

Table 8-5 CALCULATION OF BREAK-EVEN POINT

Year	New System	Old System
Year 1		
Operation cost	\$26,000	\$16,000
Increase in revenue	+\$5,000	0
Net cost	\$21,000	\$16,000
Difference in operation cost and net cost	\$5,000	0
Year 2		
Operation cost	\$16,000	\$16,000
Difference in operation cost and net cost Year 1	\$5,000	0
Increase in revenue	\$5,000	0
Net cost	\$16,000	\$16,000
Difference in operation cost and net cost	0	0

\$5000 per year. Table 8-5 shows how the break-even point is determined.

Payback Period

Calculation of the **payback period** is often done to determine whether a new system will fully recover its investment (development) costs before the end of its life cycle. In the preceding encoding example, the investment cost was \$10,000 (reconfiguring the work area), and the operating cost was \$16,000. To determine the payback period, a comparison between total old system costs and total new system costs (including investment) is made. The difference between new system and old system costs is calculated on a year-by-year (cumulative) basis. When the difference between old system and new system costs reaches zero, the payback period has been reached. Table 8-6 shows the payback period calculation for the encoding example.

In Year 1 of Table 8-5, the current system cost is \$16,000. The new system cost is \$26,000 (\$10,000 + \$16,000). The yearly difference in cost during the first year is a negative \$10,000 (\$16,000 - 26,000). Because this is the first year of calculation, the cumulative difference remains -\$10,000. During the second year, the current system still costs \$16,000. The new system costs \$11,000 (\$16,000 operating cost - \$5000 increase in reimbursement). The yearly difference between the current and the new system costs is \$5000 (\$16,000 - \$11,000). The cumulative cost difference is -\$5000 (-\$10,000 + \$5000). In the third year, the costs of the current system remain \$16,000, and the costs of the new system remain \$11,000. The yearly difference in costs is again \$5000; however, the cumulative difference in costs has reached zero. Current system (\$16,000 - 3 years = \$48,000),

Table 8-6 CALCULATION OF PAYBACK PERIOD FOR ENCODER SYSTEM

	Year 1	Year 2	Year 3
Current system cost	\$16,000	\$16,000	\$16,000
New system cost	\$26,000	\$11,000	\$11,000
Yearly difference in costs	\$10,000	+\$5,000	+\$5,000
Cumulative difference in costs	(\$10,000)	(\$5,000)	0

New system (\$26,000 + \$11,000 + \$11,000 = \$48,000). Thus, the payback period has been reached after 3 years.

The encoding system problem illustrates the difference between the break-even point and the payback point. It is important to recognize how these various CBA techniques can be used to support different arguments to purchase or not purchase a system.

Discounted Payback Period

Another CBA technique uses the **discounted payback period**. In this method, an organization determines how much a system costs in future dollars. The basic concept underlying this approach is that today's dollars are worth more than future dollars. This is because an organization can usually invest today's dollars at a certain interest rate and receive a **return on investment (ROI)**. Therefore, future dollars that are anticipated to be made by installing an information system are discounted in calculations used to determine the discounted payback period. For example, say a health care facility can invest \$1 today at 8% interest. The value of that dollar next year will be \$1.08. If it is projected that an information system will earn \$5000 next year, that \$5000 in future dollars would actually have less value than today's dollars (i.e., if the facility invested \$5000 at 8% interest, the amount would be \$5400 by next year). To illustrate how the discounted payback period is calculated, the encoding example discussed previously is used.

To determine the present value of today's dollar at any time in the future, the following formula is used:

$$1/(1 + \text{ROI})^n,$$

where ROI is the facility's expected return on investment and n is the number of years into the future. Let us assume that in the encoding example the facility expects an 8% ROI. Using the formula for present value, the discounted rate for Years 1 through 5 after system startup has been calculated and is shown in Table 8-7.

Table 8-7 indicates that 1 year after project start, the value of today's dollar is \$0.93. The value of today's dollar after Year 2 of the project is \$0.86, and so on. Calculations to determine the discounted payback period for the encoding system appear in Table 8-8. Note that Table 8-8 is an extension of Table 8-5.

Table 8-7 CURRENT DOLLAR VALUE, YEARS 1-5

Years	Future Dollar Value
1	0.93
2	0.86
3	0.79
4	0.74
5	0.68

Table 8-8 DISCOUNTED PAYBACK PERIOD FOR ENCODER SYSTEM

	Year 1	Year 2	Year 3	Year 4
Current system cost	\$16,000	\$16,000	\$16,000	\$16,000
New system cost	\$26,000	\$11,000	\$11,000	\$11,000
Yearly difference in costs	-\$10,000	+\$5,000	+\$5,000	+\$5,000
Discount (ROI = 0.08)	0.93	0.86	0.79	0.74
Discounted difference	-\$9,300	+\$4,300	+\$3,950	+\$3,700
Cumulative difference in costs	-\$9,300	-\$5,000	-\$1,050	+\$2,650

ROI, Return on investment.

Table 8-7 indicates that the discounted payback period occurs some time between Years 3 and 4. To interpret the table, the discounted difference is arrived at by multiplying the discount by the yearly difference in costs. For example, during Year 1, the discount is 0.93 and the yearly difference in cost is -\$10,000. Multiplying these figures yields the discounted difference in costs, which is -\$9300 in Year 1. All subsequent rows are calculated in the same way. To determine the cumulative difference in cost, the current year's discounted difference is subtracted from the cumulative difference. For example, in Year 2, the discounted difference (\$4300) is subtracted from the cumulative difference in Year 1 (-\$9300). This equals -\$5000, which is the cumulative difference in costs between the current and new systems by year 2.

Cost-Effectiveness Analysis

As opposed to CBA, **cost-effectiveness analysis** attempts to evaluate certain beneficial consequences in nonmonetary terms. Therefore, in cost-effectiveness analysis, desirable

benefits are not valued in monetary terms but are measured in some other unit. For example, what price could be placed on saving one life or making a patient's record available to a patient care unit more quickly? Or, can the investment in a new information system decrease medication errors or increase timelier drug administration? The determination of how much it is worth to decrease one medication error is a social question, not a technical or economic one. How much a nonmonetary item is worth is left for the specific facility to determine given current situations and constraints. There are and will be a number of organization-wide systems that do not meet monetary criteria but will still be necessary to build infrastructure and as business investments. Health care has been slow to recognize that investing in information systems is a continuing process and a regular budget item once a system is in place. As health care attempts to raise the level of consistency in the use of known quality performance in health care, it will be easier to quantify and attach dollars to the difference between high-quality and mediocre care. The information systems such as the EHR will help in this endeavor.

It should be obvious from review of the previous methods why it is important for the health information manager to have an understanding of these various techniques. As the encoding system example demonstrates, statistics can mean whatever you want them to mean. To evaluate the costs and benefits of a system objectively, a variety of analytic techniques should be used, including CBA and benefits realization. As noted, other dimensions could be added to these examples to prove the cost effectiveness and return on investment.

Other Evaluation Methods and Techniques

In addition to the three previously discussed evaluation methods (benefits realization, cost-benefit analysis, and cost-effectiveness analysis), many other evaluation techniques can be used to assess the functional, technical, and economic outcomes of system implementation. Evaluation of computer systems should be approached in the same manner as any evaluation study. As a first step, the evaluation question(s) should be framed. For example, an evaluation question may be, "Does the system work as it was intended to work?" In other words, does the system perform well technically? For an ADT system, can the admitting clerk retrieve a patient's previous admission and discharge dates? Does the system provide the patient's medical record number and demographics? Can the admitting clerk update the demographic information? Can the system easily identify possible duplicate medical record numbers for the same patient?

Another type of evaluation question might be to assess whether the system is being used as it was intended. For example, who uses the system? What functions of the systems are being used most often? Which functions are being