction in acquisition costs. An automobile that has been driven for eight years is not just discarded when a replacement is bought; it is often traded in for value. Other durables may be sold at yard sales or through classified ads. The resale value varies widely across durables, and among models and brands. In some cases, the durable may have negative residual value when the owner must pay to get rid of the durable good, because its usefulness has ended. If the disposal of the durable involves a cost, this cost should be added to the acquisition cost.

Operation Costs

Operation costs include all outlays for the durable from the time of purchase to the time of disposal. Operation costs usually occur during a period of time when the durable is in use, and thus have to be converted to present value form.

1. Repairs (PV). Consumer goods may vary significantly in cost when repair expenses are considered. The primary factors for determining repair costs include frequency and magnitude of product failure, variations across suppliers in the price of parts and labor, complexity of the product, and availability of service. Of all operation costs, repair costs are among the most unpredictable. The consumer magazine *Consumer Reports* (www.consumerreports.org) often provides data on frequency of repairs and average repair costs for many durables.

2. Maintenance (PV). Many durables require scheduled care such as lubricating, cleaning, inspecting, etc. Scheduled

maintenance can contribute substantially to the cost of operation, and varying maintenance schedules among different brand models may show one model to have a significant cost advantage. For example, an automobile model that requires oil and filter changes every 3,000 miles will be significantly more expensive to maintain than one that requires changes every 7,500 miles.

3. Disposables (PV). Many durables require disposables; that is, things that get consumed during use (i.e., ink cartridges for printers). Frequency of need and cost per unit of the disposable can result in significant operating costs. There also may be differences in the cost of disposables across different brands.

4. Energy (PV). For some durable goods such as personal computers, energy costs are negligible. For others such as refrigerators and automobiles, they can be one of the most substantial expenses of ownership. Differences in energy costs can quickly dissipate any initial price advantage.

5. Personal Property Taxes (PV). Some state and local governments regard certain durables, usually automobiles and recreational vehicles, as personal property and tax them as such.

6. Insurance (PV). For some expensive durables, homeowner's insurance will not offer protection against loss attributed to theft or catastrophe. For items such as these, the insurance premium for additional coverage is another cost.

7. Interest Expenses (PV.) Many goods are purchased on credit, and because interest charges are incurred subsequent to the purchase of the durable, they represent an operating cost.

8. Opportunity Cost (PV). When consumers dip into savings or liquidate other investments to finance the purchase of a durable, they give away the after-tax interest income. This foregone interest is often a forgotten operation cost, and it can be substantial. Along with depreciation, it is one of the two most important costs in durable good ownership (Morgan & Duncan, 1980). Although the foregone interest on operational expenses could be incorporated, the difficulty in computation discourages its inclusion.

9. Storage Costs (PV). Household space does have value. For example, electronics may occupy half a room in a home or a garden tractor may need its own storage shed. It is difficult to place a dollar value on this space when the home is owned since the "life" of the space often exceeds the service life of the durable.

10. Other Expenses (PV). Every list of expenses must include the catchall category – "other." While most of the expenses listed above could be applied generically to most durables, there are specialized expenses applicable to specific products (i.e., automobile registration and inspection fees).

An Example for Computing Life-Cycle Costs

Table 1 provides the LCC calculation for a desktop computer. Remember that the format for this information may be applied to other durable goods. It is assumed that the real borrowing interest rate is 17%, and the personal discount rate is the same as the investment interest rate at 6%.

The net acquisition costs include search costs, purchase price, accessories, sales taxes, shipping and handling charges, installation and setup charges, warranty, additional equipment, education costs, and environmental changes. The residual value, if realized, reduces the net acquisition costs. Below we discuss the costs associated with the hypothetical example in detail.

1. Search Costs. We assume that the consumer spends \$6.00 to buy a computer magazine to gather product information. Further, the consumer drives to several stores in order to do comparison shopping. We assume the consumer spends four hours shopping, driving 40 miles at 55 cents per mile (gasoline and vehicle depreciation). The time cost is \$15 per hour. Under these assumptions, the search cost is:

$$\$6 + (40 \times \$0.55) + (4 \times \$15) = \$88.$$

2. Purchase Price. We further assume that the consumer decides to buy online after comparison shopping. The consumer

buys a Dell Dimension 3000 with a 17" monitor, 512 RAM, 168 GB hard drive, and a CD/DVD burner. The price of this package is \$649. (All prices are listed in 2005 dollars. For a list of more current prices, go to: www.dell.com.)

3. Accessories. Further, the consumer buys some accessories, including speakers for \$30, Microsoft office basic software for \$149, and a Dell Photo-All-In-One Printer 962 for \$129. The total price for accessories is:

$$\$30 + \$149 + \$129 = \$308$$

4. Sales Taxes. The national average for the online sales tax rate in 2005 was 6.8%. We will assume the same tax rate for the additional equipment. Thus, the sales tax paid is:

$$(\$649 + \$308) * 6.8\% = \$65.$$

5. Shipping and Handling Charges. The shipping and handling charges are \$39, after applying a discount of \$109.

6. Installation and Set-up Charges. Home installation and set-up with Dell costs \$149.

7. Extended Warranties. The four-year limited warranty service contract with Dell costs \$160.

8. Additional Equipment. In order to use the computer in a comfortable setting, the consumer decides to purchase a computer desk and a chair at a total cost of \$400, including sales taxes, shipping and handling, and installation and setup. For simplicity, we also assume that this equipment will fully depreciate to zero at the end of the holding period.

9. Education Costs. We further assume that the consumer buys two "how-to" books to learn how to use the computer. We assume the books cost a total of \$70, including sales tax.

10. Environment Changes. The consumer needs to install a grounding outlet for the computer. This environment change costs the consumer \$100.

11. Residual Value (PV). We assume an annual discount rate of 25% for the computer and that the holding period for the

computer is four years. By the end of the four years, the consumer will sell the used computer and accessories at the residual value. However, because the residual value is realized after four years, the amount needs to be converted to present value (PV). The present value of the residual value is:

$$(\$649 + 308) \times (1 - 25\%)^4 / (1 + 6\%)^4 = \$303 / (1 + 6\%)^4 = \$240.$$

The total net acquisition costs are the sum of (1) and (10), minus (11):

$$(\$88 + \$649 + \$308 + \$65 + \$39 + \$149 + \$160 + \$400 + \$70 + \$100) - \$240 = \$1,788.$$

We continue with our example, outlining the operation costs.

1. Repairs (PV). In this example the expected repair cost is zero, because it is covered by the warranty.

2. Maintenance (PV). In the case of a computer, regular maintenance is not needed so the maintenance cost is zero.

3. Disposables (PV). For printer use, the consumer will need paper and ink. Ink is quite expensive. As such, we assume \$250 per year for the cost of paper and ink. This value needs to be converted to present value using PVFS:

$$\$250 * PVFS = \$250 * \frac{1 - (\frac{1}{1+6\%})^4}{6\%} = \$866.$$

4. Energy (PV). We assume the system consumes 400 watts per hour and operates for 300 hours per year at 20 cents per kilowatt hour. This is equivalent to \$24 per year. The present value of \$24 per year for four years is:

$$\$24 * PVFS = \$24 * \frac{1 - (\frac{1}{1+6\%})^4}{6\%} = \$83.$$

5. Personal Property Taxes (PV). In the case of a computer, the personal property taxes amount to zero.

Table 1
Life Cycle Cost of a Personal Computer

<u>Net Acquisition Costs</u>	
1. Search costs	\$88
2. Purchase price	\$649
3. Accessories	\$308
4. On-Line Sales Tax (national average as of 2005, 6.8%)	\$65
5. Shipping and Handling (3-5 day, including a \$109 discount)	\$39
6. Installation and set-up (home PC installation with Dell)	\$149
7. 4-year Ltd. warranty, at home service, nights and weekends	\$160
8. Additional equipments	\$400
9. Education costs (2 "how-to" books)	\$70
10. Environment changes (installing a grounding outlet)	\$100
11. Residual value (\$300 after 4 years) (PV)	(\$240)
Total Net Acquisition Costs (PV)	\$1,788
<u>Operation Costs for Four Years</u>	
1. Repairs (PV) (covered by warranty)	\$0
2. Maintenance (PV)	\$0
3. Disposables (PV) (ink and paper @ 250 per year)	\$866
4. Energy (PV)	\$83
5. Personal Property Taxes (PV)	\$0
6. Insurance (PV)	\$0
7. Interest Expense (PV)	\$165
8. Opportunity Cost (PV)	\$233
9. Storage (PV)	\$988
Total Operation Costs for four years (PV)	\$2,335
Total COST of Four Years of Ownership (PV)	\$4,123

6. Insurance (PV). Electronics are covered up to \$5,000 by homeowner's or renter's insurance. As such, there is no marginal cost for insuring the computer.

7. Interest Expenses (PV). Assuming the consumer takes out an installment loan of \$900 at 17% annual interest rate for two years. The monthly payment is about \$44.50. The interest payment is \$121.87 for the first year and \$43.48 for the second year. Note the computation is somewhat complicated, because the

interest paid is different for each month. The total present value is:

$$\$121.87 + (\$43.48 / (1 + 6\%)) = \$165.$$

8. Opportunity Cost (PV). The total net acquisition cost is \$1,788. The loan is \$900. Thus, the money that could have been invested somewhere else grows to \$1,788 - \$900 = \$888. By assuming a 6% net return, the opportunity cost for saving \$888 for four years is:

$$\$888 * (1 + 6\%)^4 - \$888 = \$233.$$

9. Storage Costs (PV). The computer system occupies 40 square feet of a 1,000 square foot apartment renting for \$600 per month. Thus, the storage cost is about \$24 per month (40/100*\$600), which is \$288 per year. The present value of \$288 per year for four years is:

$$\$288 * PVFS = \$288 * \frac{1 - (\frac{1}{1 + 6\%})^4}{6\%} = \$988.$$

10. Other Expenses (PV). There are no other expenses.

Thus the present value of total operation costs for four years is the sum of adding (1) to (10), and is \$2,335 for this example. Total costs are then the sum of the present value of total net acquisition costs and total operation costs. In this example, it is \$4,123.

Conclusion

Some scholars believe that Life-Cycle Costs (LCC) represent a potentially beneficial form of consumer information (Hutton & Wilkie, 1980; Miller & Stafford, 2001; Walden, 2002). Consumers may decide to base purchase decisions solely on the price, because the cost calculations require too much in terms of money, time, and effort. The purpose of this paper is not to

demand laborious and detailed calculations of LCC for each durable purchased. Instead, this exercise portrays concepts that are applicable to the purchase of all durable goods. It is not expected that students and clients will sit down with a pencil and paper (or computer) to calculate the real cost of every durable good purchase. However, doing the cost calculations in class may lead to behavior change, because students and clients will be aware of not-so-obvious costs when making real-life purchases.

The resources of each individual consumer are finite, and every purchase has an opportunity cost. Once the full cost of a particular durable is comprehended, the consumer may prefer to maximize satisfaction by spending money on a non-durable good or service such as a Caribbean cruise. Consumers should be warned, however, that non-durables also have their own hidden costs that may result in total expenditures far exceeding the advertised price.

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