Chapter 14 Managing Projects
Capital Budgeting Methods for Information System Investments

Traditional Capital Budgeting Models

Capital budgeting models are one of several techniques used to measure the value of investing in long-term capital investment projects. The process of analyzing and selecting various proposals for capital expenditures is called capital budgeting. Firms invest in capital projects to expand production to meet anticipated demand or to modernize production equipment to reduce costs. Firms also invest in capital projects for many noneconomic reasons, such as installing pollution control equipment, converting to a human resources database to meet some government regulations, or satisfying nonmarket public demands. Information systems are considered long-term capital investment projects.

Six capital budgeting models are used to evaluate capital projects:

- The payback method
- The accounting rate of return on investment (ROI)
- The net present value
- The cost-benefit ratio
- The profitability index
- The internal rate of return (IRR)

Capital budgeting methods rely on measures of cash flows into and out of the firm. Capital projects generate cash flows into and out of the firm. The investment cost is an immediate cash outflow caused by the purchase of the capital equipment. In subsequent years, the investment may cause additional cash outflows that will be balanced by cash inflows resulting from the investment. Cash inflows take the form of increased sales of more products (for reasons such as new products, higher quality, or increasing market share) or reduced costs in production and operations. The difference between cash outflows and cash inflows is used for calculating the financial worth of an investment. Once the cash flows have been established, several alternative methods are available for comparing different projects and deciding about the investment.

Financial models assume that all relevant alternatives have been examined, that all costs and benefits are known, and that these costs and benefits can be expressed in a common metric, specifically, money. When you must

choose among many complex alternatives, these assumptions are rarely met in the real world, although they may be approximated. Table 14-1 lists some of the more common costs and benefits of systems. Tangible benefits can be quantified and assigned a monetary value. Intangible benefits, such as more efficient customer service or enhanced employee goodwill, cannot be immediately quantified but may lead to quantifiable gains overall.

TABLE 14-1 Costs and Benefits of Information Systems

COSTS
Hardware
Telecommunications
Software
Services
Personnel
TANGIBLE BENEFITS (COST SAVINGS)
Increased productivity
Lower operational costs
Reduced workforce
Lower computer expenses
Lower outside vendor costs
Lower clerical and professional costs
Reduced rate of growth in expenses
Reduced facility costs
INTANGIBLE BENEFITS
Improved asset utilization
Improved resource control
Improved organizational planning
Increased organizational flexibility
More timely information
More information
Increased organizational learning
Legal requirements attained
Enhanced employee goodwill
Increased job satisfaction
Improved decision making
Improved operations
Higher client satisfaction
Better corporate image

Table 14-1 – illustrates the costs and both tangible and intangible benefits of Information Systems.

The total cost of ownership (TCO), is designed to identify and measure the components of information technology expenditures beyond the initial cost of purchasing and installing hardware and software. However, TCO analysis provides only part of the information needed to evaluate an information technology investment because it does not typically deal with benefits, cost categories such as complexity costs, and "soft" and strategic factors.

LIMITATIONS OF FINANCIAL MODELS

Many well-known problems emerge when financial analysis is applied to information systems. Financial models do not express the risks and uncertainty of their own costs and benefits estimates. Costs and benefits do not occur in the same time frame—costs tend to be up-front and tangible, whereas benefits tend to be back loaded and intangible. Inflation may affect costs and benefits differently. Technology—especially information technology—can change during the course of the project, causing estimates to vary greatly. Intangible benefits are difficult to quantify. These factors wreak havoc with financial models.

The difficulties of measuring intangible benefits give financial models an application bias: Transaction and clerical systems that displace labor and save space always produce more measurable, tangible benefits than management information systems, decision- support systems, and computer-supported collaborative work systems. Traditional approaches to valuing information systems investments tend to assess the profitability of individual systems projects for specific business functions. These approaches do not adequately address investments in IT infrastructure, testing new business models, or other enterprise-wide capabilities that could benefit the organization as a whole.

The traditional focus on the financial and technical aspects of an information system tends to overlook the social and organizational dimensions of information systems that may affect the true costs and benefits of the investment. Many companies' information systems investment decisions do not adequately consider costs from organizational disruptions created by a new system, such as the cost to train end users, the impact that users' learning curves for a new system have on productivity, or the time managers need to spend overseeing new system-related changes. Benefits, such as more timely decisions from a new system or enhanced employee learning and expertise, may also be overlooked in a traditional financial analysis.

There is some reason to believe that investment in information technology requires special consideration in financial modeling. Capital budgeting historically concerned itself with manufacturing equipment and other long-term investments, such as electrical generating facilities and telephone networks. These investments had expected lives of more than 1 year and up to 25 years. However, information systems differ from manufacturing systems in that their life expectancy is shorter. The very high rate of technological change in computer-based information systems means that most systems are seriously out of date in 5 to 8 years. The high rate of technological obsolescence in budgeting for systems means that the payback period must be shorter and the rates of return higher than typical capital projects with much longer useful lives. The bottom line with financial models is to use them cautiously and to put the results into a broader context of business analysis.

Case Example: Capital Budgeting for a New Supply Chain Management System

Let's look at how financial models would work in a real-world business scenario. Heartland Stores is a general merchandise retail chain operating in eight midwestern states. It has five regional distribution centers, 377 stores, and about 14,000 different products stocked in each store. The company is considering investing in new software and hardware modules to upgrade its existing supply chain management system to help it better manage the purchase and movement of goods from its suppliers to its retail outlets. Too many items in Heartland's stores are out of stock, even though many of these products are in the company's distribution center warehouses.

Management believes that the new system would help Heartland Stores reduce the amount of items that it must stock in inventory, and thus its inventory costs, because it would be able to track precisely the status of orders and the flow of items in and out of its distribution centers. The new system would reduce Heartland's labor costs because the company would not need so many people to manage inventory or to track shipments of goods from suppliers to distribution centers and from distribution centers to retail outlets. Telecommunications costs would be reduced because customer service representatives and shipping and receiving staff would not have to spend so much time on the telephone tracking shipments and orders. Heartland Stores expects the system to reduce transportation costs by providing information to help it consolidate shipments to retail stores and to create more efficient shipping schedules. If the new system project is

approved, implementation would commence in January 2005 and the new system would become operational in early January 2006.

The solution builds on the existing IT infrastructure at the Heartland Stores but requires the purchase of additional server computers, PCs, database software, and networking technology, along with new supply chain planning and execution software. The solution also calls for new radio-frequency identification technology to track items more easily as they move from suppliers to distribution centers to retail outlets. Figure 14-1 shows the estimated costs and benefits of the system. The system had an actual investment cost of $11,467,350 in the first year (year 0) and a total cost over six years of $19,017,350. The estimated benefits total $32,500,000 after six years. Was the investment worthwhile? If so, in what sense? There are financial and nonfinancial answers to these questions. We'll look at the financial models first. They are depicted in Figure 14-2 .

FIGURE 14-1 Costs and Benefits of the New Supply Chain Management System

		Estimated Costs & Benefits - New Supply Chain Management System					
2	Year		0	1	2	3	4	5
3			2012	2013	2014	2015	2016	2017
4	**Costs**							
5	Hardware							
6	Servers	7@80,000	560,000					
7	Backup servers	4@80,000	320,000					
8	PCs at loading dock	100@1250	125,000					
9	Radio-frequency devices	1000@$1175	1,175,000					
10	Storage		800,000					
11								
12	**Network infrastructure**							
13	Routers & hubs	300@4100	1,230,000					
14	Firewalls	2@6300	12,600					
15	Wireless RF network		1,750,000					
16	Backup network system		1,150,000					
17	Telecom links		74,250	225,000	225,000	225,000	225,000	225,000
18								
19	**Software**							
20	Database		475,000					
21	Web servers (Apache)		0					
22	Supply chain planning & execution modules		1,187,500					
23								
24	**Labor**							
25	Business staff		425,000	115,000	115,000	115,000	115,000	115,000
26	IS staff		1,225,000	525,000	525,000	525,000	525,000	525,000
27	External consultants		576,000	95,000	95,000	95,000	95,000	95,000
28	Training (end users)		382,000	35,000	35,000	35,000	35,000	35,000
29		Sub Total	11,467,350	995,000	995,000	995,000	995,000	995,000
30								
31	**Maintenance and Support**							
32	Hardware maintenance & upgrades			240,000	240,000	240,000	240,000	240,000
33	Software maintenance & upgrades			275,000	275,000	275,000	275,000	275,000
34		Sub Total		515,000	515,000	515,000	515,000	515,000
35		Total by Year	11,467,350	1,510,000	1,510,000	1,510,000	1,510,000	1,510,000
36		Total Costs	19,017,350					
37	**Benefits**							
38	Reduced labor costs			1,650,000	1,400,000	1,400,000	1,400,000	1,400,000
39	Reduced inventory costs			3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
40	Reduced transportation costs			1,300,000	1,300,000	1,300,000	1,300,000	1,300,000
41	Reduced telecommunications costs			250,000	250,000	250,000	250,000	250,000
42		Sub Total	0	6,700,000	6,450,000	6,450,000	6,450,000	6,450,000
43								
44		Net Cash Flow	-11,467,350	5,190,000	4,940,000	4,940,000	4,940,000	4,940,000
45								
46		Total Benefits	32,500,000					

Fig 15-1   Fig15-2   (+)

This spreadsheet analyzes the basic costs and benefits of implementing supply chain management system enhancements for a midsized midwestern U.S. retailer. The costs for hardware, telecommunications, software, services, and personnel are analyzed over a six-year period.

THE PAYBACK METHOD

The payback method is quite simple: It is a measure of the time required to pay back the initial investment of a project. The payback period is computed as follows:

$$\frac{\text{Original investment}}{\text{Annual net cash inflow}} = \text{Number of years to pay back}$$

FIGURE 14-2 Financial Models

	Year	0	1	2	3	4	5
3 Updated files for Capital Budgeting Chp 14 LT 1 Capital Budgeting Methods							
4 Net Cash Flow (not including original investment) for years 2012-2017		$5,190,000.00	$4,940,000.00	$4,940,000.00	$4,940,000.00	$4,940,000.00	
5 Net Cash Flow (including original investment) for years 2012-201	-$11,467,350.00	$5,190,000.00	$4,940,000.00	$4,940,000.00	$4,940,000.00	$4,940,000.00	

7 Payback Period = 2.5 years			Cumulative Cash Flow
8 Initial Invest	Year 0	-$11,467,350.00	-$11,467,350.00
9	Year 1	$5,190,000.00	-$6,277,350.00
10	Year 2	$4,940,000.00	-$1,337,350.00
11	Year 3	$4,940,000.00	$3,602,650.00
12	Year 4	$4,940,000.00	$8,542,650.00
13	Year 5	$4,940,000.00	$13,482,650.00

15 Accounting Rate of Return			
16 (Total benefits - Total Costs - Depreciation)/U		Total Benefits	$32,500,000.00
17		Total Costs	$19,017,350.00
18 Total Initial Investments		Depreciation	$11,467,350.00
19	Tot. benefits-Tot. costs-Deprec		$2,015,300.00
20		Life	6 years

22 Return on I	2.93%

24 Cost-Benefi	Total Benefits	$32,500,000.00	1.71
25	Total Costs	$19,017,350.00	

27 Net Present Value =		
28	=NPV(0.05,G3:L3) $10,158,359.99	

30 Profitability Index		
31	PV =NPV(0.05,G3:L3)/11,467,350	1.89

33 Internal Rate of Return		
34	=IRR(G4:L4)	33%

Fig 15-1   Fig15-2

To determine the financial basis for a project, a series of financial models helps determine the return on invested capital. These calculations include the payback period, the accounting rate of return on investment (ROI), the cost-benefit ratio, the net present value, the profitability index, and the internal rate of return (IRR).

In the case of Heartland Stores, it will take more than two years to pay back the initial investment. (Because cash flows are uneven, annual cash inflows are summed until they equal the original investment to arrive at this number.) The payback method is a popular method because of its simplicity and power as an initial screening method. It is especially good for high-risk

projects in which the useful life of a project is difficult to determine. If a project pays for itself in two years, then it matters less how long after two years the system lasts. The weakness of this measure is its virtue: The method ignores the time value of money, the amount of cash flow after the payback period, the disposal value (usually zero with computer systems), and the profitability of the investment.

ACCOUNTING RATE OF RETURN ON INVESTMENT (ROI)

Firms make capital investments to earn a satisfactory rate of return. Determining a satisfactory rate of return depends on the cost of borrowing money, but other factors can enter into the equation. Such factors include the historic rates of return expected by the firm. In the long run, desired rate of return must equal or exceed the cost of capital in the marketplace. Otherwise, no one will lend the firm money.

The accounting rate of return on investment (ROI) calculates the rate of return from an investment by adjusting the cash inflows produced by the investment for depreciation. It gives an approximation of the accounting income earned by the project.

To find the ROI, first calculate the average net benefit. The formula for the average net benefit is as follows:

$$\frac{(\text{Total benefits} - \text{Total cost} - \text{Depreciation})}{\text{Useful life}} = \text{Net benefit}$$

The net benefit is divided by the total initial investment to arrive at ROI. The formula is as follows:

$$\frac{\text{Net benefit}}{\text{Total initial investment}} = \text{ROI}$$

Total initial investment In the case of Heartland Stores, the average rate of return on the investment is 2.93 percent. The weakness of ROI is that it can ignore the time value of money. Future savings are simply not worth as much in today's dollars as are current savings. However, ROI can be modified (and usually is) so that future benefits and costs are calculated in today's dollars. (The present value function on most spreadsheets can perform this conversion.)

NET PRESENT VALUE

Evaluating a capital project requires that the cost of an investment (a cash outflow usually in year 0) be compared with the net cash inflows that occur many years later. But these two kinds of cash flows are not directly comparable because of the time value of money. Money you have been promised to receive three, four, and five years from now is not worth as much as money received today. Money received in the future has to be discounted by some appropriate percentage rate—usually the prevailing interest rate, or sometimes the cost of capital. Present value is the value in current dollars of a payment or stream of payments to be received in the future. It can be calculated by using the following formula:

$$\text{Payment} \times \frac{1 - (1 + \text{interest})^{-n}}{\text{Interest}} = \text{Present value}$$

Thus, to compare the investment (made in today's dollars) with future savings or earnings, you need to discount the earnings to their present value and then calculate the net present value of the investment. The net present value is the amount of money an investment is worth, taking into account its cost, earnings, and the time value of money. The formula for net present value is this:

$$\text{Present value of expected cash flows} - \text{Initial investment cost} = \text{Net present value}$$

In the case of Heartland Stores, the present value of the stream of benefits is $21,625,709, and the cost (in today's dollars) is $11,467,350, giving a net present value of $10,158,359. In other words, for a $21 million investment today, the firm will receive more than $10 million. This is a fairly good rate of return on an investment.

COST-BENEFIT RATIO

A simple method for calculating the returns from a capital expenditure is to calculate the cost-benefit ratio, which is the ratio of benefits to costs. The formula is

$$\frac{\text{Total benefits}}{\text{Total cost}} = \text{Cost-benefit ratio}$$

In the case of Heartland Stores, the cost-benefit ratio is 1.71, meaning that the benefits are 1.71 times greater than the costs. The cost-benefit ratio can be used to rank several projects for comparison. Some firms establish a minimum cost-benefit ratio that must be attained by capital projects. The cost-benefit ratio can, of course, be calculated using present values to account for the time value of money.

PROFITABILITY INDEX

One limitation of net present value is that it provides no measure of profitability. Neither does it provide a way to rank order different possible investments. One simple solution is provided by the profitability index. The profitability index is calculated by dividing the present value of the total cash inflow from an investment by the initial cost of the investment. The result can be used to compare the profitability of alternative investments.

$$\frac{\text{Present value of cash inflows}}{\text{Investment}} = \text{Profitability index}$$

In the case of Heartland Stores, the profitability index is 1.89. The project returns more than its cost. Projects can be rank ordered on this index, permitting firms to focus on only the most profitable projects.

INTERNAL RATE OF RETURN (IRR)

Internal rate of return (IRR) is defined as the rate of return or profit that an investment is expected to earn, taking into account the time value of money. IRR is the discount (interest) rate that will equate the present value of the project's future cash flows to the initial cost of the project (defined here as negative cash flow in year 0 of $11,467,350). In other words, the value of R (discount rate) is such that Present value – Initial cost = 0. In the case of Heartland Stores, the IRR is 33 percent.

RESULTS OF THE CAPITAL BUDGETING ANALYSIS

Using methods that take into account the time value of money, the Heartland Stores project is cash-flow positive over the time period under consideration and returns more benefits than it costs. Against this analysis, you might ask what other investments would be better from an efficiency and effectiveness standpoint. Also, you must ask if all the benefits have been calculated. It may be that this investment is necessary for the survival of the firm, or necessary to provide a level of service demanded by the

firm's clients. What are competitors doing? In other words, there may be other intangible and strategic business factors to consider.