
CHAPTER 5

FINANCIAL MANAGEMENT FOR FACILITY MANAGERS

Fred Klammt

Principal

Aptek Associates

E-mail: fredk@jps.net

5.1 FUNDAMENTAL PRINCIPLES OF FINANCIAL MANAGEMENT FOR FM

Financing is all about creating value. It is about making smart decisions and leveraging assets to allow an organization's workers to be productive without disruption. Facility management's (FM's) overall goal is to take care of the physical assets of the organization, avoid disruption to ongoing business operations, and leverage (extend the life of) assets. Leveraging involves financial management skills and, in the facility world, focuses on two main areas: capital project evaluations and operating budgets.

Within these areas a wide array of financial analysis and decision-making principles and tools can be applied to FM. Facility renovation projects are always competing for capital dollars with other departments' projects. Facility managers constantly evaluate the best buy between competing alternatives. Difficult repair or replace decisions need to be made before a costly repair is authorized. The return on investment for a new database or computer-integrated facility management (CIFM) system needs to be detailed. Many other facility applications require financial analysis and management skills.

Most facility managers report to the operating and financial side of their organizations and to the chief financial office (CFO). It is the responsibility of the CFO to increase cash flow as much as possible while reducing risk. If an asset is not continuously producing cash flow or adding value, the CFO must take action. Underperforming assets can contribute to poor overall performance and make an organization vulnerable.

It is therefore essential that the FM function be aligned with the overall organizational goals and with the CFO's business objectives. Financial analysis must be done with a proper perspective. Although the financial side takes priority in many cases, there are other considerations and priorities, such as operational, safety, and political issues that may have higher priority than financial returns. It makes absolutely no sense to do full-cost accounting and life cycle analysis for a project on a building whose lease expires in the next two years.

An important concept in all financial analysis is the concept of the time value of money. This means that today's liquid cash can be put to work earning income and will be more valuable in the future than it is today. This is the basic concept of economics that drives today's financial markets.

5.2 PLANNING

Two other areas that facility managers need to be aware of are:

- Financial analysis and management must always be kept in the proper perspective: the overall mission of the company
- What is the overall financial view of their companies, such as:
 - What was the company's stock price yesterday, last week, last year?
 - Why was the stock price up or down?
 - What was the key driver of corporate profits last year?
 - What will be the key driver in the next decade?
 - Who is the company's most important customer?
 - Who is the company's largest supplier?
 - What is the company's average productivity rate, lost time rate?

5.1.1 How Financial Analysis Fits Into FM's Organizational Role

How financial analysis fits into facility manager's organizational role is a key question that is unique for each company and department. FM is an internal service and a liability on the bottom line. As such, it must create value and promote its financial contribution to the overall organization. Financial analysis provides a standardized tool that helps CFOs and executive management to decide where to put money. It is important that facility managers follow accepted financial practices so that others can easily understand their analysis and make fair comparisons to other projects. It is also important that they market their services and push their agendas to the forefront by using accepted financial analysis.¹

This section deals with generally accepted financial principles from engineering and accounting disciplines. Each organization will have its own customized financial practices and facility managers must be adept at using their internal financial analysis tools.

5.1.2 The Goals of Finance and Accounting Principles

The goals of finance and accounting principles are to provide standardized tools that all companies and finance managers can use, enabling comparisons between different departments and companies. Success in decision making is enhanced by understanding the financial impacts of various alternatives.

While most companies have unique and confidential financial goals, there are some financial goals that are common to all for-profit companies:

- Lowest operating costs
- Highest revenue
- Maximize returns and profits
- Reduce risks
- Conserve capital
- Shortest time to market
- Minimum turnover

Facility managers must know and understand their company's overall business plan and financial goals. They need to know how these assets are currently performing and their role in the overall company's goals. They must leverage their company's physical assets in pursuit of, and to add value to, these goals.

5.1.3 The Fundamental Financial Analysis Tools

The fundamental financial analysis tools that facility managers use to perform project evaluations and budgeting have evolved over the past ten years and now are focusing on return on net assets (RONA). Here is a listing of these financial tools in chronological order:

1. Simple payback (SPB)
2. Life-cycle costing (LCC)
3. Return on investment (ROI)
4. Activity based costing (ABC)
5. Total cost of ownership (TCO)
6. Return on net assets (RONA)

Each financial tool provides value and insight in a specific application. The history of these financial tools has evolved toward higher and higher stakeholders. From simple engineering analysis, such as payback periods, to the total cost of ownership—which encompasses more than life-cycle costs—we have now arrived at a financial indicator that is used in most corporate boardrooms.

Every organization has its own unique internal financial analysis methods. In this section, we will focus on seven financial tools that are commonly used by many organizations involved in FM:

- Cost benefit analysis
- Payback periods
- Risk and return
- Internal rate of return
- Present value analysis
- Return on net asset (RONA)
- Off-balance sheet assets

The next section of this chapter will deal with life-cycle costing.

5.1.3.1 Essential Data. Before we get started, there are some basic data that are needed for all financial analysis:

Discount Rates. Discount rates are essential to financial analysis. Other terms used are interest rate, cost of capital, and hurdle rate. A simple discount rate is the company's cost to raise capital. This is the weighted average on all sources of debt and equity financing used by the company. Many companies use a higher discount rate to reflect various risks. It is important for facility managers to know what their current organization's discount rate is and to use it in all financial analyses.

Expense Budgets. Budgeting consists of two basic areas: expense and capital. Expense budgets deal with ongoing operating expenditures and focus on the labor and materials to keep a facility in good repair. There are always costs beyond a facility manager's control which will impact budgets and financial performance. It is important to plan for these. All budgets have some built-in contingencies. Sometimes these contingencies are determined as a percentage of the total expense budget—generally 2–5%. Many times they are listed as “miscellaneous” or “emergencies” line items.

Common expense items for all facilities include:

- *Services:* custodial, landscaping, security, and food services
- *General Repair:* carpentry, plumbing, and roof
- *Technical Repair:* electrical, HVAC, fire, and mechanical

Capital Budget. Capital budgets focus on replacing aging or underperforming assets, and on renovations and tenant improvements (TIs) to accommodate corporate churn and customer require-

5.4 PLANNING

ments. In some organizations, facility managers have a specific window of time to submit next year's capital budget requests. Sometimes these requests are nicknamed "blue sky," or "wish lists." After the facility manager submits capital requests, internal financial analysts lump all the capital requests from all departments together and rank the projects by financial returns and fund those within the company's overall capital budget. Other companies will fund capital projects throughout the year based on need and fund availability.

Project Evaluations. Project evaluations are important to the discipline of FM. When is a project to be funded and when is it not? How do you decide? One of the main decision factors in giving a project go-ahead is financial analysis. Facility management needs to highlight the answers to these questions in their project submittals:

- What benefits does the project bring?
- Will the project enhance business operations? How?
- What is the payback of the project?
- Is this a customer requirement? What is the customer's benefit?
- What is the risk? . . . of doing nothing? . . . of alternative projects?
- Is there an eminent safety, environmental, or health risk?

Before submitting their capital budget requests, facility managers need to perform an internal analysis and push the project's best benefits to the forefront. When financial analysts perform their funding analysis, they are usually not aware of certain hidden risks or needs that are difficult to put into financial calculations. It is the facility manager's responsibility to call attention to these.

5.1.4 Cost Benefit Analysis

Facility managers typically provide cost benefit analyses for all substantial *capital* expenditures. For *expense* budgets, they need to provide cost benefit analyses whenever an increase in budget is requested. For example, if a facility manager wants to increase the frequency of preventive maintenance on electrical systems or on roof inspections, an analysis of the benefits of a more reliable electrical system or longer roof life would show the financial returns that can be expected and make it easier to obtain expense budget funding.

It is somewhat more difficult to calculate cost benefits for expenses used in providing an internal service that does not generate revenues, than to calculate cost benefits for capita. However, calculating cost benefits of avoiding disruption to operations and extending the life of physical assets is straightforward and needs to be done. Facility managers need to determine the benefit and value these improvements provide their organization. While it is impractical to calculate the return on investment for facility maintenance, it is easy to calculate the risk of lost business productivity lost for each minute of electrical system disruptions and downtime for the electrical and back-up systems of a building.

If an overall facility operations and maintenance budget represents 1% of the organization's overall labor and operating budget, it is ludicrous to cut corners within a 1% budget that can affect 90%+ of the company's productivity and on-going operations. The facility manager must have the skills and marketing capability to put forward the cost benefit of their expense budgets and capital improvements and the associated risks to the overall business of not funding these initiatives.

Manufacturing operations take no shortcuts when it comes to their budgets and potential impact on production run-time. Having a production line stop due to poor maintenance of the electrical system is not tolerated in the manufacturing industry. Mean time between failure (MTBF) and reliability centered maintenance (RCM), along with numerous other programs are essential to reducing the risk of production stoppage.² Similarly, facility managers must have supporting data and benefits of minimizing electrical failures, providing good indoor air quality (IAQ), and having properly operating physical assets.

- a. Determine all benefits of the project
- b. Determine the life of the project or asset
- c. Determine all front-end costs—include everything
- d. Calculate all on-going (monthly, quarterly, annual) costs
- e. Determine and add up all the on-going benefits
- f. Calculate the simple payback as follows:

$$\frac{\text{Start-up costs (c)} + [\text{on-going costs (d)} \times \text{life cycle (b)}]}{\text{Start-up benefits (a)} + [\text{on-going benefits (e)} \times \text{life cycle (b)}]}$$
- g. Financial results: SPB, ROI, IRR, NPV

FIGURE 5.1 Generic Financial Return Calculation Process.

Here is a generic process for calculating return on investment (ROI). This methodology will be used in several subsequent areas of this chapter. In calculating ROI, the discipline of process is most important. If using financial calculators, see section 5.1.6, Risk and Return, within this chapter.

Let's take the example of a CIFM (computer integrated facility management) software package and calculate the return on investment for such a project following the generic process shown in Figure 5.1.

a. Benefits of the Project

- Reduced labor—improved productivity
- Improved accuracy of data
- Faster retrieval of needed data

b. Life of the Project

In this example, the life of the project is not dependent on the life of the software, but on the life of the CIFM concept, which could be as long as the building or company exists. A realistic CIFM life may be twenty years.

c. Front-End Costs

- Hardware and software; prerequisite needs (workstation, OS, teledata/power connects)
- Purchase, maintenance, training

d. On-Going Costs

- Meetings, training, data entry, consulting
- Supplies, equipment, space, utilities, maintenance
- Upgrades, debugging/troubleshooting, compiling

e. On-Going Benefits

- Timeliness of data
- Space savings
- Budgeting savings—construction, space planning

f. Simple Payback Calculation

$$\frac{\text{Start-up costs (c)} + [\text{on-going costs (d)} \times \text{life cycle (b)}]}{\text{Start-up benefits (a)} + [\text{on-going benefits (e)} \times \text{life cycle (b)}]}$$

In a hypothetical case, this calculation may look like this:

$$\frac{80\text{k (c)} + [20\text{k (d)} \times 20 \text{ (b)}]}{100\text{k (a)} + [50\text{k (e)} \times 20 \text{ (b)}]} = 480\text{k}/1,100\text{k} = 0.436 \text{ years}$$

5.6 PLANNING

g. *Financial Results*

Convert the calculation in “f” to your own internal financial methodology or use one of the financial tools discussed in the following section.

In this example, the costs of \$480k to start and operate the CIFM system will be recovered within 3–4 months by the benefits the CIFM system will provide the organization. It is important for the facility manager in this CIFM example to document and accurately enumerate the benefits the CIFM system will provide to the organization. For example, in many companies, “time to market” is a critical competitive advantage. A CIFM system may contribute (e.g., by shortening moving cycles) to this timing and, therefore, this benefit needs to be included.

5.1.5 Payback Period

Payback period is a simple but powerful analytic tool that is commonly used to assess a project’s return on investment—how quickly will the initial investment be recovered? There are several variations of payback period analysis. Simple payback analysis is most commonly used due to its ease of calculations. The definition of payback period is “the number of years needed to recover the initial investment.”

When comparing two or more projects, the project with the shorter payback period is preferred. Cash inflow (benefits gained), rather than net earnings (as used in rate of return calculations) are used in payback analysis. A more robust payback analysis involves:

- *Upside:* Paybacks are easy to calculate and have applicability to most facility capital projects.
- *Downside:* Payback analysis does not account for the value of time, and it does not measure profitability: *what happens to cash flows after the project payback has occurred?*

Figure 5.2 illustrates an example using payback period analysis. In this example, it is important to note that there are many other possible calculations, such as lamp disposal costs, lumen depreciation curves, lamp cleaning, and possible socket replacement costs, etc. There are also other benefits, such as improved safety, productivity, etc.

5.1.6 Risk and Return

Let’s face it, life has risks. Business decisions and operational management involves assessing the possible risks and reducing them to maximize returns. Minimizing risk is becoming more important in all business activities. Technology and business processes change quickly, unpredictably, and with great uncertainty. Within this environment it is difficult to minimize risk because future factors are continually evolving and changing. Risk management is fast becoming the preferred decision-making tool. What is the risk of not doing something, or the risk of implementing a solution?

The ultimate goal in risk management is the creation of a single overall picture of the uncertainty facing an organization. Risks are interconnected and interdependent. How do we describe and define them? The “Risk Spectrum” identifies “global risks” and four types of “organizational” risks: financial/market, political/regulatory, legal liability, and operational.

The key to risk management is to look at integrated, or strategic, aspects of financial/market, political/regulatory, legal liability, and operational risks together, rather than separately. The biggest problem facing us, however, is how to measure all these risks in terms of their potential likelihood, their possible consequences, how they correlate with each other, and how they will affect the facility operation. Risk assessors use engineering estimates for property exposures, leading to maximum foreseeable loss (MFL) and probable maximum loss (PML). Actuarial projections are employed for expected loss levels where sufficient loss data are available. Scenario analyses and Monte Carlo simulations are used when data are thin, especially to answer “how high is up?” questions. Probabilistic and quantitative risk assessments are used for toxicity estimates for drugs and chemicals,

Sample project: Retrofit warehouse fluorescent lighting system to HPS system
Existing lighting system:
100—F40's, 2×4 fixtures with 3 lamps per fixture; 5000 run h/yr \$0.10/KW, \$5.00/KW demand. Lamps have 15,000 h life
Proposed lighting system:
50—70/Watt HPS fixtures; Lamps have 24,000 h life
Energy savings calculation:
Existing system current cost $100 \text{ fixtures} \times 3 \text{ lamps/fixture} \times (0.040 + 10\% \text{ ballast}) \text{ KW/lamp} = 13.2 \text{ KW}$ $13.2 \text{ KW} \times 5000 \text{ h/yr} = 66,000 \text{ KWH}$
Proposed system future cost $50 \text{ fixtures} \times (0.070 + 10\% \text{ ballast}) \text{ KW/lamp} = 3.85 \text{ KW}$ $3.85 \text{ KW} \times 5000 \text{ h/yr} = 19,250 \text{ KWH}$
Difference $13.2 \text{ KW} - 3.85 \text{ KW} = 9.35 \text{ KW} \times \$5.00/\text{KW} \times 12 \text{ mo/yr} = \$561/\text{yr}$ $66,000 \text{ KWH} - 19,250 \text{ KWH} = 46,750 \text{ KWH} \times \$0.10/\text{KWH} = \$4,675.00/\text{yr}$ Total energy savings: $\$561 + \$4,675 = \$5,236$
Maintenance and material cost savings:
Existing system maintenance and material cost 15,000 lamp life/5000 run h = 3 yr replacement cycle (0.33/yr) Assume 0.20 h per lamp change, labor cost is \$40/h $100 \text{ lamps} \times 0.2 \text{ h/lamp} \times 0.33/\text{yr} \times \$40/\text{h} = \$264/\text{yr labor}$ $100 \text{ lamps} \times \$1/\text{lamp} \times 0.33/\text{yr} = \$33/\text{yr material}$
Proposed system maintenance and material cost 24,000 lamp life/5000 run h = 4.8 yr replacement cycle (0.21/yr) Assume 0.5 h per lamp change, labor cost is \$40/h $50 \text{ lamps} \times 0.5 \text{ h/lamp} \times 0.21/\text{yr} \times \$40/\text{h} = \$210/\text{yr labor}$ $50 \text{ lamps} \times \$50/\text{lamp} \times 0.21/\text{yr} = \$525/\text{yr material}$
Difference Maintenance costs = $264 - 210 = \$54/\text{yr}$ Material costs = $33 - 525 = <\$492>/\text{yr}$ Total maintenance and material savings = $\$54 + <\$492> = <\$438>$
Simple payback calculation:
Cost for retrofit is \$25,500.00 $(50 \text{ fixtures} \times (\$250 \text{ materials} + \$160 \text{ labor})) + \$5000 \text{ fluorescent fixture removal costs}$ Annual Savings: $\$5,236 \text{ energy} + <\$438> \text{ labor \& materials} = \$4,798.00$ SPB = $25,500/4,798 = 5.3 \text{ years}$

FIGURE 5.2 Example Using Payback Analysis. A lighting retrofit has a very straightforward simple payback analysis. There are two major components of this example: energy and labor + material savings. Each must be calculated separately and must be based on the same assumptions. This example follows an engineering type calculation and does not take into account benefits of improved visual perception (i.e., faster parts picking in warehouse), safety improvements, etc.

5.8 PLANNING

and to support policy decisions. For political risks, facility managers rely on qualitative analyses of “internal experts.”

Organizations need a combination of all tools so they can deliver sensible and practical assessments of their risks to their stakeholders. The first stakeholder is the Board, now required to take responsibility for risk in many jurisdictions. Other stakeholders are employees, customers, suppliers, regulators, investors, financial analysts, lenders, and, finally, the public and the communities where facility operations occur. Each stakeholder group has a different perspective on risks, possible outcomes, and desired responses. Each constituency requires a different description. The challenge is to develop a common “language of risk” that will enable us to communicate effectively with these various stakeholders.

Facility managers can reduce the risk of physical asset failure by establishing strategic planning processes and perform due diligence on workscope performance and supplier issues. Here are some other risk issues:

1. Confidentiality: Owners must take steps to minimize this risk by identifying beforehand what information is not to be made available to internal and outsourcer’s employees. Contract provisions may include restrictions of moving employees to competitors.

2. Intellectual Information: Accessibility to corporate intellectual property is a high-risk issue. Basic protective measures must be included in all operations. Copyrights, trademarks, patents, and non-disclosure agreements must be used and actively enforced.

3. Inappropriate Workslope: There is an assumption made that an outsourced workslope is not part of a company’s core competency. Later, it is discovered that part of the core competency was indeed outsourced, thereby compromising strategic contributions. It is therefore extremely important that each function be closely scrutinized before outsourcing takes place and not to place critical competitive competencies with the outsourcer. Another solution would be to bring the outsourcer into the decision-making process and work with a supplier that has this depth of experience.

4. Service Levels: This is a sizeable risk when outsourcing. Too often, customer service levels and quick responsiveness decreases over time. All too often technical specification contracts allow for lower service level—which is why performance-based contracts are used to specify service levels. These contracts can also provide cost incentives and penalties for specific measurable service-level criteria—specific levels that must be clearly specified and monitored.

Financial risk is the focus of this chapter and the tools presented are useful in determining which projects and expenses present the least financial risks.

5.1.7 Internal Rate of Return

Many people are familiar with return on investment (ROI). The more common financial indicator used by companies internally is internal rate of return (IRR). IRR is used mostly in capital budgeting and is a measure of the rate of profitability.

The technical definition of IRR is the discount rate that yields a new present value of zero (see next section). Stated another way, IRR makes the present value of cash flows equal to the initial investment. If the IRR of a specific project exceeds a specified cutoff rate, the project is added to the recommended list.

$$\text{rate of return} = \text{net income/investment}$$

IRR is used to select the most financially beneficial investment for the company. Each year a company must decide which projects to fund. From a financial perspective, the IRR is used to rank projects based on financial returns to the company. IRR varies between companies. There is no one algorithm that is used by all companies. Each company has its own variables and unique versions. The correct form and methods to use in calculating IRR depends on the organization’s finance people. Every organization has its own rules, methods, and formats. It is important for facility managers to understand and follow their customized internal financial analysis methods.

- *Upside:* In financial circles, IRR is the most popular and often used analysis tool. It is relatively straightforward and allows for equitable comparisons between capital investments. It includes the time value of money and cash flow concepts.
- *Downside:* The IRR method may give unrealistic rates of return—they may be too high! A 50% IRR is an unrealistically high rate of return—the IRR calculation may be suspect.

5.1.8 Present Value Analysis

Of all the financial tools available to the facility manager, present value analysis, commonly referred to as net present value (NPV), is the most useful. The basic definition is:

$$\text{NPV} = \text{present value of future cash flows} - \text{net investment}$$

NPV deals with the time value of money. The basic concept is “The present value of a cash flow is what it is worth in today’s dollars. Present value incorporates the time-value principle by discounting future dollars (computing their present value) using the appropriate discount rate (interest rate). In investment analysis, this discount rate is the cost of capital.”³ Figure 5.3 gives an example of determining whether to replace a roof or increase the preventive maintenance budget using the NPV formula.

Many facility staff shy away from applying financial accounting tools to their daily jobs, monthly reports, and annual summaries, due to their complexity and time requirements. The usual reason for this is that financial accounting is beyond their expertise and too complex. By learning how to do these financial calculations and taking the time to do them on a regular basis, facility managers can reduce the breakdowns and reactive nature of their operations by obtaining proper funding and recognition of the added value their operation provides to the organization. Financial accounting transcends all areas of business, and FM is no exception. By learning and applying some simple financial tools, a great return for a small investment of time can be gained.

- *Upside:* There are three distinct advantages to present value analysis: 1) It uses cash flows rather than net earnings (i.e., payback analysis); 2) It recognizes the time value of money; and 3) Value increases when funding only projects with positive net present values.
- *Downside:* Present value analysis presumes that one can make detailed predictions about future cash flows. Cost of labor, materials, and overhead are hard to predict the farther out in time one goes. The discount rate will also change over the life of a project.

5.1.9 Return on Net Asset (RONA)

Return on net asset (RONA) is defined as:

$$\frac{\text{Change in net assets}}{\text{Total net assets}}$$

This represents the change in value of an organization’s assets over the past year. If it is growing, then the company is using its assets better than before; if it is declining, it may represent a change in asset leveraging strategy. As with most financial ratios, there are no quick and simple answers to one ratio—It must be compared with other ratios.

What is important is the fact that RONA is a key ratio within many organization’s composite financial indexes. And, it is the most important financial health indicator of physical assets; hence, its importance to facility managers.

To optimize RONA (the ratio of dollars per asset), it is possible to reduce operating cost per asset or to decrease the amount of assets owned without affecting returns. This requires providing only what is needed at the right time for each asset. The FAM (Facility Asset Management) (see next section) process can be used to optimize RONA.

Problem statement: Do we increase roofing PM budget or get a new roof?		
Roofing facts		
Installed 1986		
Replacement cost = \$1 million		
Rated life = 17 yr		
Discount rate = 6%		
Operational cost calculation		
Current operating costs:	Future operating costs:	
PM = \$3,000	PM = \$10,000	
Repairs = \$400	Repairs = \$200	
Energy = \$2,500	Energy = \$2,500	
EHS = \$800	EHS = \$0	
TOTAL = \$6,700	TOTAL = \$12,700	
Difference between future – current operating costs = \$6,000 per year		
Capital cost calculation		
Current replacement cost:		
Expected life at current PM = 17 yrs		
Therefore replacement year 'A' would be 2003		
NPV of 'A' is \$746,200		
Future replacement cost:		
Assume that increased PM budget will increase life of roof by 10 years		
Therefore replacement year 'B' would be 2013		
NPV of 'B' is \$458,100		
Difference between future – current replacement cost = \$288,100		
Summary		
	Operational \$	Current NPV \$
Current PM	\$6,700	\$746,200
Increased PM	\$12,700	\$458,100
Difference	\$6000 $\times$ 10 yr = \$60K	\$288,100
Conclusion		
For an increased preventive maintenance budget of \$60,000 over ten years, the capital budget of \$1 million for roof replacement is delayed by 10 years saving \$288,100 of capital value at 6% discount rate.		

FIGURE 5.3 Example of Roof Repair or Replacement.

As more and more companies have off-balance sheet assets, it will be harder to compare the performance of assets between different companies. Internet-based companies (those with significant investments in electronic commerce) usually have a very high RONA.

5.1.10 Off-Balance Sheet Assets

Many businesses are investing more in bits and bytes than in bricks and mortar. Financial pundits claim that the current accounting and financial systems are increasingly irrelevant due to the growth of intangible assets: ideas, brands, ways of working, franchises, and the influence of the Internet on the economy. Intangible assets are replacing physical assets. They claim that managers cannot decide whether a project is worthwhile, or even how to assess the value of a project. These pundits maintain that a new knowledge-based financial and accounting system needs to be established. The old accounting system is based on antiquated principles that rely on double-entry bookkeeping that

is increasingly irrelevant today. Companies' net asset value is increasingly relying more on intangible assets than on physical assets.

Intangible assets can be grouped into four main areas:

- Product innovation
- Company brand value
- Structural assets
- Monopolies

Facility managers are concerned with structural assets that focus on better, smarter, different ways of doing business (not bricks and mortar). Physical assets are increasingly limited in their usage and have conflicting ways to be used. Intangible assets (such as databases and software) can be used in multiple ways in multiple locations by multiple customers for multiple transactions—thereby increasing substantially their value over the limited uses of physical assets. Value is created through transactions that have no physical interaction. Software and Internet transactions add value based only on the existence of a communication link and an authorization code. Perhaps FM in the future will be more involved with the infrastructure management of data and communication centers. Storefronts will still need to be taken care of by facility managers.

Some of the solutions currently being considered include:⁴

- Satellite accounts (capitalize intangibles)
- Normalized earnings (past + future)
- Knowledge asset valuations
- Percentage revenue from new products

These solutions do not present any one acceptable financial measurement system, but together they all point at the amount of future value a company has based on its current knowledge base. Bricks and mortar, as well as the management of facilities, are not going away soon and there needs to be an awareness that, increasingly, more value is being created through telecommunications and software transactions that have no physical assets in play.

5.2 FACILITY ASSET MANAGEMENT (FAM) FINANCIAL MODEL

It is the responsibility of the facility manager to take care of the physical assets of the organization—facility managers are the stewards of an organization's assets. Effective management of physical assets distinguishes the FM from other professional managers. One of the best processes to manage these assets and add value to the organization is through the FAM process.

5.2.1 What Is FAM and How to Get Started

FAM is a combination of engineering, finance, and business management principles that track the performance of an organization's physical assets. The goal of FAM is to increase the RONA (see previous section).

The simplest way to review a company's assets is to look at a summary of replacement values of physical assets within a summary database. This database would ideally contain the following information:

- Asset description
- Date asset was put into service
- Current condition of asset

5.12 PLANNING

- Current replacement value of asset
- Depreciation to date
- Major repairs to asset
- Performance index

5.2.1.1 Asset Inventories. In order to get started in the FAM process, an inventory of all assets must be done. This is a simple, yet difficult task for most facility managers. Simple, because it involves merely the counting and assessment of physical things; complex, because it reaches across all organizational boundaries and can be easily forgotten about. Facility managers are usually too busy with their daily operations and capital projects and assume that catching up on the changing physical inventories can be done at the end of the fiscal year or whenever it is needed. It is time consuming to inventory all physical assets every few years. Most companies struggle to maintain a continually accurate physical asset database. The asset inventory is the foundation upon which all operations are built, and it is critical to any financial and operation management: “*If you don’t know what you have . . . how do you know what to do?*” The key to successfully maintaining an accurate asset inventory lies in the process.

By installing a simple process that monitors the dynamic changes to asset inventories as daily work and projects are done, facility managers can be assured of a continually accurate asset inventory. The first question of what to inventory depends on the organization’s need for detail and available resources. The answer lies somewhere between “*door knobs to buildings*.” While inventorying every doorknob may improve the detail accuracy, it adds little value and becomes very cumbersome and costly to update. Inventorying only the number of buildings or square feet occupied is too general and does not provide useable details to make decisions about major operational assets. The next question is how to update the asset inventory database.

Before plunging into inventorying all assets, it is important to have an update process in place. This is especially true for large facilities. During the process of inventorying assets, the assets will change. Work done on the electrical system or on an exterior landscaping project may change the number of E-panels or trees that were inventoried. A simple process to update the asset inventory may include tying asset codes into each work order or supplier invoice and integrating/linking the two databases.

5.2.1.2 Condition Assessment. Condition assessments (CAs) are an important and integral part of asset inventories (see also Chapter 9). CA must be a continuous process based on accurate asset inventories and sound engineering principles. CA is essential in forecasting repairs, capital renewal budgets, and replacement needs. A standardized process must be used to make valid comparisons and appropriate investments. Individual bias, corporate politics, changing assumptions, etc., have no place in a good CA process. The CA must be strictly based on a technical and engineering evaluation of the current state of an asset.

The purpose of a CA process is to provide a long-term, time-phased program that accurately forecasts work needed to maintain assets in a productive and reliable state. A uniform inspection process must be established. Keeping an updated asset inventory and CA of those assets in a database is essential to good FM practice. There are standard engineering and economic equations that can provide facility managers with long-term management systems for their physical assets.

5.2.1.3 Leveraging Assets. Asset value is defined as: the present value (price) of all future cash flows associated with that particular asset. This is usually related to stocks and bonds, but is also applicable to physical assets. Extending the life of the physical assets of a company is one of the important responsibilities of a facility manager.

5.2.2 Maintenance and Operations (O&M) Budgeting

In developing a budget for new projects, capital renewal, and facility operations, it is important to understand the needs and service levels of the overall organization. An on-going facility budget is

like a roadmap for the future of the FM department—what will be needed to operate and maintain physical assets to support the business mission? Other departments' budgets affect the facility budget. One example: Information services (IS) will need to adjust its budget based on facility plans for retrofits, reconfigurations, additions, or conversions of building areas that will have different network and telecommunication needs. Likewise, the facility department may need to adjust its budget based on IS plans for increasing data centers, networking, and other technology improvements.

The highest costs in FM are the operational and maintenance costs over the lifespan of the physical assets. Many companies refer to these budgets as their operations and maintenance (O&M) budgets.

It is common for the O&M costs of a facility to be more than ten times higher than the original construction costs over the total lifespan of the physical assets. Therefore, it is essential (from the start) that the proper preventive maintenance and repairs are performed to assure effective operational and financial performance of physical assets.

Budgets are essential to controlling a company's costs. Adherence to budgets requires planning, on-going financial discipline, and constant adjustments. In deciding what the appropriate annual operating budget for a facility is, there are several approaches. Table 5.1 gives a comparison of these budgeting methods. These methods are based on typical organizations' progression:

1. Zero-Based: When a building or asset is first operated, there is little history available and few benchmarks available for the specific operations incurred. The first year may well become the baseline year to learn about the asset's operating costs.

2. Historical-Based: Once an asset has been in operation for at least a year, a history is established. It is commonplace to budget for next year's asset operations based on the same or ± 5 –10% of last year's budget.

3. Benchmarked—Unit Costing: To encourage continuous improvement in operating costs and to remain competitive within their industry, many organizations are looking to benchmarking their costs and setting their budgets accordingly. Benchmarked budgeting is an important first step in pointing out areas for improvements. Underperforming areas are quickly identified and investigation and improvements can be started quickly. The disadvantage is the difficulty of comparing one company's unique internal customers and operations with another.

One particular process in use (especially for capital projects) is unit costing. While unit costing can yield competitive bids and can be useful in standardized systems and projects, it can also be misleading when specialized custom projects and services are needed. R. S. Means has historical and benchmarked data commonly used by FM and suppliers to budget this way.⁵

4. Activity-Based: Based on activity-based costing (ABC) and activity-based management (ABM) general accounting principles, this activity-based budgeting focuses on each activity within a process and allocates the actual incurred costs for each activity physically being done. There is no "smearing" of overhead and indirect costs across the entire company's operations. ABC is an extremely long and cumbersome process, but the payoff can be tremendous. Companies that have gone through ABC have raised their competitiveness to a higher level.

TABLE 5.1 Comparison of Operations and Maintenance Budgeting Methods

Budget method	Accuracy	Fairness	Most used
Zero-based	N/A	N/A	First-year
Historical-based	Very small	Small	Most common
Benchmarked	Questionable	Minimal	To get competitive
Activity-based	High	Good	Control labor costs
Asset-based	Very high	Excellent	Leverage assets

5. Asset-Based: Based on the discussion in the previous section on FAM, asset-based budgeting—when used in conjunction with ABC—is the most accurate and best financial operational budgeting method. It is based on the current condition history of all physical assets that the FM is responsible for and leaves little room for error. It does require adequate resources and continual updating to provide value. Most facility budgets are grossly underfunded when FAM budget costs are totaled.

Sound budgeting leads to better management. By requiring all departments to plan and adhere to a budget, financial discipline is instilled throughout the company. Senior management has an accurate indicator of the company's costs and can maintain cash flow. Without this financial discipline, companies would be held hostage to large fluctuations of operating costs.⁶

Here is a checklist for FM budget performance:

- Is it aligned with the business mission?
- Does it accommodate other departments' plans?
- Does it take into account regional COLA?
- What will the asset's overall condition be?
- Does it have adequate contingencies for unforeseen emergencies?
- Does it include last year's carry over?

One budgeting process that has been successfully used by many companies is to base their expense budgets on specific work programs that start from the asset inventory, specify service levels, and cost out each work task in individual line items. Here are the steps in setting up a simple work program and budget:

1. *Physical Inventory:* See the previous section on asset inventories.
2. *Service Levels:* Decide what level of service customers need. Do they want a low-end (Kmart, Yugo) type facility? Do they want a high-end (Nordie, Lexus) type facility?
3. *Performance Frequencies:* Decide what the minimal technical service frequencies need to be and add the customer requirements. There is a direct relation between service levels of step #2 and how often a service is performed.
4. *Financial Factors:* How long does each service take? What materials and equipment are needed? What is the cost per hour for each service? Verify that internal external hourly rates are equitable.
5. *Crunching Numbers:* The arithmetic is simple, but the sheer reiteration can be overwhelming. Most facilities can support anywhere between 50 to 100 work program line items. Each item must be calculated with its own unique inventory units and service level frequency. Most calculations follow this formula:

$$[\text{inventory item}] \times [\text{performance frequencies/year}] \times \\ [\text{hours to perform} + \text{materials}] \times [\text{unit labor} + \text{material costs}]$$

A sampling of a simple work program and budget may look similar to the illustration in Table 5.2. It lists the inventory of physical assets, service levels, and performance frequencies, along with expected costs per unit of labor and material. There is also a column for major services—such as overhauling a chiller, or major repairs anticipated for an HVAC rooftop unit that may occur once every five years or so.

5.2.2.1 Financial Impact of Facility Disruptions. What is the cost of one hour of downtime for a company's accounts receivable department? Manufacturing production lines know exactly what one minute of downtime costs their operations, and they avoid it at all costs. Facility managers need

TABLE 5.2 Sample of Typical Work Program and Budget

Line item #	Budget descriptions	Work tasks	Inventory units	Unit of measure	Annual freq.	Hours/ service	Major \$/serv	Material \$/serv	\$ per hour	Total annual cost
2.0	Site	Inspect buildings	54	Sites	52	2.0		1	35	\$199,368
3.0	ME PM	OH doors	178	Doors	2	1.5		25	75	\$48,950
3.1		Garage equip+	318	Units	2	3.0		55	42	\$115,116
3.2		Air compress.	18	Units	1	2.0		15	65	\$2,610
4.0	ME service calls	Requests	514	Units	30%	3.0		20	46	\$24,364
4.1		Kitchen equip	46	Units	20%	6.0	20	50	40	\$33,028
5.0	Plumbing systems	Repairs	638	Fixtures	20%	2.0		60	45	\$19,778
6.0	HVAC PM	Pkg. units	77	Units	4	3.0	200	60	53	\$269,192
6.1		Chillers	2	Chillers	12	10.0	300	183	68	\$48,872

to know what the downtime costs of their facilities are if the electrical or HVAC systems fail and take appropriate steps to ensure their reliable operation.

Reliability centered maintenance (RCM) is the discipline of assuring reliability of physical systems. The first step in RCM is to identify and prioritize the physical assets (see FAM process) according to their impact on the organization's overall business operations. A simple start would be to identify the obvious high priority (e.g., electrical) and low priority (e.g., furniture) assets that could impact business operations. The next step in RCM is to identify all plausible ways in which the equipment could perform below expectations. Once the likely failure modes and their effects have been identified, a cost effective condition-based maintenance solution is planned and carried out. This may be as simple as adjusting the time schedules for programmed preventive maintenance, or as complex as acquiring sophisticated diagnostic equipment and scheduling facility downtime to perform the condition testing.

Another way of assessing the financial impact of disruptions is to look at industry benchmarks for various industries' downtimes. Consider the example in the following section.

5.2.2.2 Capital and Expense Linkage—Repair versus Replace. One of the most difficult decisions facing facility managers is when to replace a physical asset. Is it best to replace it just before it breaks? Is it best to replace it before the next major repair? Or is it best to replace it now? Consider these two scenarios:

1. After thousands of dollars of repairs have been made to an asset (which is halfway through its useful life) another major failure occurs. Is it more prudent to replace the asset or to make another major repair?
2. A critical physical asset has reached the end of its rated life, but shows no sign of deterioration and has an excellent performance record. Is it replaced or not?

All capital assets depreciate and eventually become outdated, obsolete, or nonoperational. Primary assets that are critical to a key business operation need to be replaced on a preset condition or run-time. Assets that are critical to human comfort and general business operations need to be replaced when they are approaching the end of their useful life, and before major repair expenditures are made. There comes a time when an asset's next failure is the trigger to replace it rather than to repair it. So how does one decide whether to repair or replace?

There are many questions that need to be answered:

- Is there a safety or health risk?
- Is the asset critical to a key business operation?
- Has the asset reached the end of its useful life?
- Will the expense budget support the next major repair?
- Will the capital budget support replacement costs?

A simple example is the calculation of repairing or replacing a roof, as shown in Figure 5.3. Roof replacement involves the expenditure of capital funds, whereas preventive maintenance involves expenditure of expense funds. When facility managers request additional funding for increasing preventive maintenance schedules on the roof to lengthen roof life (defer capital expenditures), they need to provide the financial comparisons so that the organization's financial decision makers have a proper analysis at hand. When this financial comparison is provided, the likelihood of obtaining the appropriate funding increases.

5.2.3 Financial Performance Measurements

Key performance indicators (KPIs) are an important measurement tool for businesses. FM departments must have their own KPIs that are aligned with the core business KPIs. Here is a listing of some typical FM KPIs (over a unit of time):

- Operational hours
- Areas of responsibility (AOR) (total sq. ft., number of customers, business volume, etc.)
- Response times
- Rework
- Value added
- Number and performance of suppliers
- Employee/supplier employee turnover
- Innovations—new processes
- Employee satisfaction
- Customer satisfaction
- Plan versus actual on contracts
- Number of items on punchlists

Financial performance cannot be the sole determinant of performance of facility operations. CFOs may focus on financial indicators, but they too (along with FM) realize that there are more important drivers behind the financial numbers. Performance results are what counts. A properly executed measurement system reflects the strategy of the organization, and avoids the costly mistake of guiding an organization in directions that are not aligned with its strategy. This is what most of the old measurement systems do. The importance of measurement comes down to the saying: *"You can't improve what you can't measure."*

The accepted way of measuring is to develop metrics (measurement ratios) based on a business strategic plan which provides key business drivers and criteria for metrics that managers would most like to monitor. Processes are then designed to collect information relevant to these metrics and reduce it to numerical form for storage, display, and analysis. Decision makers examine the outcomes of various measured processes and track the results to guide the company and provide feedback. Usually these outcomes are in the form of a written report or are viewed on an Intranet. Because these reports consist of mainly financial indicators, today's measurement systems focus

organizations on past performance and encourage a short-term view of the company's business strategy. There is a better way.

5.2.3.1 Balanced Scorecard (BSC). The best method for evaluating business performance is the balanced scorecard (BSC). BSC is not a fad, it is an important tool in managing any project, operation, or budget. A properly constructed BSC gives you the high altitude view of an operation and can drill down to pinpoint and improve problem areas quickly. Since initial publication in the Harvard Business Review of January 1993, the concept of the BSC has been interpreted in many different ways. While some people have chosen to view the BSC simply as a focused set of financial and nonfinancial measures, the proper use of a BSC is much more.⁷

A new approach to management measurement was developed in the 1990s by Robert Kaplan (Harvard Business School) and David Norton (Renaissance Solutions, Inc.). Recognizing some of the weaknesses and vagueness of previous measurement approaches, the BSC provides a clear prescription of what a company should measure in order to "balance" the financial perspective with other vital operating metrics. The basic premise of the BSC is that you need more than one or two key indicators of performance and it needs to be more than just financial data. The BSC focuses on four main areas:

- Learning and growing
- Business processes
- Customer
- Financial

It can be seen that these four perspectives relate directly to four Malcolm Baldrige Quality Criteria categories: human resources (Category 5); business process management (Category 6); customer focus (Category 3); and business results (Category 7). These four areas account for over 70% of the total possible scoring in this Quality Award Criteria. The BSC translates vision and strategy into a tool that effectively communicates strategic intent, and motivates and tracks performance against the established goals.

5.2.3.2 Designing and Using a BSC. "Building a balanced scorecard seems simple, but is deceptively challenging." This quote summarizes the frustrations of one executive who had embarked upon the development of a BSC with disappointing results. The design of a BSC should not be underestimated. There are two essential ingredients to the successful design of a BSC:

1. An architect who has a framework, philosophy, and a methodology for designing and developing the new management system.
2. A client who will be totally engaged and assume ultimate ownership of the project, understanding that he or she must live with the results long after the architect leaves.

One way to start using a BSC approach is to reengineer FM measurement systems. Define what learning and growing in each of the four areas really means to the organization or project strategy, then define what succeeds in each of those areas and measure it. There are many other approaches to BSC that involve more detailed steps.

Just having a great BSC does not do anything by itself. Facility managers need to take action based on what the BSC tells them. Measurement without action has no value. The whole purpose of the BSC is to prompt a manager about where and when to take action. BSC enables a manager to react like a pilot—making continual adjustments to regain a proper flight pattern toward the goal. Most BSCs have some sort of an automatic rating system applied to them. This shows the progress (or lack of) in each of the key areas. Most companies that use BSC roll-up their BSCs throughout the entire organization. Individuals, small project teams, and departments are usually where BSCs get started. The data is then summarized on a department or division-wide basis and so forth. The final summary "report card" that the senior executives see is the final product. If specific

interventions are needed in one or more areas, it is easy to drill down through the organization, pinpoint the root cause problem area, and take corrective actions.

A properly managed BSC will show you the progress of implementing a strategic plan. If the goal is to improve certain areas and the BSC does not show improvement occurring, then the strategic and/or logistic plans need to be revised to overcome a roadblock, or to redirect action plans. A good BSC should tell the story of the business strategy.

Three criteria help determine if the performance measures within the BSC do, in fact, tell the story of a strategy:

1. **Cause and Effect Relationships:** Every measure selected for a BSC should be part of a chain of cause and effect relationships that represent the strategy.
2. **Performance Drivers:** Measures common to most companies within an industry are known as "lag indicators." Examples include market share or customer retention. The drivers of performance ("lead indicators") tend to be unique because they reflect what is different about the strategy. A good BSC should have a mix of lead and lag indicators.
3. **Linked to Financials:** With the proliferation of change programs underway in most organizations today, it is easy to become preoccupied with a goal such as quality, customer satisfaction, or innovation. While these goals are frequently strategic, they also must translate into measures that are ultimately linked to financial indicators.

5.2.3.3 Applying BSC to FM. The four main areas of the BSC can be applied here. Here is one example of measuring the value of outsourcing using a BSC. You need to adapt these areas to the specific overall business strategy that led you to the outsourcing contract in the first place.

1. **Learning and Growing:** Metrics here include training hours per year for the facility manager and supplier's workers. More importantly, measure the value and skills/performance improvement of the workers. Turnover in employees is an applicable indirect metric.
2. **Business Processes:** This is the number of processes reengineered and/or automated, data-streaming accuracy, integration of processes into business strategy, number of new processes introduced, etc.
3. **Customer:** CSI 5 Customer Satisfaction Index. This is survey results and comparisons to baseline, number of complaints, customer retention, response time, average speed to answer (ASA), etc.
4. **Financial:** This is the most common: \$/sq. ft., total cost, \$/employee, etc.

By looking at all of the indicators simultaneously a more holistic picture of the overall health of the operation can be obtained. The BSC has been selected by many government agencies as an appropriate general structure for a strategic measurement and management system. Government offices, warehouses, bases, and facilities have much the same support services and user needs as a private company's. There are degrees of efficiency within operating and support processes that can be measured, benchmarked, and improved. Here is a quote out of a recent U.S. government manual on measurement:

A performance measurement system such as the balanced scorecard allows an agency to align its strategic activities to the strategic plan. It permits—often for the first time—real deployment and implementation of the strategy on a continuous basis. With it, an agency can get feedback needed to guide the planning efforts. Without it, an agency is "flying blind."

Companies that have been using the BSC for some time and have successfully integrated the tool into their management processes see significant financial and operational results. The CEO of a large insurance company estimates that by using their BSC as a catalyst for MIS improvements, he was able to increase product profitability by nearly \$30 million over a two-year period. Others describe the intangible benefits gained from being able to "understand the drivers of business

success” and “educate the organization, deciding how, when, and where to raise the bar.” By developing a BSC that truly tells the story of the FM business strategy, a foundation will be set for a management system that is capable of driving dramatic improvements in performance.

5.2.4 Forecasting Future Financial Requirements

Every year facility managers are asked to prepare next year’s budget and submit their budget adjustments for long-term financial projections. Occasionally they are asked to submit 3–5 year budget plans for both expense and capital expenditures.

The ultimate objective of all service businesses is to maximize profits and customer satisfaction. This goal must be in the forefront of all facility strategies. The problem is that no one variable can completely determine either of these outcomes—in fact there can be hundreds of variables that influence the outcome.

Uncertainty about the future causes a decline in the value of money; in other words, risk increases with time (see section on risk). No one can predict with certainty either the future value of money or future facility operational needs. However, there are tools that can be used to predict some of the future risks and forecast what the most likely facility budget needs to be.

There are four distinct characteristics about services that impact financial forecasting:⁸

- Intangible
- Perishable
- Heterogeneous output
- Simultaneous production and consumption

Accurately forecasting services (budgets), such as FM, requires answers to some difficult questions:

- Who are the future customers? What will they require?
- What is the capacity/utilization of the current service system?
- What are the equipment requirements?
- What will the future tasks be? New—current—abandoned?
- How will resources be assigned to these tasks?
- What are future reliability needs?

Some of the answers to these questions can be answered by the long-term business strategy of the company. Another answer comes from performance measurements (see previous section). Historical performance measurements provide the best foundation for future forecasting. All services require an understanding of customers’ needs. Facility managers need to know what the future churn rates, response times, and other customer expectations will be, in addition to having a comprehensive database of physical asset conditions.

5.2.4.1 Leading Edge Forecasting. With recent advances in computers and software systems, simulation tools are now available to help overcome challenges in planning and managing service systems. Simulation is particularly helpful in performing “what-if” scenario analysis for forecasting future system performance. Simulation helps achieve the greatest improvement in service system performance in the shortest amount of time.

The problem with current forecasting technologies is that they are limited to two-dimensional spreadsheet analyses. They neglect the dynamics of a system that involves multiple variables that must be tracked in order to reflect the reality of the system. The processing performed by spreadsheets (no matter how complex the macros are) are static in nature and do not take variability of performance variables into account. The results from spreadsheet analysis for systems are therefore

flawed. The concept of a “moving time clock” cannot be introduced into spreadsheet analysis. Hence, the need for a better analytical tool: simulation.

Simulation combines the friendliness of a spreadsheet, the methodology of flow diagramming, the visual benefits of a CAFM/CIFM system, and the intuition of facility managers to help make better business decisions. It reduces financial resources by avoiding inappropriate investments. It is more accurate and complex than all other financial analytical tools. Simulation moves a manager from “As-is” toward “To-be.”

Simulation is the only technology that truly allows one to forecast the future by taking into consideration all of a system’s randomness and variability. Simulation allows one to advance the time clock and fast-forward to see the future responses to the current or proposed system. Without simulation, a manager is left to predicting the future based on past results. *It is tantamount to driving a car looking out the rear window.* Simulation performance measures are both quantitative and time-based and measure the efficiency and effectiveness of a system configuration and operating logic.

Simulation can also be used to facilitate resource-capacity investments. Simulations can be used for:

1. **Decision Support:** Causes of problems and consequences of solutions
2. **Scenario Planning:** Explore alternative futures in real-time
3. **Customer Education:** Investigate value and uses of complex products and services
4. **Training:** Build skills and understanding in an interactive and risk-free environment

Another use for simulation is to predict and fund the “right” amount of capacity to deliver and manage the business effectively. The objective here is to achieve efficiency and service-level targets without overspending. This application is particularly useful to large FM organizations that have vast, spread-out resources and critical service delivery targets to meet. The use of simulation as an operational decision support tool can assist in looking forward to the impact a current decision will have on future asset and business operations. A proper FM simulation model can provide the means to anticipate problems and risks and to alleviate them before they occur.

Table 5.3 illustrates a comparison of traditional financial strategic forecasting tools and a comparison to simulation tools advantages.

All too often, right after a new facility, new project, or new service process is started, there are significant problems identified that compromise the ability of facility managers to meet their business objectives. By simulating the project or process before it is implemented, problems can be resolved and correction actions taken without affecting the physical environment, the customer, or the business operation.

The reader is referred to various excellent publications on simulation for further information.⁹

TABLE 5.3 Traditional and Simulation Forecasting Comparison

From traditional tools	To business simulation
1. Forecasting from historical data	1. Forecasting based on system dynamics
2. Static, hard-coded results	2. Individualized results that can be experienced
3. Assumptions are inflexible and hidden	3. Greater realistic control of analysis
4. Navigation and pace preset	4. Navigation and pace driven
5. Generic responses with no business model	5. Robust business models including customer and competitor behaviors
6. Learn by review + diagnostics of past	6. Learn by doing, analyzing future system response

5.3 LIFE-CYCLE ANALYSIS

The concept of life-cycle analysis is the most important part of financial management for all businesses—including FM. Life-cycle thinking means taking a holistic view of a product or service—from the raw material extraction through production, distribution, usage, and final disposal. Life-cycle thinking is referred to in many different labels. This section will deal with:

- Life-cycle costing (LCC)
- Life-cycle assessment (LCA)
- Full-cost accounting
- Commissioning

From an overall business perspective, life-cycle analysis can provide a sustainable competitive advantage. While mergers and acquisitions and, increasingly, technology speed and bandwidths may drive companies to new heights, life-cycle analysis is what keeps businesses around for the long term. Short-term thinking, from quarter to quarter, may be suitable to the retail industry; but long-term thinking is what sustains businesses through the rough spots of down cycles and where life-cycle analysis adds value.

No business area has a longer life cycle than real estate and buildings. Some buildings are built to last over 150 years, whereas other buildings have a designed life of only 30 years. The commercial life cycle of buildings is different than their useable life: shopping centers cycle in 11 years, warehouses in 25 years, with most commercial building somewhere in-between.¹⁰ Besides being used for analysis in design alternatives, life-cycle thinking is also an important part of facility operations.

Perhaps the single most important program a facility manager can undertake to reduce life-cycle costs is a robust preventive maintenance program. In section 5.2.2.2, Capital and Expense Linkage—Repair vs. Replace, the example of roofing repair or replace analysis, a form of life-cycle analysis, was used to look at the impact an increased preventive maintenance program would have on roof life. Prudent design decisions need to be made in the earliest stages of facility and project designs since they will irreversibly affect the next 15–30 years of a facility's operation.

5.3.1 Life-Cycle Costing (LCC)

This section deals with optimizing the life-cycle costing (LCC) of facility and real estate projects. The scope of this section is to deal within the closed system of the facility itself and not with the issues outside of the facility. Those issues are dealt with in the next section under life-cycle assessment (LCA). An easy definition of LCC is: “The accounting of cost in relationship to activities performed in developing a product or service from creation to retirement.”

According to ASTM, the definition of LCC is:

ASTM E833-89: (LCC is . . .) A technique of cost evaluation that sums over a given study period the cost of initial investment less resale value, replacements, operations, energy usage, and maintenance and repair of an investment decision. The costs are expressed in either lump sum present value terms or in equivalent uniform annual values.

There are many ways to reduce life-cycle costs. Figure 5.4 shows that the maximum impact on life-cycle costs occurs in the first conceptual preliminary design phase of a project. Once the design and construction of a project are completed, it gets more difficult to impact future life-cycle costs. However, there are steps a facility manager can take throughout the life of the facility to ensure that life-cycle costs do not increase.

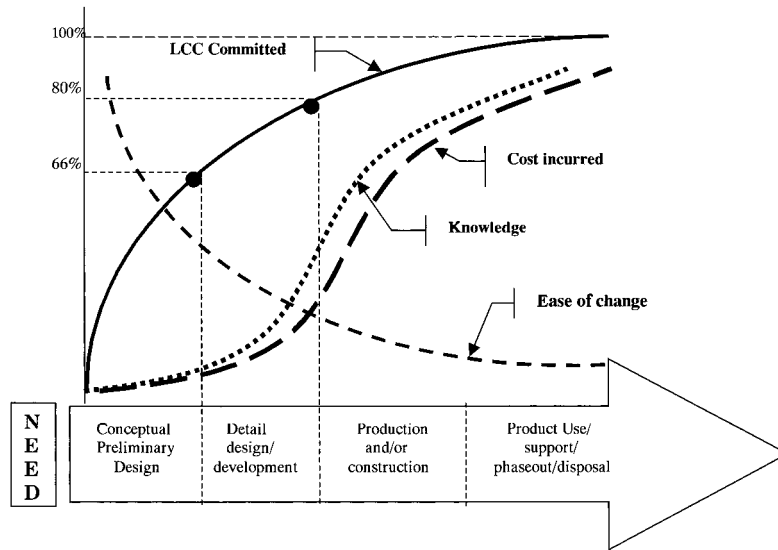


FIGURE 5.4 Cumulative Life Cycle—Phases of LCC.

The preliminary design phase deals with evaluation of possible alternatives. These possibilities are usually limited to the team of senior executives with regard to their vision, needs, and financial constraints. It is at this point that the senior facility manager needs to bring forth various operational scenarios and alternative design strategies that can be optimized through robust design and provide input to the LCC analysis.

The discipline of LCC analysis usually follows these steps:

1. Define need for analysis
2. Establish analysis approach
3. Select a model to facilitate evaluation process
4. Generate appropriate information
5. Evaluate alternatives
6. Recommend solution

The facility manager can have the most influence in steps 4 and 5 with regard to providing accurate information on long-term operational costs and introducing feasible and proven design and construction alternatives. Many of these alternatives come from the hard lessons learned during the daily operation of facilities.

The relationships of various facility design and operational phases for a facility are shown in Figure 5.4.¹¹

During the conceptual preliminary design, facility managers need to ask questions about the future facility:

- What is the expected physical life of the building?
- What is the expected life of the components and systems within the building?
- What will be needed along the life cycle of the building to realize its full life?

These and other questions are critical in establishing a long-term FM strategy that provides proper funding and responsiveness to building and customer needs and reduces the risks of not attaining the entire building's life. The benefits of this approach are:

- Continued value of asset
- Minimal long-term annual maintenance costs
- Minimal breakdowns and operational disruptions
- Resale value maximized
- Visual and aesthetics appeal increased

Most new construction and retrofits deal with a sizeable initial capital cost. Once initial investments are known, a comparison based on future operational costs and benefits can be made. Similar assumptions are made for all alternatives so that equitable comparisons are possible and the life cycle of physical assets can be optimized.

5.3.2 Full-Cost Accounting (FCA)

Full-cost accounting (FCA) refers to accounting methods that allocate environmental costs, both direct and indirect, to a product, product line, service, process, or work activity. It looks beyond the specific closed system within an organization and addresses the company's total cost of ownership.

FCA goes beyond LCC and includes the impact the financial investment has outside its immediate occurrence. For example, if you were installing a new chiller, the LCC would provide the financial information only from the standpoint of the installed cost to when the unit is salvaged. FCA looks at the total cost of the raw materials used to manufacture the chiller, the real transportation costs to get the chiller to your site, the cost of acquiring and disposing all the chemicals used by the chiller, the real energy costs to power the chiller, the cost of caring for the chiller, etc. In other words, the entire life cycle of the chiller must be considered—beyond its facility use and disposal.

FCA offers a framework to aid decision makers with short- and long-term program planning and it can help identify measures for streamlining and improving operations. Unlike other common methods of accounting that record only current outlays of cash, FCA takes into account all of the monetary cost of resources used or committed to facility projects which may differ from cash outlays. Many companies and communities nationwide are already using FCA as a way to make programs sustainable in the long term, and provide the best service for the least cost.

5.3.3 Life-Cycle Assessment (LCA)

An even more comprehensive and holistic view than life-cycle costing (LCC) or full-cost accounting analyses is life-cycle assessment (LCA). LCA involves enlarging the boundary of the system within which the facility or project is viewed. LCC deals with a specific closed system limited to the immediate project and its location. FCA limits itself to the system or project in question. It does not take into account the project's impact on its surrounding community, on the resources required to make and deliver the materials and equipment used at the building site, nor on its environmental impact. LCA includes the design implications for the environment and the overall industrial ecology. The overall goal of LCA is to make more environmentally sound decisions regarding business operations—including facility design and operations. LCA came to the forefront with its inclusion in the ISO14001 series of worldwide standards. It embraces a concept called "design for the environment" (DfE), which addresses the design of products and processes (including services) in ways that can eliminate or minimize the creation of environmental damages. DfE lowers the overall waste disposal costs, reduces the expenses of regulatory compliance, and reduces total life-cycle costs. LCA also includes the concept of *industrial ecology*, which studies how materials and energies flow, how they are transformed within broad industrial and consumer activities, and what

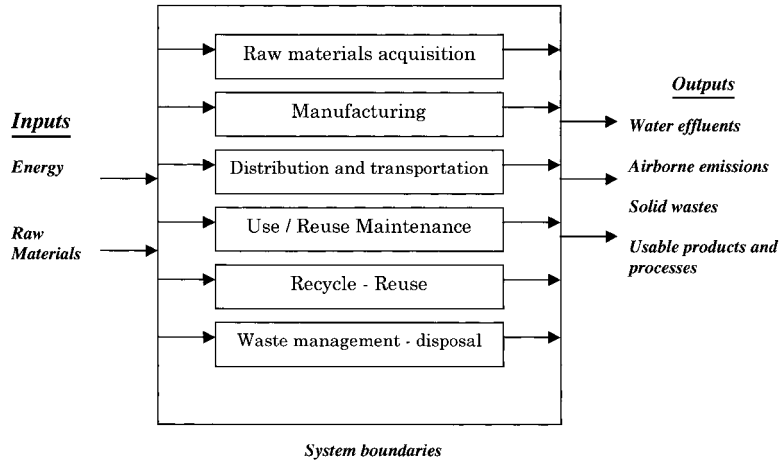


FIGURE 5.5 Life-Cycle Assessment Process.

effects they have on the environment. Industrial ecology includes factors such as political, social, regulatory, and economical issues. It seeks to place these systems within the framework of regional and global issues rather than just the specific localized issue that other analyses focus on.

LCA encourages businesses to understand the full range of environmental costs and to integrate these into basic decision making. Figure 5.5 illustrates this process.

The basic steps in doing LCA are:

1. Define goals and scope of assessment
2. Perform life-cycle inventory analysis
3. Assess life-cycle impact
4. Evaluate and implement improvements

LCA studies are time and resource intensive. Data gathering is complex and expensive. The reader is referred to the extensive literature that is available on ISO14001 and 14040/1 for additional details on this methodology. As more industries and businesses embrace a more holistic financial analysis, LCA will be pushed into the forefront of financial management tools. Facility managers need to become aware of their role in LCA analysis and look outside their immediate property boundaries to obtain a true picture of the resources their facilities are using.

5.3.4 Commissioning

Commissioning a building is a time-proven process for turning over from construction to operation. The definition of commissioning is “delivering owner functional intent.” As building systems get more complex and LCC, FCA, and LCA analysis become a necessity, real estate directors and facility managers are turning their attention to developing a sound commissioning process for their new projects.

The need for commissioning and providing a building operations and maintenance manual was first recognized more than thirty years ago in Europe and specifically in the United Kingdom. As the built environment aged, it became vitally important to plan for maintenance which would pre-

vent structures from deteriorating so far that they were no longer useful or even safe. Millions of dollars were allocated annually to this task. In the meantime, construction continued and new buildings were being completed at a record rate. It was determined that planning and implementing preventive maintenance programs from the first day offered both practical and economic advantages. Commissioning recognizes these advantages by including the start-up and maintenance costs along with the construction costs of a building. Today, maintenance is a multi-billion dollar business far outpacing the original construction costs, and the process of commissioning can substantially reduce lifetime maintenance costs.

The actual commissioning process should include all aspects of the building: its systems along with the site, structure, systems, and finishing requirements. How will the landscaping be maintained after it is fully grown? How will the exterior envelope be sealed from the elements—what if effervescence sets in? Are there architectural elements that will have a negative impact on the occupants—how can they be mitigated? Is the HVAC air balance within specifications and what is required to maintain high indoor air quality (IAQ)? What will the basic cleaning requirements be for the interior finishes—what chemicals should be avoided? How heavy will the traffic flow be within each area and what damage might occur? Is there enough data available to determine priorities when faced with multiple challenges? Are training classes available? What kind of support can be expected from the manufacturers and local contractors? All these questions can best be answered by both the design and construction and maintenance personnel, rather than any single party.

To get off on the right foot, the start-up and commissioning of a building needs to include the following:

1. At least one complete “full-load” test of all building systems
2. All operating manuals for substantial systems
3. Specification and cut sheets for equipment and special materials
4. Training by the installing contractors directly to the future operators of that system
5. Videos of the training or, at the very least, easy to understand, nonthreatening manuals
6. From the construction group—all warranty documents, evidence of code compliance, occupancy permits, etc.
7. From the material suppliers—all warranty documents, recommended maintenance procedures, content information, etc.
8. Release of mechanics and other liens
9. Maintenance schedule and procedural specifications for systems and finishes
10. Signed contracts for specialized first-year maintenance
11. A database of all equipment suppliers, local vendors, manufacturers, and replacement part order forms
12. A database of all material suppliers, local vendors, manufacturers, and ordering specifications

By focusing on one aspect of the building commissioning process, it becomes readily apparent how this can positively impact a project and its overall occupancy. From a technical systems standpoint, there are four major systems to look at when it comes to commissioning a building: electrical/lighting; HVAC; roofing; and environmental, health, and safety (EHS). These four areas also, coincidentally, are the four major issues within the ongoing operation and maintenance of any building. Each of these sections requires its own special attention, so we can only give a cursory view in this article. Here is a short list of some things to check for during building commissioning for each system:

- Electrical/lighting
 - Proper grounding, sequencing, phase balancing
 - All lamps and fixtures operative

- Controls and adjustments work properly
- Attic stock of special lamps and ballasts provided
- Fixture manufacturer data and warranty information received
- HVAC
 - The air balance report shows design air volume delivered to each zone and space
 - All thermostats are properly located and calibrated
 - High IAQ
 - All chiller and boiler units are functioning and have been broken in properly
 - Maintenance crews have been trained on all system requirements
 - Water treatments for all systems are in place
 - EMS and remote controls calibrated and working properly
- Roofing
 - Are all “foreign” objects removed from the roof?
 - Do all roof drains work properly—best to check with flowing water.
 - Is access to roof appropriately restricted?
 - Are warranty documents provided and understood and authorized contractors in place?
 - Are all RTUs, exhaust fans, skylights, access hatches, screens, etc., properly secured?
- Environmental, health, and safety (EHS)
 - Are all safety issues resolved—hand rails, eyewashes, etc.?
 - Are hazardous materials identified and MSDs in place?
 - Waste management and recycling program in place.
 - Is everyone trained on the EHS issues?
 - Have ADA accommodations been provided for and communicated?

Whew—what a short list! The real list is ten times longer. And, if you do all of these items properly on a 1 million+ square foot building, you will spend hundreds of hours. The HVAC section alone may take this long.

Reality is usually filled with a last minute rush of getting the building ready for occupation and these commissioning items are “necessarily” skipped over or delayed. But at what cost? Or maybe a simple checklist is crossed off instead of meticulously verified. This all means that you are already working with deferred (ignored) maintenance before your first occupants enter the building. Maintenance costs will increase, not decrease, over time as a result of poor commissioning. The upcoming thousands of hours that you will be spending responding to these issues (that could have been resolved in a few hundred hours) is the first example of the “pay for it now or pay for it later” syndrome.

5.3.4.1 Commissioning’s Potential Financial Benefits. Looking at just one example of what needs to be considered, it is easy to see why commissioning is so important and has been embraced more recently in the United States. Commissioning can ensure that:

- The performance of new equipment has been tested and verified in the presence of the staff who will be responsible for their future operations.
- The intended benefits of the new equipment, energy saving features, etc., are communicated to and understood by the operators, users, and managers.
- Routine maintenance and calibration is started on queue and not deferred. It is clearly understood what is to be done and when.

- Attic stock of replacement components and materials, or contacts of suppliers where they may be purchased, is provided.
- All manuals, cut sheets, specifications, as-built drawings, maintenance and warranty information are conveyed to the staff that will be operating the building.
- Budgets correctly reflect the expenditures involved and provide a reliable source for determining historic data.
- Deferred maintenance expenses, including premature replacement costs, are kept to a minimum.
- Successful design is recognized and costly problems are avoided in the future.
- Feedback on successes and failures are given to the design team.

In general, the old “turn key” approach to building start-up is slowly going out of vogue. Building owners and occupants demand a more proactive approach along with a properly trained staff that knows how to keep the building systems operating smoothly and the physical appearance from deteriorating. Maximum comfort, attractive surroundings, and significant savings are not conflicting points, but a common goal.

Getting the flywheel of building operations and asset management off to a smooth start is what commissioning is all about. Once deferred maintenance or other programs come into play, the flywheel’s momentum is changed. As the added weight slows the process down, the energy (money) needed to bring the momentum back up to an acceptable level becomes more and more frightening. Building commissioning is the grease that can keep everything moving at a steady rate, support continuing smooth operations, and reduce future costs.

5.4 ON-GOING FACILITY FINANCES

Not only can capital and major repair projects benefit from LCC and ROI analyses, the daily operations of the facility can also benefit from financial analyses. Conversely, daily FM operations need to accurately track and provide good data for major repair and capital project financial analyses.

Three major areas that impact financial analysis and are important for FMs in keeping accurate data are:

1. Asset inventories
2. Computer-integrated facility management (CIFM)
3. Contracts

5.4.1 Updating Asset Inventories

As discussed in section 5.2.1.1, asset inventories, a fundamental part of ongoing facility management is maintaining an accurate inventory of physical assets. Keeping the asset database updated is fundamental to conducting valid condition assessments and essential in providing data for all financial budgeting and analysis.

The physical workplace is a dynamic, ever-changing world. Physical assets are continually being switched around, replaced, removed, or eliminated. Some of these changes are minor, others are major—most changes are insidious. Changes to physical assets occur during renovation projects and during major repairs. Facility managers need to track these asset inventory changes on a continual basis. Consider these two on-going changes:

- When a 100' × 100' turf area in the landscaping is converted to a patio or parking area—that’s a 10,000 sq. ft. reduction in turf maintenance and a 10,000 sq. ft. increase in sweeping or pavement care inventory.

- One of the most insidious inventory changes occur when electricians add duplex outlets or other minor electrical changes for customers—these small changes can add up to electrical phase imbalances and potentially overload circuitry.

While this change may not seem significant, it is the constant repetition of these small changes that end up as major changes to your asset inventory. Unless the facility manager keeps track of all these small changes, the accuracy of the physical assets database is reduced and eventually will be so inaccurate that it is rendered useless and would require an overall asset inventory count to be retaken—a timely and expensive process.

As stated in asset inventory, a process to update the physical assets needs to be in place. For small facilities, this is relatively straightforward. For large conglomerates, this is a time-consuming process, but even more important. This updating process needs to be kept going throughout the life of the facility to ensure proper replacement cycles and reliable operation. The updating process can include simple changes, such as including physical asset coding on work orders and contractor invoices. It may involve bar coding and scanning technology.

5.4.2 Contract Pricing Issues

Every facility requires some contract labor to keep it operational. Whether the function is entirely outsourced, or only one general contractor is used for special, occasional work; supplier management and contract issues require some knowledge of pricing.

There comes a time in every contract negotiation or outsourcing initiative when pricing and financial issues are considered. Sometimes special financial analysts are brought in—internal support analysts, auditors, or third party external analysts. The overall intent of contract financial analysis needs to be clearly stated up front: What is the goal or purpose? Is this analysis being performed before, during, or after a contract or outsourcing service is provided? If before, then the intent may be to compare internal to external costs and will influence the outsourcing initiative. If during an ongoing contract, then the intent may be to compare cost savings and benefits, or to verify contract performance. If after, then the intent may be to focus on the contract renewal pricing and workscopes, or to perform a post mortem of lessons learned.

5.4.2.1 Getting Started. The basic steps in any facility financial analysis are to collect internal and external costs, total them, compare them, and project them along their life-cycle future costs. As discussed earlier in this chapter, in the initial collection stage it is important to pull together ALL costs that are associated with a specific work activity or service. There are many hidden and unassociated costs that are impacted by facility operations and these may need to be included as well.

The next step is to decide: *For what time period will data be reviewed?* Will it be for the previous fiscal year (most common)? Will it be for the last six months or three months? Whatever time period is chosen, internal and external operational data collection need to follow these minimum criteria:

- Substantially stable operation over entire period
- Complete financial data and details available
- CAFM–CIFM data accurately captured over entire period
- Consistent operation throughout the period (no work stoppages, etc.)

Once the time decision is made, the workscope boundaries need to be specified. Financial analysts may collect the above data for each specific trade or work activity. This is usually very cumbersome and difficult. Most organizations do not track detailed costs for each separate work activity. Costs are usually lumped into general categories such as HVAC, electrical, carpentry, workstations, general administration, and so forth. If the categories cannot be compared fairly to

external services, then it will be difficult to have a fair and equitable outsourcing analysis. Some companies use their CIFM systems to provide this detail and embark on a 3–6 month time period in which they collect all the data and required details.

Next, for the selected time period the following are added together for the specified workspace:

- Internal
 - Labor costs (include indirect percentage, usually ranging between 120 to 200%)
 - Material and equipment costs (purchases, leases, rentals)
 - Stores inventory (carrying costs)
 - Travel (fleet costs if applicable)
 - Warranty costs
 - Training
 - Administrative
 - Insurance
- External
 - Supplier labor costs
 - Material and equipment
 - Mark-ups and profit margins
 - Subcontractor costs
 - Bonding, insurance
- Support
 - Occupancy costs (\$/sq. ft.)
 - CIFM maintenance
 - Purchasing, procurement
 - Administrative

The reason to break down the costs in detail is to allow for easier comparisons now and in the future. It is difficult to go back and break down lump costs unless they were rolled up initially. For example, labor costs may be comparatively similar, but support cost comparisons may be way out of line and warrant further investigation.

5.4.2.2 Crank and Grind. Once financial analysts have prepared this data collection then it is time to crank and grind. First, they look at the current proposals from outsourcers or what the current outsourcer's performance has been, and then look at comparative internal performance. Comparative analysis can include straight-line analysis; that is, subtracting one from the other over time, or could involve NPV (net present value) and RONA (return on net asset) conversions.

5.4.2.3 The Downside. For those in the FM operations business, there is one major downside to financial analysis: it deals strictly with the financial risk. It does not take into account health and safety risks or operational risks. Seldom is any consideration given to market and competitive conditions or to customer satisfaction. Most financial analysts do not know the difference between an HVAC and a UPS systems nor what is the right amount of preventive maintenance for either system at different usage and aging patterns. It is the facility manager's responsibility to make sure that these issues are not drowned out by the financial background noise. Internal costs are sometimes misleading. They do not take into account market conditions and are hamstrung by internal overhead and administrative loading. External costs can also be misleading: a supplier may not be billing the true cost of providing the service (loss leaders, etc.).

5.30 PLANNING

5.4.3 Internet, Software, Financial Calculators

The ever-changing Internet contains a wealth of information on financial software and analytical tools and can assist in doing financial analyses. Appendix A in this chapter lists some Internet sites (as of January 2000) that facility managers may find useful regarding financial analysis and financial calculators. There are also many financial calculators (sometimes called business calculators) on the Internet. Among the most popular are Hewlett Packard and Texas Instrument financial calculators that can perform many financial functions. Some common financial and mathematical functions performed by financial calculators are:

- TVM (loans, savings, and leasing)
- Amortization
- Cash flow analysis
- Cash flow functions/No. of functions
- Print table with HP 82240B
- Bond price and yield
- Depreciation methods
- Interest rate conversions
- Currency conversions and unit conversions
- Statistical analysis
- Std deviation/mean/weighted mean
- Forecasting, correlation coefficient
- +, −, ×, /, %, 1/x, +/−, 1n, X, e^x, n!, y^x, SUM x, SUM x², SUM y, SUM y², SUM xy
- LOG, 10x, PI, x

Financial calculators are essential to performing simple calculations. Rather than resorting to financial interest tables to perform discounting and ROI analysis, facility managers need to know how to use the basic functions of a financial calculator. Financial calculators are beneficial, especially when compared to laborious manual calculations and look-up tables—but beware of their shortcomings and use them judiciously. A word of caution on using financial calculators: do not believe their results unless you use these calculators on an on-going basis or know the algorithms and approximate answers to the financial question. A financial calculator will most likely give you the wrong answer if you are unfamiliar with its operation. This is because *most financial calculators have multiple memories that may or may not be cleared, have different ways of entering various interest and discount rates, and different time periods.*

5.4.4 Integrating with CIFM Systems

Financial analysis within FM needs accurate input data. These data are usually supplied by a CIFM system. CIFM systems are a great resource for historical data tracking, ratio analyses, and comparative data analyses. Unfortunately, there are no stand-alone CIFM systems that have fully-integrated financial analysis capabilities. Several CIFM systems can provide basic lease management, asset value, and repair cost data summaries. Repair or replace decisions, ROI, RONA calculations, and other financial analyses are usually done with third-party software modules or with Excel™ macros.

CIFM systems are essential to providing the basic data needed to perform financial analysis and forecasting:

- Year asset was installed
- Operating costs

- Energy, EHS issues
- Asset condition
- Repair and trend history
- Major repair details
- Warranty information
- Replacement cost
- Depreciation

Advantages of using CIFM systems to aid in financial analyses include:

- Improved budget analysis and planning
- Improved forecasting
- Faster access and retrieval
- Faster turnaround time
- Better decisions
- Reduced operating costs
- Improved capital outlays
- Less labor needed

CIFM systems provide quantitative benefits to the facility manager. These are some of the areas that need to be considered when doing LCC analysis of CIFM systems:

- Longer equipment life
- Less time to drawing updates
- Greater space utilization
- Fewer duplicate asset purchases
- Improved disaster recovery
- Less corrective maintenance
- Effective parts inventory

The advantages of using third-party accounting and financial software packages are that in-house expertise is not required to perform the calculations. A CIFM system can also provide a wealth of additional information that is more important than the financial analysis:

- EHS and legal issues
- Safety risks
- Worn-out equipment
- Technology obsolescence

When looking for CIFM compatibility with financial analysis tools, consider these issues:

- Ease of use
- System interfaces
- Flexibility
- User interfaces
- Other departments' interface

CIFM systems are a great resource for historical data tracking, ratio analysis, and comparative data analysis; however, they do little in assisting with financial forecasting.

5.32 PLANNING

5.4.5 Using Simulation for Financial Forecasting

Using historical data to predict what will happen in the future is like driving your car by looking out the back window—past events and performance do not tell you what is coming in the future. Sophisticated forecasting tools have been available to large industries for many years. These tools are now starting to be used by facility managers and real estate directors to make more intelligent forecasts of future system performance and reduce future risks.

One cannot use a static model (CIFM) to study a dynamic problem. By modeling current and future business scenarios, facility managers can eliminate, or at least mitigate, much of the uncertainty that inevitably happens when facilitating changes. It will save capital budgets by avoiding inappropriate investments. When used effectively, it can also improve the on-going operational bottom line.

5.4.5.1 Simulation Overview. People create and run simulations in their minds every day: planning investments, coordinating transportation, analyzing relationships, and making business decisions. For most of us, the term “simulation” conjures up images of academies predicting the economy, the military playing war games, airlines teaching pilots, MBA’s modeling businesses, engineers modeling power plants, and video game enthusiasts playing SimCity™. As useful as these simulation tools can be in all these situations, only a few people have the resources, knowledge, and tools to use simulation. There are currently several business simulation models that have been developed for the real estate and facility professional. FMs can also use several of the simulation software platforms that are available to develop simulations for their own processes and predict future behaviors of their processes, thereby reducing risks to their business operations.

5.4.5.2 System Dynamics. At the heart of these simulation products is a sophisticated methodology for developing continuous simulations, developed in the 1950s and 1960s at MIT by Professor Jay W. Forrester (inventor of computer memory), called System Dynamics. More recently, Peter Senge revitalized systems thinking concepts in his books on *The Fifth Discipline*. Systems thinking involves changing paradigms about the way the world works, the way corporations work, and the human role in each. Senge and his colleagues teach managers to look for interrelationships among system elements; to avoid placing blame in favor of finding the true, long-term solution to a problem. System dynamics takes this one step further.

System dynamics is less well-known than system thinking. Its purpose is to give managers a tool to understand the complex systems that they are charged with controlling. The methodology uses computer simulation models to relate the structure of a system to its behavior over time. It is based on defining the changing relationships between entities using formulas. Continuous simulation is best used for analyzing behaviors that cannot be easily viewed as discrete events. With this simulation software, the ability to use this complex theory is now put in the hands of managers, marketers, and mere mortal real estate and facility managers.

Simulation allows you to run hypothetical “what-if” scenarios on a computer model without disturbing the actual system. It allows understanding of randomness and variability in a business environment. Simulation allows you to forecast by looking forward and analyzing what is coming. It allows you to contain future risks and capture the dynamics of your business environment in a flexible, breakable, changeable model using multiple “what-if” scenarios.

Simulation models can also be used to manage change and can result in dramatic improvements in business performance and profitability. Each scenario offers its own ROI alternative. Alternatives that do not match business objectives can be eliminated and tradeoffs in implementation strategies and their effect on customers and profits can be explored.

Simulation combines a familiarity with spread sheets, the methodology of flow diagramming and process mapping, and the visual benefits of graphical outputs—all to help make improved business decisions and financial forecasting. Business process reengineering (BPR) unleashed the power of information technology by enabling organizations to break the rules and create new ways of working.

TABLE 5.4 Traditional Tools vs. Business Simulation

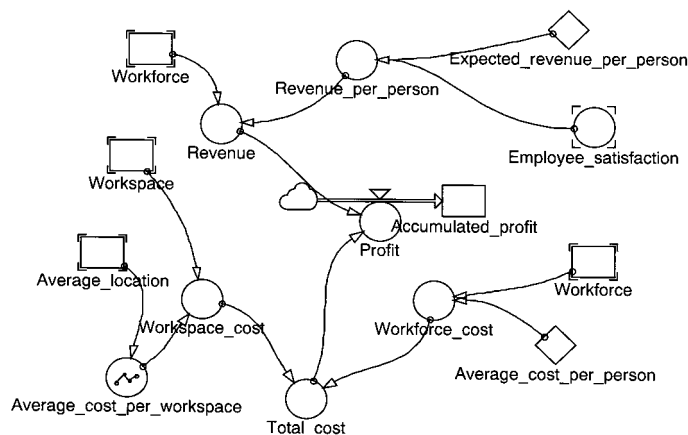
From traditional tools	To business simulation
1. Forecasting from historical data	1. Forecasting based on system dynamics
2. Static, hard-coded results	2. Individualized results that can be experienced
3. Assumptions are inflexible and hidden	3. Greater realistic control of analysis
4. Navigation and pace preset	4. Navigation and pace driven
5. Generic responses with no business model	5. Robust business models including customer and competitor behaviors
6. Learn by review + diagnostics of past	6. Learn by doing, analyzing future system response

Business process simulation enables organizations to reengineer more effectively. It allows them to think “outside the box” and determine new ways to run a business. Table 5.4 lists the traditional methods and the corresponding business simulation objectives to move towards. Business scenarios that differ dramatically can be easily explored and compared with a computerized model with better decisions being the result.

Real estate and FM are about relationships and risk management, not only with the people involved, but also with the complex variables that impact daily operations. Just as economic models are driven by interest rates, consumer confidence, housing starts, currency valuations, etc., so, too, internal infrastructures and physical facilities are driven by many variables.

Managing infrastructure is all about managing RISK, which is defined as *the measure of probability and consequence of not achieving a defined goal*. Risk management is the process of identifying, assessing, and controlling risk. A manager can only avoid, reduce, transfer, and assume risk. By identifying and optimizing their key business processes, companies can get the maximum performance from their resources and achieve dramatic financial benefits. They can save money by avoiding unnecessary expenditures.

5.4.5.3 Case Study. Nippon Telephone (NTT DATA) based in Tokyo, Japan, was the first company to apply financial simulation modeling to its leasing management operation. By applying such

**FIGURE 5.6** Nippon Telephone Simulation Model.

techniques, NTT was able to look at their space standards and decide what the optimal standard was in relation to profits, employee satisfaction, time to lease, etc. One of the NTT simulation models is shown in Figure 5.6.

Sensitivity analyses showed that the optimal figure was at 9m², whereby the standard workspace maximizes accumulated profit. This observation resulted in the conclusion that when the space standard is increased to this level, the profits were optimized while other conditions stayed the same.

APPENDIX A WEB SITES FOR FINANCIAL MANAGEMENT

Other Service Industry Financial Analysis Sources

- <http://www.healthedgroup.com/noframes/subjects/finance.htm>
- <http://www.epa.gov/opptintr/acctg/rev/tbl3-5.htm>

Financial Calculators

- HP 12C, 17B, 19B, 38G, 48G: <http://www.hp.com/calculators/purchase/financial.html>
- Texas Instrument Business Analyst—Real Estate: <http://www.ti.com/calc/docs/busi.htm>

General Finance Analysis

- <http://www.sandia.gov/pv/sysd/Economics.html>
- <http://www.nissd.com/sdes/papers/deslcc.htm>
- <http://www.iso.ch/9000e/9k14ke.htm>
- <http://www.tc207.org/home/index.html>
- <http://www.environment.gov.au/epcg/eeu/consumption/lessons.htm>
- <http://www.nap.edu/books/0309054419/html/29.html>

APPENDIX B DEFINITIONS OF FINANCIAL TERMS

Assets. Real, intangible, and financial items the corporation owns or has a claim upon. Assets traditionally appear on the left side of the BALANCE SHEET.

Balance Sheet. One part of the FINANCIAL STATEMENT which lists the wealth of the corporation at a specific point in time. Traditionally, ASSETS appear on the left and LIABILITIES on the right and the two must be in balance. EQUITY is a form of liability representing what the corporation owes to the stockholders.

Breakeven. The breakeven volume is the number of units the company must sell to recover its fixed and variable costs of production, at a given price. The breakeven price is the price the company must charge to recover its fixed and variable costs, at a given sales volume.

$$QBKEVEN = FC/(P - AVC) \text{ or } PBKEVEN = (FC/Q) - AVC$$

Cash Flow, Cash Flow Statement. Cash flow measures the profit of the company over a given time period in cash terms (as opposed to accrual terms). A CASH FLOW STATEMENT is generated by beginning with an accrual-based INCOME STATEMENT, and making the following adjustments:

- add back in noncash expenses, such as depreciation
- subtract increases/add decreases in operating assets

- add increases/subtract decreases in operating liabilities
- subtract cash going to/add cash coming from capital investments
- add cash coming from/subtract cash going to financing activities

Debt. An obligation or liability arising from borrowing money or taking goods on credit. Forms of debt include bank loans, bonds sold to investors, and various types of “commercial paper.” Debt holders are creditors of the company; stockholders are owners of the company.

Depreciation. A noncash expense entered on the income statement to recognize the reduction in value of FIXED ASSETS due to wear and tear.

Discount Rate. The rate at which future cash flows are discounted because of the time value of money.

Income Statement. One part of the FINANCIAL STATEMENT which lists the REVENUE, EXPENSE, and PROFIT (or loss) of the company over a period of time. Traditionally, revenue appears on the right and expenses on the left.

EDIT = Earnings Before Interest and Taxes. PROFIT before you subtract interest and tax expenses. It measures efficiency of operations independent of financial matters such as interest rates and tax rates.

EBITDA = Earnings Before Interest, Taxes, Depreciation, and Amortization. PROFIT before you subtract interest, tax, and noncash expenses. It measures efficiency of operations independent of interest rates, tax rates, and capital investments in plant, equipment, and intellectual property.

Equity. The “book value” of the company’s stock. (Not the market value it is trading at on the stock exchange.) Equity holders are owners of the company.

Equivalent Annual Cost. The cost of obtaining and maintaining an asset annualized over its life (as if you were leasing it from someone else).

Expense. Payments made by the company to others for value received. DEPRECIATION is a “noncash” expense used to estimate the decrease in value of a FIXED ASSET over time.

Financial Statement. A comprehensive description of the company’s finances including the BALANCE SHEET, INCOME STATEMENT, and CASH FLOW STATEMENT.

Fixed Asset. An asset such as property, plant, equipment, or intellectual property that has a long life and cannot be expensed in a single year.

Fixed Costs. Costs which do not vary significantly in the short term with the volume or production. Property, plant, and equipment are examples.

Income Statement. One part of the FINANCIAL STATEMENT which lists REVENUE, EXPENSE, and PROFIT (or loss) of the firm over a period of time.

Internal Rate of Return (IRR). Mathematically, IRR is the discount rate at which the investment has zero net present value (NPV). If that is a little too abstract, you can think of it as return on investment (ROI), although that is mathematically incorrect. IRR is used to compare and contract different projects that the corporation could invest in. Higher is better. There is no formula for IRR, but spread sheets can calculate it, iteratively.

Leverage. The ratio of total assets to total equity. A “highly leveraged” company will have high total assets in relation to low equity.

Liabilities. Any claims against the firm. Liabilities traditionally appear on the right side of the BALANCE SHEET.

Net Present Value. The initial cost of an investment (a negative number) plus the PRESENT VALUE of the future CASH FLOWS it will generate (a positive number).

Nominal Dollars. Dollars which are not adjusted for inflation or time value of money.

Opportunity Cost of Capital. The value of other opportunities you gave up to invest in the capital project in question.

Present Value. Future cash flows in terms of their value today, using a DISCOUNT RATE.

Real Dollars. Dollars at some other time adjusted to their value in current-day terms.

Revenue. Money (or other value) received for products sold to customers.

Time Value of Money. A dollar today is (usually) worth more than a dollar tomorrow, due to

inflation, costs of borrowing, and risk. The DISCOUNT RATE measures the difference between current and future dollars.

Variable Costs. Costs which vary in the short term with the level of production. Raw materials are an example.

APPENDIX C ACRONYMS USED IN THIS CHAPTER

ABC	Activity-based costing
ABM	Activity-based management
AOR	Areas of responsibility
BPR	Business process reengineering
BSC	Balanced scorecard
CA	Condition assessment
CAFM	Computer-aided facility management
CFO	Chief financial officer
CIFM	Computer-integrated facility management
COLA	Cost of living adjustment
CSI	Customer satisfaction index
DfE	Design for the environment
EHS	Environmental, health, and safety
FAM	Facility asset management
FCA	Full-cost accounting
HVAC	Heating, ventilation, air conditioning
IAQ	Indoor air quality
IRR	Internal rate of return
IS	Information services
KPI	Key performance indicators
LCA	Life-cycle assessment
LCC	Life-cycle costing
MFL	Maximum foreseeable loss
MIS	Management information system
MTBF	Mean time between failure
NPV	Net present value
O&M	Operations & maintenance
PML	Probable maximum loss
RCM	Reliability-centered maintenance
ROI	Return on investment
RONA	Return on net assets
SPB	Simple payback
TCO	Total cost of ownership
TI	Tenant improvements
TVM	Time value of money

ENDNOTES

1. A word of caution: Different countries and different United States localities have unique financial regulations and laws that may be different from those offered in this chapter.
2. Campbell, J. 1995. *Uptime*. Productivity Press.
3. Schall L. D., and Haley, C. W. 1983. *Introduction to financial management*. McGraw Hill, p. 219.
4. Lev, B. *Financial statement analysis: A new approach*.
5. Means, R. S. 1998. *Means assemblies cost data*, 20th annual edition. Kingston, MA: R. S. Means Company.
6. An excellent reference on developing costs data and budgeting is available through the AACE (Association for Advancement of Cost Engineering through total cost management) and its web site at <http://www.aacei.org>
7. References for further reading on BSC:

Norton, D. P. 1996. *The balanced scorecard: Translating strategy into action*. Cambridge, MA: Harvard Business School Press.

Cooper, R. 1998. *Cost and effect: Using integrated cost systems to drive profitability and performance*. HBS Press.

Harvard Business Review articles include: Cooper, R. 1998. *The promise—and peril of integrated cost systems*, (July–August) and Norton, D. P. 1996. *Using the balanced scorecard as a strategic management system*. (January–February).

CD-ROM interactive simulation, *Balancing the corporate scorecard*, available from HBS Publishing.

In 1994, HBS Management Productions produced a four-part videotape series, *Measuring corporate performance*, which presents concepts and companies' experiences with activity-based cost management and the Balanced Scorecard.
8. Sasser, W. E. et al. 1978. *Management of service operations*. Boston: Allyn & Bacon.
9. References for simulation reading:

Harrel, C. et al. 1995. *Simulation made easy—a manager's guide*. Institute of Industrial Engineers.

Profozich, D. 1998. *Managing change with business process simulation*. Prentice Hall.
10. Flanagan, R. et al. 1989. *Life cycle costing*. Oxford: BSP. pp. 44–45.
11. Fabrycky, W. et al. 1991. *Life cycle cost and economic analysis*. Prentice Hall.

