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Practical financial decision making : essential tools

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Practical Financial Decision Making ESSENTIAL TOOLS

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Preface

The focus of this book is to help you develop a disciplined procedure to identify current and future problems within an organization, and to position the organization to exploit future occurrences. Today, these objectives require, at least, a basic understanding of the available analytical tools and techniques.

Remember the old saying "If the only tool you have is a hammer, all problems look like a nail."

This book is intended to help you:

- Identify blockages in your organization that interfere with decision making.
- Develop a system to obtain data and convert it into information.
- Apply techniques to uncover patterns or trends.
- Demonstrate the use of analytical tools for problem solving and improvements throughout an organization.
- Improve the budgeting and forecasting process.
- Develop an evaluation process for acquisitions and divestitures, as well as other long-term projects and programs.

The use of analytical techniques has been greatly expanded and enhanced by the development and widespread availability of software. Numerous tools which only several years ago required large equipment and facilities are now available via our laptops. These tools operate in an Excel environment and are frequently accessible via the **tools** option. Examples include regression analysis, linear optimization and **Scenario Manager** (basic "what if analysis").

Software for other statistical tools (simulation, etc.) or advanced versions of the above tools are available in the marketplace. Additional sources are noted in the text.

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Chapter 4: Analytical Models—Decision Aids

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Chapter 1

Environmental Forces Affecting Decisions

Introduction

Decisions are not made in a vacuum. They are the product of an entire organization. Therefore, everything, from its structure and reward systems to its risk profile, plays an important role in selecting and implementing decisions.

A scientific approach to decision making must address these environmental issues, as well as to provide analytical tools and techniques to assist in the decision process. Chapter 1 begins the overall management of decision making by identifying a number of the structural issues or forces, and the influences they can have. In this way, we can also understand how to better manage their impact.

After working through this chapter go back and ask yourself the following question:

Are there policies in my organization which
interfere with arriving at and implementing decisions?

For example, do we extend our depreciation period for assets too long, and thereby keep sunk costs on our books which support the status quo? How about our compensation programs? Do they encourage desired behavior?

The purpose of this chapter is to

- Explore the evolution of financial decisions.
- Introduce the purposes and limits of a scientific approach to decision making.
- Identify the factors that influence decisions.
- Begin to address how environmental factors can be managed to assist in reaching and implementing the best decisions.

Historic Focus of Financial Decisions

The development of financial decision tools and techniques has moved from external financing (1920s) and survival (1930s) to encompass all aspects of a modern organization. The acceptance of new ideas concerning economic theory in the 1950s probably did more than any other event to increase the use of analytical techniques. This evolutionary process has resulted in a significantly expanded role for financial professionals, and the development and use of decision tools to address an ever-widening range of issues.

The period of growth and innovation in the 1920s created a need for additional capital. This resulted in the predictable focus on liquidity and financing. The events of the 1930s directed the study of finance to defensive or survival issues. The corporate collapses and fraudulent actions by some management resulted in government regulations. Thus, significantly increasing the amount of financial data provided externally. This led to increasing the role of financial analysts, as they were better able to compare the financial condition and performance of companies.

Throughout the next two decades, financial analysis looked at issues within companies from an outsider's viewpoint. The experiences of the 1930s educated financial professionals to review issues as a third-party lender or investor.

During the 1950s to the early 1960s, budgeting (operating and capital) and cash flow analysis and control became the vehicles which expanded the role of analytical tools. Over the next 1-2 decades, models were developed to value firms from a lender's or investor's viewpoint (valuation models). This led to calculating the impact of internal decisions on valuations and linking the previous external focus to an internal awareness. The formulation of portfolio and efficient market theories helped to complete the basic "tool box."

Increases in inflation and an expanding global marketplace (both first became noticeable during the 1970s) drove the next stage of analysis. Fluctuations in inflation resulted in significant increases in interest rates and capital replacement costs, as well as increasing reported profits from the sale of older assets, including inventory. While inflation has been considerably tamer in recent years, the CPI in 1980 was in the mid-teens.

The development of a global marketplace with competition from nontraditional sources has and continues to increase the number and frequency of decisions. In addition, as technology changed at an increasing rate, financial decision making tools had to be adapted to an ever-widening array of situations. The singular focus of the 1920s on financing has been replaced by a growing and changing list of issues ranging from new product development to production and capital programs. The risk of making a poor decision has never been higher, nor has the number of required applications for analytical tools. A summary of the historic events that have helped to shape the current climate for financial decision making include:

- 1920s—external financing
- 1930s—survival
- 1950s—economic theory
- 1950s through 1960s—budgeting, cash flow analysis, controls
- 1970s—capital and interest rate analysis (inflation
- 1980s and beyond—system-wide improvements, globalization

Decision Making—Art and Science

Making decisions and taking action is fundamental for all management. Therefore, the outcome of analysis must have a direct implication for management's actions. Hopefully, it is understood that analytical tools and techniques cannot provide the entire basis for every decision. Managers

are constantly called upon to make decisions. At any given instance, the use of an analytical decision tool may result in the same decision an experienced executive would make. However, would you recommend that the future direction of an enterprise be dependent upon a single manager's, or small group of managers', experiences? Using the right tool provides the discipline required when faced with complex problems.

The advent and expanded use of computers virtually assures the existence of volumes of data at any time. At times, the sheer volume of data can confuse and delay decisions. Selecting and managing the significant data (evidence) and transforming it into information is key to making good or accurate decisions.

The use of the correct tool can

- Provide a full range of alternatives and their system-wide impact.
- Enable people to debate the merits of a decision, with less emotion and relying more on facts.

The purpose of this book is to provide the tools to significantly increase your long-term potential for making the right decisions. This is the Science part of decision making. The Art comes from interpreting the information and linking it in a unique way, thus providing insights missed by others. The key takeaway when considering the decision making process is in the difference between science and art:

1. *Science*—tools to increase the long-term potential for making the right decisions
2. *Art*—Interpreting information and liking it in a unique way

This concept is a central theme to this book and will be referenced in later chapters.

Behavioral Finance

The study of behavioral finance has exploded in the past decade. Behavioral finance attempts to explain how emotions and psychology influence our investment decisions. The famed investor, Warren Buffet, often comments that a successful investor needs a temperament to control urges that lead to trouble in investing. Psychologists have identified a tendency in people to think they have control over events even when they do not. This can lead them to imagine trends when none exist, or believe they can spot a pattern and thus predict the future. The toughest part of investing is not the intellectual analysis, but the emotional aspects.

Some of the factors which significantly influence our interpretation of data and therefore decision making, fall into the following areas:

- *Anchor Effect*–Often a disproportionate weight is given to the initial information we received. This is particularly true if it supports our position. The situation can be further complicated if the initial data is shared with others and used to form a "preliminary" view. At this point inertia can take over.
- *Overreaction to Random Occurrences*–We tend to look for systematic patterns in data. While often underlying patterns do exist, sometimes so-called random events are actually

random. Constructing a relationship which does not exist among data points results in our decisions being systematically wrong.

- *Overconfidence*–It appears that there is a human tendency to be over confident in our abilities and knowledge. Overconfidence will ultimately result in mistakes, often of a significant size.

- *Optimism*–Another human trait. Optimists underestimate the potential of bad outcomes. A series of modestly, but consistently core optimistic assumptions can, when combined, make a forecast overly and dangerously optimistic.

- *Follow the Herd*–Following widely known actions by others. This provides a false sense of comfort to people that they are not alone. In addition, if their actions fail, they can make comments such as, "No one knew." While this behavior may provide comfort, it rarely leads to success or changes to the status quo. Remember, the old saying, "The fool does what the wise man did first." Based on a study by Money magazine (July 2006), just before the 2000 crash, Wall Street analyst "buy" recommendations outnumbered "sells" by 37 to 1. The same article noted, only 5 out of 40 economists surveyed in June 1990 forecasted that year's recession.

- *Loss Aversion*–People feel the pain of loss considerably more than the pleasure of an equal gain. This can be magnified by a misdirected reward system, which rewards even small short-run gains, and severely punishes reasonable and promising, long-term actions which fail. In such a case, innovation will suffer.

- *Endowment Effect*–People tend to value things more once they own them, no matter what has happened to their actual worth. To test this, ask a person about the value of their house or a stock after a significant drop in the market.

Structural Blockages to Decisions

As demonstrated by studies in behavioral finance, decisions are not always based on the best analytical approach or answer. Decisions are not made in a vacuum, but are products of the entire organization. Successful decisions require a disciplined process for managing the resources of the organization.

In today's competitive environment no organization is at a steady state, it is either improving or deteriorating, whether or not this is obvious at that moment. It is impossible to be at a steady state given constant changes in markets, costs and competitors. Problems have become more complex. Therefore, it is vital that managers understand the influence structural blockages can have to either slowdown or destroy the decision making process.

A silo mentality can develop. An idea that does not fit neatly into a specific category or function can be quickly discarded. A systems approach to decision-making often incorporates "soft" variables, such as attitudes and beliefs. While these variables are not easy to quantify, or even recognize, they have a significant impact on the decision process. The key components to consider are outlined in the following sections:

1. Perceived risk
2. Inertia and bias
3. Organizational structure
4. Reward systems
5. Paradigms

Perceived Risk

Each of us has a unique risk profile. Tolerance for risk plays a major role in many of our decisions. This is also true of companies. Based on past corporate experiences and a number of other factors, decisions are made which determine the organization's future.

Remember, even the best decision tools rarely provide you with a risk-free answer. The product of scientific approach is likely to give you the best avenue of action, based on current or past information. Even an action which will result in a favorable outcome 90 percent of the time will be disappointing 10 percent of the time.

Try the following exercise with your friends or members of the various organizations you participate in.

Exercise 1-1

The following diagram demonstrates a simple game. The rules are as follows:

Everyone must play.

You can only play once.

Each participant pays $200 before playing.

Each player selects a bowl (A or B) and is then blindfolded prior to selecting a marble.

Payment to the participants is made based on the color of the marble, and the marble is then returned to the appropriate bowl.

The players cannot form a group and divide the proceeds. "Everyone for themselves."

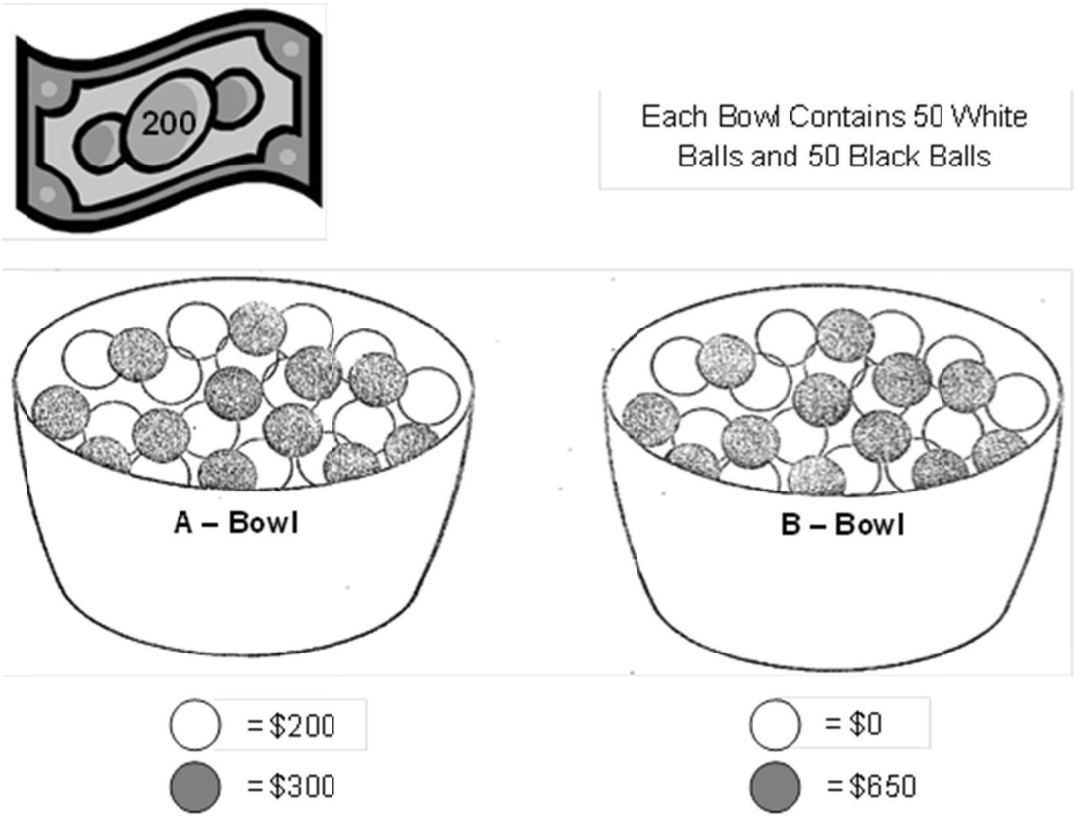
While you are not going to actually collect or pay money, each player should behave as if they were really betting $200. Have each person tell you which bowl they chose.

Although Bowl B provides the highest expected return, the risk of loss will drive many, sometimes the majority, to select Bowl A. We will further develop the role risk plays in decision making throughout this program. The expected values from an infinite number of attempts at each bowl are:

$$\begin{aligned} \text{Bowl A} = .5 \times \$200 &= \$100 \\ .5 \times \$300 &= \underline{\$150} \\ &\underline{\underline{\$250}} \end{aligned}$$

Bowl B = .5 × 0 = $ 0
.5 × $650 = $325
$325

It is worth noting one obvious but important fact, if the amount of the bet is continuously increased, and the payments also raised in the same ratio, eventually everyone would select Bowl A. Although the analysis does not change, the potential pain of loss does.



Inertia and Bias

There is a well-known law of inertia in physics which states that a body will stay at rest or in uniform motion, in the same straight line or direction, unless acted upon by some external force. This law also applies to decision making. Once a decision is made, the activities initiated from the decision can take on a life of their own and be followed almost blindly to their conclusion. This can occur even if subsequent events have modified the desirability of that conclusion.

In fact, poor long-term decisions can take considerable effort to modify since their early champions may attempt to protect the decision from continued scrutiny. In these instances, the original decision makers may feel threatened by changes and spend time hoping that future events will salvage their original decision, rather than identifying the needed change.

Bias can result for a number of reasons, including inertia and past experiences. Both prior failures or successes will form a bias toward future decisions. A bias, at times, can be subtle and therefore difficult to detect. It can result in

- Misinterpretation of raw data to support a position.
- Looking for data that supports your position. Once found, the search for data is ended.
- Disregarding data that questions the current thinking as "random" or "not meaningful."

Our training and "common sense" tells us that past costs should not influence current or future decisions. That is why they are called "sunk." Despite this, sunk costs are a major reason for the "status quo." For example, we fear that if we change our production or distribution process we will have to write-off asset values.

The fear of the recording a loss can make people act irrationally. Why else would someone sell a stock that is currently above its initial price and still rising, while holding a stock that has fallen in value and has questionable future prospects? More often than we want to admit, people sell their winners and hold losers.

Acknowledging that these forces are often at work can be a first step to eliminating or reducing their impact. A scientific approach to decision making requires that we are open to new findings.

Organizational Structure

An organization's structure should be based upon the significant activities of the business(es), with periodic reviews as the business(es) and the environment change. The structure of an organization is too important to rely on an evolutionary process. However, in large organizations, structures are often established and only significantly changed when it becomes obvious that they are not working.

Small venture organizations are usually in higher risk businesses and lack resources for development. If successful, these companies often do not have sufficient management talent or experience, or other resources, to fully exploit their potential markets. Large organizations are typically set up in a hierarchical structure which is designed with a number of objectives, including the protection of its current assets and businesses. The existing culture in large hierarchical structures has, as one of its objectives, the continuation of much of the status quo, while smaller or venture companies are dedicated to change.

Be aware there are significant forces at work in every organization to protect the status quo. Change creates uncertainty and that results in fear. Periodically refer to table 1-1 to remind yourself about the pros and cons of structures.

Reward Systems

Reward systems are the primary mechanism whereby management shows the members what it expects of them, provides positive reinforcement for acceptable acts, and negative responses to unacceptable actions. Successful management takes the time and considerable effort to identify those activities which are key to the organization's success, and at least attempts to measure an individual's and group's results at these activities. Regardless of what is said by management, people will respond to signals provided by their organization's compensation system.

Table 1-1: Organizational Structure Comparison

	Start-Ups or Ventures	**Large Organizations**
Structure	Informal—can appear chaotic.	Hierarchical.
Culture	Stress change—change creates opportunity.	Protect assets or businesses—can threaten current assets, wealth, or products.
Operating Mode	Action first, then fix mistakes.	Extensive analysis prior to taking action.
Strengths	New Ideas or products. Decision maker(s) close to customers.	Production and marketing ability.
Weaknesses	Limited experience and resources for mass production and marketing.	Decision maker(s) often removed from customers.

For an organization to provide the correct signals, it must have a view of its goals and the necessary steps to achieve them. This overall view is then broken down into discrete activities for all levels within the organization. The process is often complicated by the fact that most large organizations have more than a single business unit. Each will have a series of goals, which can be quite different and require different compensation schemes.

Compensation systems and their effects on the people are a dynamic process which can greatly assist in attaining or frustrating an organization's goals. Frequently, the impact of a compensation scheme is subtle and therefore, the effects of an improper plan may escape detection by management for some time. Better managed companies, recognize the potential impact of compensation and strive to implement systems which are consistent with the organization's goals.

People will ultimately respond to a system of rewards and punishments regardless of the organization's intended goals. For example, if the development of new products or procedures is thought to be an important activity, but people are compensated based on production, day-to-day production activities are likely to receive the lion's share of attention. If individuals are punished for unsuccessful ideas, regardless of their apparent merit when initiated, and rewarded for successful efforts, even if they have relatively little impact, they are likely to respond by applying their efforts to safer areas where success is more likely. They will avoid higher risk, but potentially higher return activities.

Management can become overly concerned with the immediate reaction of the financial markets to short-term results, while not paying adequate attention to the longer term effects of decisions. Due to the influence of shareholders and outsiders and the relative ease of measuring near term results, a significant portion of a person's compensation is often based on the short-term or stock (equity) price. This may teach managers that their job is to assure short-term success even at the possible expense of long-term growth.

Such a limited focus helps to explain the actions of the foreman who forgoes routine maintenance to hold down costs while shortening the life of a major asset; the middle manager who "cooks the books" without the knowledge of his supervisor, to report results he perceives

his supervisor will find acceptable, or possibly influencing senior management's decision to spend mega dollars to financially engineer their company's stock price, via stock buybacks, while reducing R&D expenditures. None of the above are meant to address the extreme situations demonstrated by companies such as Enron, WorldCom, Global Crossing, and so on. But, there certainly appears to be a strong correlation between rewards and management's activities even in these cases.

The traditional accounting system provides the data for many organizational decisions, including executive compensation. This system produces reports containing variances from budgets, forecasts and prior periods. Where does the typical organization measure the cost of lost opportunities due to an inappropriate action, or no action? Many of our standard systems or practices can place an emphasis on consistency even at the expense of growth. Is the development of new products or processes vital to your company's success? If so, do you formally track the number of failed projects? Too low a level may indicate a shortage of new ideas. Does your reward system encourage or discourage taking "reasonable" risks?

Paradigms

As an example or pattern, paradigms can help to focus our attention on the usual causes of problems, or typically successful behavior (practical). However, they can also be self-imposed limits to our thinking, and therefore to improvements. Remember, if you do not change what you are doing, nothing will change. Adhering to paradigms can stop us from looking for answers, or stop us from accepting them once they are discovered.

Advancement requires us to challenge long-held paradigms. As an example, let us quickly review a brief part of the history of automobile production. Historically, mass production of automobiles required long runs of similar units (economics of scale). This caused periodic over investment in inventory, with the corresponding risk of producing the wrong models and, at times, long delays in filling a customer's order.

Lean systems are customer-centered and are driven by the customer's Pull for the product. Therefore, the ideal is to produce products based upon an order. However, for auto production, this had to be balanced by efficiency (unit cost) which required a leveling of capacity. The transition to smaller production lots required numerous die changes. In the 1940s, Toyota took 2 to 3 hours for a die change. By the 1960s, it was 3 minutes. Two decades earlier, this was thought of as being impossible. This change redefined auto production by more closely aligning production with demand.

Question paradigms. Look outside your company and industry for ideas. Typically, people who disprove old paradigms are those that have no investment (outsiders) in the current situation. Acceptance of a scientific approach to solving problems can be key to eliminating this type of blockage. Improvement is not a random event.

Chapter Summary

It is important to understand the influence that a few important considerations exert in your organization. As part of an overall improvement program, eliminate or reduce these influences. For example, look at your financial policies and reward systems. What behavior do they encourage? The core topics to consider as discussed in this chapter include:

- The evolution of financial decisions has moved from an external view (lender's or investor's) to a process for system-wide improvement.
- Decisions are a product of an entire organization.
- A scientific approach to decision making provides the discipline and tools for improving the decision process.
- Human characteristics play a key role in decision making.
- Organizations frequently have one or more structural blockages to decision making.

Chapter 2

Turning Data Into Information

Introduction

Successful organizations view information as an asset to be contributed to and shared. Therefore, they have a culture of continuously gathering raw data concerning key activities and turning it into useful information. The conversion can be trickier than originally thought.

This chapter introduces techniques which can be easily learned and applied. They require little to no statistical knowledge, and can greatly improve your ability to interpret data and identify and solve problems. In addition, the user will be better able to determine if a more advanced tool is required and if so, which one.

The purpose of this chapter is to

- Discover how successful organizations capture and manage data.
- Describe the analytical techniques used to turn data into information.
- Introduce fundamental forecasting techniques.
- Identify the forces impacting time series information.
- Introduce the key concepts relating to basic probability theory.

Management's Role

Successful organizations share a number of common characteristics including

- A view that information is an asset to be contributed to, shared, and used.
- Encouragement of members to experiment to improve current procedures or products and, within limits, tolerance of failure.
- Understanding by participants of the decision process.
- Decision making, action oriented management with a willingness to make difficult or unpleasant decisions.

The first two characteristics encourage or mandate that members use analysis to find new or better answers, and continue to build the organization's information base. Information is available from numerous sources. An effective data-gathering and interpreting process does not require a large, special-purpose, staff. In fact, to be successful this process must be part of an organization's normal activities and not some "special project."

Training in basic data management tools and a core belief in the importance of gathering and sharing data can have a significant positive impact on an organization. For example, a salesperson making visits to current or potential customers may gain insights into a company's inventory levels and purchasing pattern, as well as competitors' pricing. If this data is not recognized as important, or not shared, it will have little or no impact on the organization. Only by understanding its importance, and being able to collect the data and share the resulting information, will the salesperson's organization gain valuable insights into business patterns and their competitive position.

The third characteristic assures members know the basis for decisions. The final one demonstrates management's willingness to act upon information, even if it is unpleasant (accept reality).

Obviously, when making a decision, the more inclusive the available information, the more likely we are to make better decisions and to feel more comfortable with them. The importance of information has long been recognized in many areas of human effort. Ancient armies looked for ways to infiltrate enemy lines and intercept messages to better understand their enemy's strengths and weaknesses. Sports teams, professional and amateur, have staffs which scout and analyze potential opponents, as well as maintaining volumes of statistics about their own team.

Although data and information collection and assimilation are basic to many human activities, its importance is not always recognized. If you do not believe this, remember one of the stated key benefits to forming the Department of Homeland Security was to better share information previously spread over several government agencies. It took a terrorist attack on U.S. soil to deal with this basic organizational problem.

All decisions begin with data or information, whether assumed or actually gathered and evaluated. Data collection and information preparation precede any decision or action. However, once a decision is made and implemented our job is not over. A scientific approach requires that we periodically review the results of decisions to test their current validity. Events can, and often do, change the parameters used to make a decision. The use of analytical tools and techniques cannot be viewed as "once done and finished." Figure 2-1 is an example of such a tool.

Graph

As previously noted, the first step in any decision is to gather data. Often, a surprising amount of information can be gained by the way the raw data is grouped and presented. There are numerous recurring events or forces which cause periodic and routine fluctuations in data. By using a few basic techniques these patterns can be identified.

The first tool for data mining is usually drawing a picture (graph). Even the most analytical minds often find it easier to see patterns via a picture versus staring at a table of numbers.

When trying to summarize large amounts of data, it can be useful to distribute the data into classes or categories, thus, isolating the number of occurrences that fall into each category. Frequency distributions can be helpful for a wide range of activities that require isolating members of a group's population. These range from characteristics of people (physical traits, test

scores, buying habits, and so on) to isolating the source(s) of routine breakdowns or delays (see figure 2-2).

Figure 2-1: Example Decision Making Process

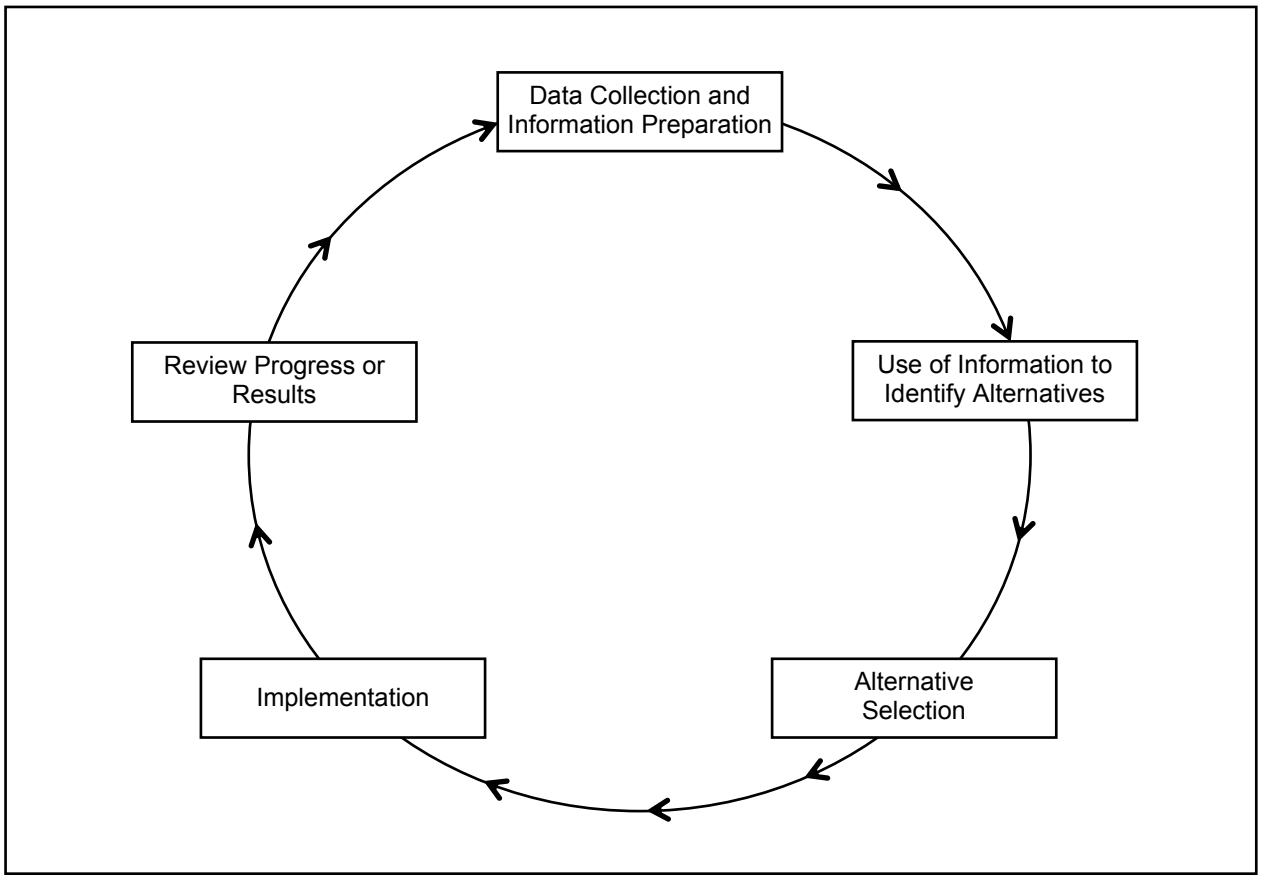
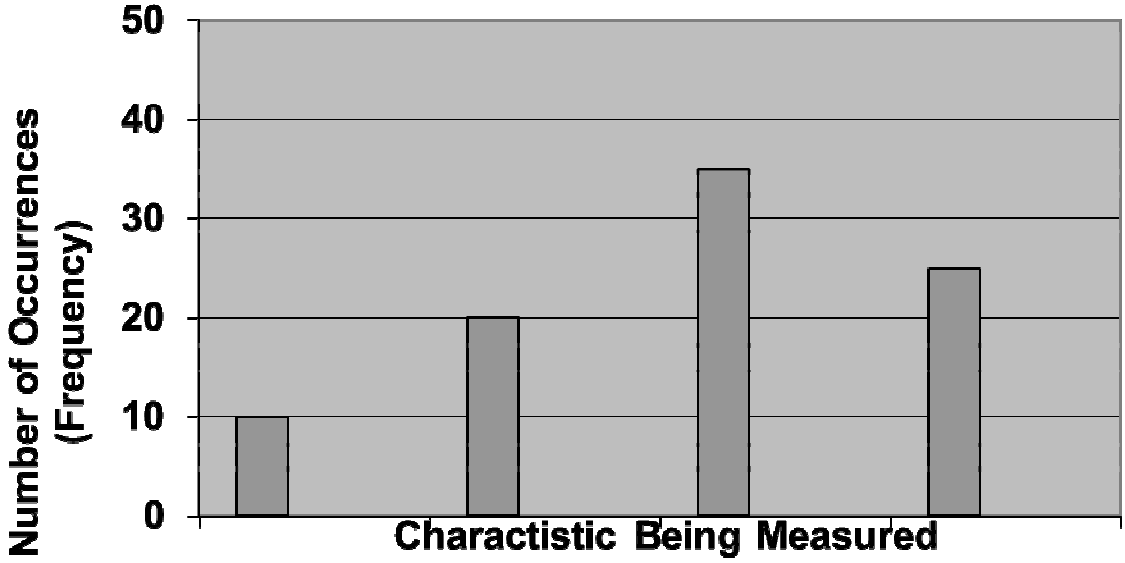


Figure 2-2: Example Frequency Distribution Chart

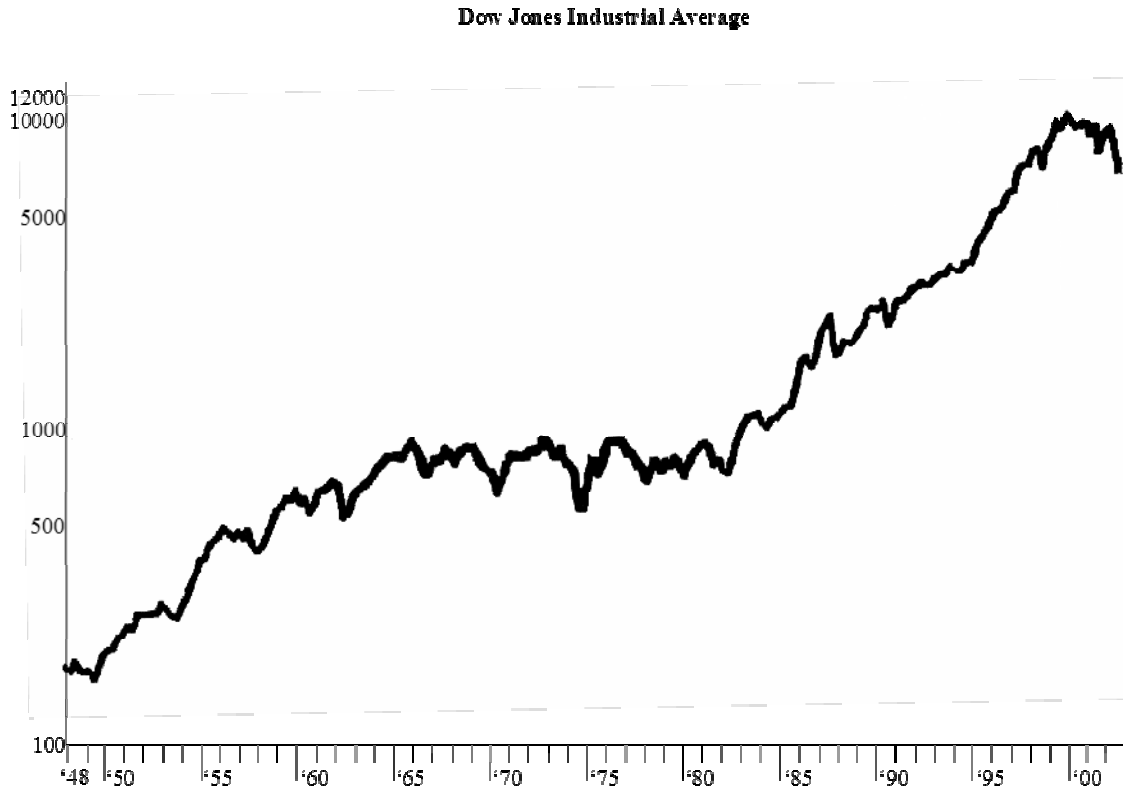


Constructing a line graph is a standard technique for exploring a series of data collected over time. A general strong trend can cover up nontrend periods, sometimes of significant duration.

Look at the following graph of the Dow Jones Index over an extended time period (figure 2-3). While the trend is clearly up, the period between 1966 and 1982 was down. What would happen to a company that made a large capital investment, that came onstream in 1967, based on a similar history of aggregate growth rates in sales? How about an individual investing for retirement targeted for 1970? Remember an overall trend does not insure all data points will follow it.

Give yourself as many visual aids as possible early. Rates of change, groupings and even trends are often easier to isolate visually.

Figure 2-3: Sample Market Diagram Indicating Capital Investment over Time



	Average Change (%)
1948-66	10.4
1966-82	-1.2
1982-99	16.5

Data Management Tools

As managers, we often measure activities and results versus an average. Targets, including budgets, are established using averages. During and after an event or time period, variances are taken from the target or a series of reference points. For example, comparisons to budgets, prior quarters, months, last year, and so on. Often, this gives rise to a series of correspondence explaining the differences. All of this activity is based on two assumptions:

1. The target was originally correct.
2. Variations from the target, or reference point, are seen as problematic.

This section asks some basic questions about the first assumption, and provides a few alternatives. A later chapter will discuss, in more detail, which variations are meaningful.

Average

An average is a value which is thought to be typical of a set of data. The most common average is arithmetic. This results from adding the values of the specific data points and dividing the sum by the number of observations. For example, the array of data below.

Data: 2, 5, 11, 14, 20

$$\text{Average: } \frac{52}{5} = 10.4$$

A few things are immediately obvious. First, the actual range of this array is fairly wide: 2-20; next, the average of 10.4 does not exist as an actual point in the array. How valid is 10.4 as a target or expected value?

A variation of this measure can be to weight the results of several occurrences. This approach is often used when attempting to anticipate future data points. The most recent data is given the largest weight, as it is thought to be more representative of the future (up-to-date). It is also employed when arriving at a single measure from a series of separate events or measurements, often of varying importance.

For example, a student's final grade reflects measures from a series of events. Some events are more important (mid-term exam versus a quiz). The final grade must include this. Thus, the individual grades are given a weight to reflect their importance.

Median

The median is the middle value of a set of numbers arranged in order of magnitude.

Data: 2, 4, 5, 6, 8, 9, 11, 15, 19

Median: 8

It can also be the average of two middle values.

Data: 2, 4, 5, 8, 12, 15, 18, 21

$$\text{Median: } \frac{8+12}{2} = 10$$

Although, the median does not address a potentially wide range of data, it can, at times, be a more meaningful measure than the arithmetic average. Remember, an average can be an artificial data point.

Mode

The mode is the value which occurs most often within a set of numbers. It is the most common value. The mode may not exist in all cases and even if it does, it may not be unique. Sometimes, especially with limited data points, the unique mode may not be seen. Often, a larger sample will expose the actual mode.

Data: 2, 3, 5, 5, 8, 10, 15

Mode: 5

Data: 2, 3, 5, 8, 10, 15

Mode: None

Data: 2, 3, 5, 5, 8, 10, 15, 15

Mode: 5 and 15

In a frequency curve, the mode is obviously (since it occurs the most times) the value at the maximum point on the curve. Often, the mode can be a better indicator of expected results or level of activity than either an arithmetic average or median.

Comparison—Average, Mean, and Mode

Look at these three tools for initial direction when reviewing raw data. They are also worth testing prior to establishing targets. The median or mode may not only be more accurate, but they may enable you to measure an occurrence significantly earlier than an average can be calculated. A prime example of this is "length of life."

For example, if you are attempting to measure the life expectancy of a product, calculating the average would require you to wait until all products had failed. Calculation of the median could be done when 50 percent of the products failed and the mode once the peak of the distribution or frequency had occurred. This could provide valuable insights, perhaps years before the average was available.

When analyzing populations, averages can often be "correct," but misleading. Assume a university, when reporting graduates' starting salaries, noted an average annual starting salary of $32,750. This average was based on the following actual per graduate results.

Salaries: $20,000, $22,000, $25,000, $25,000, $25,000, $30,000, $55,000, $60,000.

While the average is "correct" it does not reflect expected results. Only two graduates had salaries equal or greater than the reported average, while six were below. It is likely the two above the average were due to other circumstances, such as prior experience. For graduating students a $25,000 target is probably more realistic.

Moving Average

When all that is wanted is a smoothing of the data, and no mathematical equation is required, a moving average can be used. Mechanically, the method of moving averages is simple, but it

often can provide a better understanding of the raw data. The use of a moving average to identify or to predict future occurrences is based on the two factors:

- Smoothing the raw data helps to see trends that were hidden by the velocity or variations in the data.
- Belief that recent data is a better indicator of the future.

In general, a moving average tends to smooth the data by averaging out the unusual highs and lows. This tends to dampen the short-duration variations. A moving average can be based on various time periods. Most frequently, monthly or quarterly periods are used. However, any period can be used.

Simply, when constructing a moving average, the oldest data is excluded as soon as data for the most recent period becomes available. In a twelve-month average starting with January 2005, that data would be excluded and January 2006 included as a basis for calculating a new twelve-month average. A quarterly moving average might be used to smooth variations over a longer period. In this instance, the average of the actual data for each quarter would be calculated and used to represent a single point. Care needs to be taken when determining the time period to be used. Be sure that the data points being dropped are no longer of statistical value. Also, that by excluding them, you are not losing the ability to see a longer term trend.

The use of smoothing techniques, including exponential smoothing, as basic forecasting tools are discussed later in this chapter and in chapter 4.

Seasonality

Many businesses experience seasonal activity. These include the obvious retail, vacation travel and construction, as well as numerous others such as auto production and refineries. Auto producers change models in late summer through early fall, petroleum refineries change from producing heating oil to gas, back to heating oil, and so on, based on seasons.

Look for seasonal patterns. It can be important not only to correctly forecast annual sales, but to determine their occurrence during a period. This enables you to match resources with demand thus, reducing working capital, and often investments in fixed capital assets. A simple example follows:

- Assume total sales of 1,000 units in a year X as shown below

Spring	200
Summer	350
Fall	300
Winter	150
	1,000 units

- On average 250 units were sold per person ($\frac{1{,}000}{4} = 250$).
- We forecast a 10 percent growth in total sales for the next year. We would forecast seasonal sales by weighting each based on last year's sales. Pay attention to the

distribution of the data. Functionally, this increases each season's results in year X by 10 percent versus increasing total sales and averaging them over the four seasons.

Spring $\frac{200}{250} = .80$

Summer $\frac{350}{250} = 1.40$

Fall $\frac{300}{250} = 1.20$

Winter $\frac{150}{250} = .60$

Spring $\frac{1{,}100}{4} \times 80 = 220$

Summer $\frac{1{,}100}{4} \times 1.40 = 385$

Fall $\frac{1{,}100}{4} \times 1.20 = 330$

Winter $\frac{1{,}100}{4} \times .60 = \underline{165}$

$\underline{1{,}100}$ units

Uneven Growth or Decline Patterns

Earlier, we used several techniques including moving averages and graphing to uncover trends in data. However, you may or will experience situations where, while helpful, they are not sufficient.

For example, look at the data below. While techniques exist to mine the data for future trends (data points), sometimes just exploring it in detail provides the best initial results. Again, graphing is usually a good first step.

Years	Sales ($)	Growth (%)
1	$100,000	—
2	$110,000	10%
3	$115,500	5%
4	$120,120	4%
5	$123,724	3%
6	$126,198	2%
7	?	?

Averages, moving averages, compound growth rate calculations, and so on, would not fully reflect this steady decline. Since they are based on historical data, they may be slow to react in some instances. Graph and look at the data itself.

In addition, you may experience situations where sales grow faster for a period, then slow. This could be seen in industries as different as fashion (time periods will be shorter) to software operating systems, equipment, and so on. The overall sales pattern can result from upgrade or replacement cycles.

Use all the available tools to gain insights. But, always seek to understand the driving cause(s) for change. This is the key to constructing a viable model. Hopefully, this will become obvious with the example in chapter 5.

Years	Sales ($)	Growth (%)
1	$100,000	—
2	$120,000	20%
3	$138,000	15%
4	$151,800	10%
5	$159,390	5%
6	$164,172	3%
7	$169,097	3%
8	$202,916	20%

Exponential Smoothing

Exponential smoothing is a frequently used forecasting technique. Unlike moving averages, it does not require the user to maintain significant historical data files. Moving averages assume that the most recent data is the most meaningful. That is why old data points are replaced by more recent data.

Only three data points are required to forecast using exponential smoothing.

- Most recent forecast.
- Actual results for the above forecast period.
- Smoothing constant.

The smoothing constant (alpha) determines the reaction to differences between the forecast and actual results. It is arbitrary and is selected based upon management's anticipated response time between the forecast and actual.

Exponential smoothing assumes that the forecast results for the next period are related to the prior forecast plus a portion of the error in the prior forecast.

$$Ft = Ft - 1 + a([At - 1] - [Ft - 1])$$

Where

Ft = The exponentially smoothed forecast for period *t*.
Ft-1 = The exponentially smoothed forecast for the prior period.
At-1 = The actual results in the prior period.
a = Alpha

The more stable the activity the smaller the constant (alpha). Therefore, alpha might be .05 if we were forecasting food sales for a location versus .20 to .30 or more, for a new video game, game machine, and so on. The model is changed based on management's expectation and past results.

Assume that the sales forecast, of a stable commodity, for last month was 500 units. Actual sales were 450 units. The forecast for next month would be (using a .10 constant).

$$Ft = 500 + .10\ (450 - 500)$$
$$Ft = 500 + -5$$
$$Ft = 495 \text{ units}$$

This technique is used since it is relatively easy and surprisingly accurate in selected cases. It does not require large amounts of historical data, and modifications based on actual results can be done rapidly. Significant changes in Alpha may provide an early indication of modifications to previously existing relationships or trends. Exponential smoothing is the basis for many inventory models.

Time Series

A time series is a set of observations taken at specified times, normally at equal intervals. Common examples of this include: the daily closing prices of the Stock Exchanges, weather conditions (temperatures), monthly sales revenue or production.

Time series frequently demonstrate typical or characteristic movements. For reasons discussed below, understanding these can be extremely important for many activities, from budgeting and sales forecasting to planning capital expenditures and acquisitions. These movements or trends can be summarized into four groups:

- *Long-Term*—The general direction in which the data appears to be moving (also called the secular trend). When graphed, the data provides a general picture of its direction or movement over time.
- *Cyclical*—The long-term swings (variations) around the trend line. The cycles may or may not follow a specific pattern. In economics, the swings are used to refer to a Business Cycle. Therefore, while the long-term economic trend of the U.S. economy has been upward, we have experienced periods of above and below trend economic growth (Business Cycles).
- *Seasonal*—The identical patterns in time series data following corresponding months in successive years. These routine variations result from recurring events. For example, the increase in tourism into Florida during the winter months, or the predictable spike in sales

prior to Christmas. Seasonality is important in a surprising number of businesses. It can impact you directly or indirectly, through suppliers. The auto industry goes through model changes annually, petroleum refineries change production – gas, heating oil, and so on.

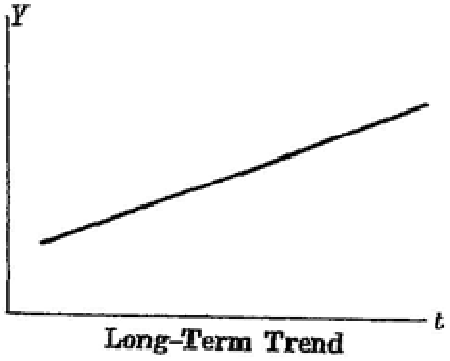
- *Random*—As noted earlier, sometimes events that appear random really are random. These events can include weather – floods, hurricanes, and so on, or actions by people, such as a labor strike, or a violent act at one of our schools, and so on. While these events may last only a short time, the results can have a long-term impact, potentially even causing a totally, or partially new cyclical pattern.

When analyzing a time series we need to examine four factors – trend (T), cycles (C), seasonal (S) and random (R). The variable in the time series (Y) is a product of these factors.

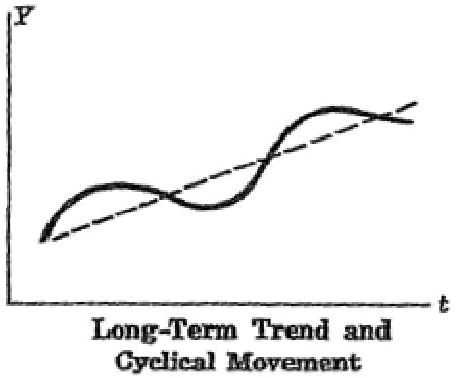
$$Y = T \times C \times S \times R$$

Therefore, when analyzing a time series, review each of the factors that can impact the overall movement. The following graphs (figure 2-4) demonstrate movements in a time series.

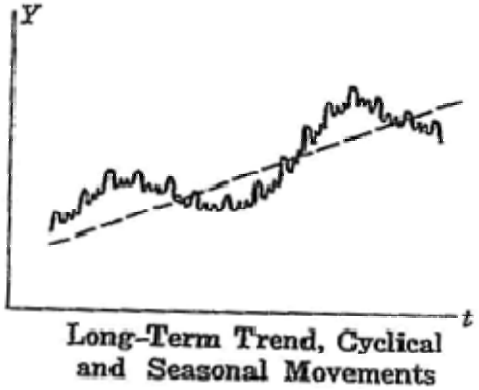
Figure 2-4: Example Time Series Graphs



Long-Term Trend



Long-Term Trend and Cyclical Movement



Long-Term Trend, Cyclical and Seasonal Movements

Exercise 2-1

Identify the factor (T, C, S or R) associated with each of the following:

1. Department store sales prior to the start of a new school year.
2. Monthly rainfall for a specific location.
3. Required increase in auto production due to a continuous growth in population.
4. Hurricane damage to a building.
5. Economic recession.

Probability

The classic example of probability is a coin toss. Each time a coin is tossed there is a 50 percent chance of either a head or tail. However, that does not mean that if you toss it twice you will get one of each.

As of Super Bowl XLI the AFC team had lost 8 of the last 10 coin tosses. But they had won 8 of 10 games. What conclusions might we draw from this? First, 10 tries are not sufficient to arrive at a 50/50 split. Also, winning the coin toss has no impact on the game's outcome. Now, if we begin to look for relationships that do not exist, we might decide that losing the toss results in winning the game. Remember, sometimes events are random.

The estimated probability of an event is taken as the relative frequency of the occurrence of the event, when the number of observations is very large. The probability actually becomes the limit of the relative frequency, as the number of observations increases indefinitely. Therefore, if we toss a coin an infinite number of times, we expect to get 50 percent heads and 50 percent tails. The more tries, the closer we will get to a 50/50 split.

In many cases, the results of applying analytical techniques to a problem will result in identifying the most likely answer. Remember, this does not assure that the desired outcome will happen! But, following the "best course of action" will over the long-term provide the best results. Go back to Exercise 1-1. If you could play the game 100 times would it change your selection?

Statistics is the body of principles and techniques for dealing with numerical data. Often, statistical analysis includes the use of probability concepts and drawing statistical inference from data. Even if you have not realized it, you have done this numerous times in your experience. The old saying, "If it walks like a duck and quacks like a duck, it's probably a duck," is evidence of this. Information is inferred from limited data. Examples in business include

- Market research.
- Establishing inventory levels.
- Quality testing.

In each of these cases, statistics are used to estimate results. This can range from customers' demand for current or new products, to arriving at conclusions about a group of products, by testing only a few. Auto companies do not test all their vehicles to determine their safety. They arrive at conclusions about the fleet's safety performance based on relatively few tests.

Basic probability theory can play a significant role in establishing budgets and action plans. If the success of a plan relies on the outcome of several unrelated events, the overall probability may be considerably lower than it appears. For example, if the success of each of 5 events is 90 percent, the overall probability is only 59 percent (.9 × .9 × .9 × .9 × .9 = .59). The exercise below demonstrates this.

Exercise 2-2

Calculate the probability of boys and girls in families with 3 children. Assume equal probabilities for boys and girls.

Number of boys	0	1	2	3
Probability	?	?	?	?

Chapter Summary

Review the list of tools, techniques and theories discussed in this chapter. Make certain you understand their application to basic data management and forecasting. If not, go back and review the material before going further. It is important to establish a basic level of training in your organization concerning the importance and use of the following key concepts, all discussed in this chapter:

- Formal data collection and information management systems.
- Graphing
    - Frequency distribution
    - Line graph
- Averages
- Median
- Mode
- Moving average
- Seasonality
- Exponential smoothing
- Time series analysis
- Probability theory

Chapter 3

Problem Solving Tools

Introduction

This chapter demonstrates the use of various improvement tools. While not always obvious, the use of statistical techniques is incorporated into these tools. Using them can provide an individual or organization with several benefits including

- Assistance in discovering the underlying causes of problems.
- Gaining acceptance of decision making techniques by a large group of people.
- Positive results, which can provide a "beachhead" for more statistical tools.

The chapter begins with addressing the concept of world-class (benchmarking), and then provides a series of tools to improve performance for a wide variety of activities. Remember, in problem solving you are often placed in the role of detective. By gathering data and processing it into information trends can become visible.

The tools introduced in this chapter were selected based upon their applicability in a significant number of situations. Think about how they could be applied in your organization. Continue to ask yourself why, until you uncover the cause of a problem.

It is equally important to study events that succeed, as well as actions which fail. As a detective you are seeking clues from the best of outcomes (BOB – Best-Of-The-Best), as well as those from failures (WOW – Worst-Of-The-Worst).

Often the reason(s) for successes and failures are easier to see in the extreme. As an early step of any analysis, try to isolate the relationship between cause and effect. For example, profits (effect) result from doing a variety of things well (cause). Attempting to discover the cause(s) of BOBs and WOWs can be very helpful in focusing management's attention on important factors, thus, eliminating the noise that exists in every organization. BOB and WOW factors, when used correctly, can help

- Eliminate noise from analysis
- Focus on data from successes and failures
- Identify cause-effect relationships
- Guard against ending evaluations too soon

When trying to uncover a cause-effect relationship, it is easy to stop at the first apparent answer or relationship. However, when diagnosing a problem, focusing on extremes (BOB and WOW)

can often help to uncover the factors that actually contribute to an outcome. Pareto Diagrams or Fishbone Charts, discussed later in this chapter, can often assist in this process.

The purpose of this chapter is to

- Demonstrate the use of several problem solving tools.
- Benchmarking – targeting world-class.
- Target Costing – evaluating value streams and fighting inertia.
- Mapping – uncovering hidden inefficiencies.
- Networking- project planning and implementation.
- Pareto Analysis – focusing attention on a few, key activities (Law of Vital Few).
- Cause and Effect or Fishbone Analysis – disciplined framework for problem analysis, while encouraging group participation.
- Theory of Constraints – framework to maximize performance of an entire system or process.

Benchmarking

Especially in a global market, best-in-class is a moving target. Current competitors are continuously improving their processes, products and services. In addition, new entries can enter the market with products which either directly compete with you, or indirectly reduce demand for your product.

Markets are dynamic and, therefore, are in a constant state of change. In a global market, products trend toward becoming commodities at an increasing rate of speed. Even those once seen as specialty or high-tech items can quickly move toward commodity status.

This puts increasing pressure on pricing, which, in-turn, places pressure on development, production, delivery, and service costs. Test this for yourself; compare the cost of a calculator, laptop, or a television several years ago versus today. Sorry if some of these bring back bad memories.

In this environment, management constantly looks for signals of events which will impact their competitive position. This can be in the areas of new products, competitors or a new way to produce or deliver existing products. New entries may begin competing on a cost basis, but as experience shows, they can quickly achieve a strong position based on quality. Despite numerous examples of the transition to quality, it continues to be overlooked by traditional producers. Just look at Hyundai's recent progress in the U.S.

The strategic goal of every management must be to position its organization as

The Low Cost Producer of its Products with Equal or Better Quality vs. The Market.

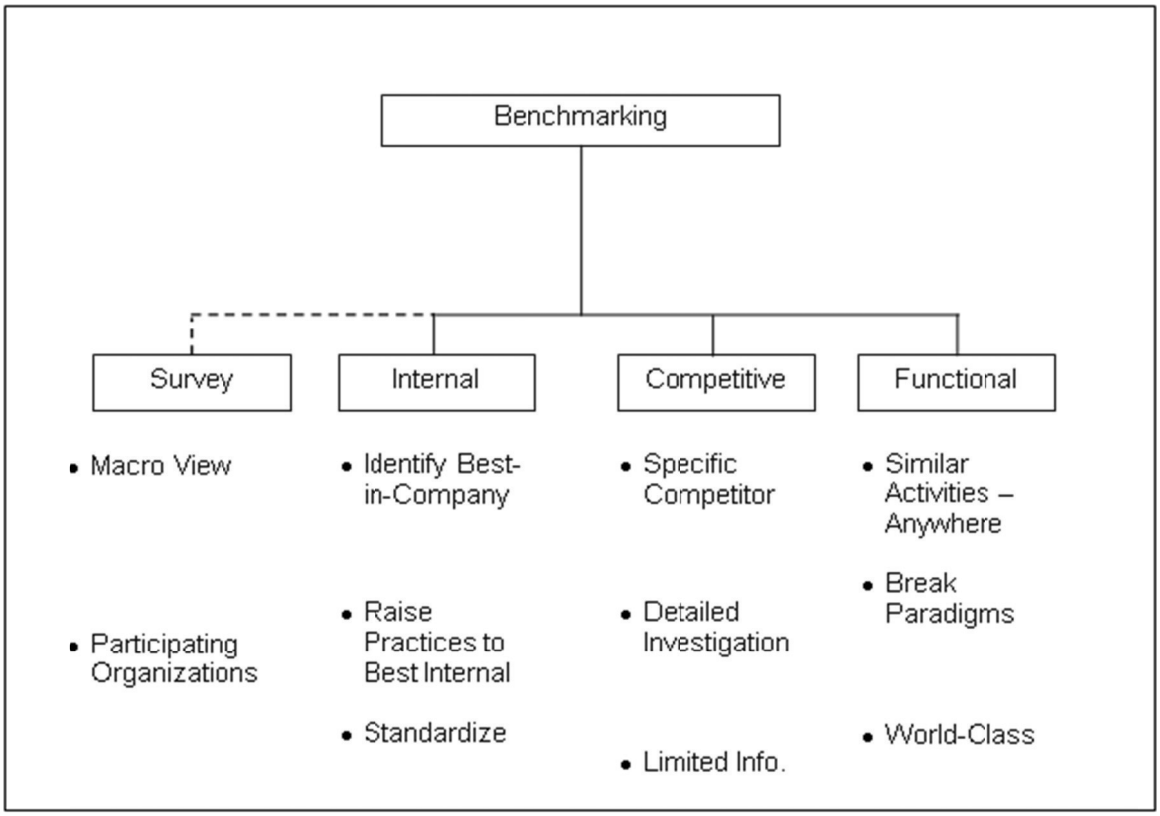
If achieved and sustained, the above position is virtually impossible for your competitors to counter.

Benchmarking provides a disciplined approach to view what others are doing in the marketplace. There are three generic types of benchmarking:

- *Internal* – Compares similar activities throughout an organization.
- *Competitive* – Compares directly to a competitor.
- *Functional* – Compares similar functions with others (noncompetitors).

Figure 3-1 shows the relationship among the three generic types of benchmarking and how they can be used to provide a benchmarking strategy.

Figure 3-1: Industry Benchmarking Overview



Competitive Benchmarking—Current Status

For this discussion, we will assume you have already conducted internal benchmarking, and implemented a system assuring standardization and the sharing of improvements across the organization. While I am not typically a fan of competitive benchmarking, it can provide some useful information. A review of public information, and information gathered through normal standard business contacts (customers, suppliers, and so on) may provide insights into competitors' current activities. My resistance to competitive benchmarking results from three concerns:

- Need to limit information exchanged due to legal issues.
- A personal commitment not to assist competitors in becoming smarter, therefore, better competitors.
- Key paradigms are normally not broken and significant progress made, without looking outside your environment.

Functional Benchmarking—Future Opportunities

Functional benchmarking has the advantage of gaining new insights from noncompetitors with similar functions. Henry Ford studied meat packing in developing the assembly line, as well as packaging methods used by Sears Roebuck. Taichi Ohno studied U.S. supermarkets in the late 1940s and 1950s in developing JIT and formalizing Toyota's Production System. It was by studying supermarkets that he saw the power of a Pull System. Nothing happens in the system until the customer pulls a product from a shelf. This triggers action back to the farmer, thus providing the goods as required by the customer.

Paradigms are normally disproved, resulting in significant improvements, by people outside the current environment. What could a hotel gain from studying the client registration process from a rental car company? How about a hospital studying selected processes at efficient hotels?

Functional benchmarking starts with a commitment to continuous improvement and two basic assumptions:

- You can learn from organizations outside your industry with similar functions. Transferable value-creation processes.
- Others do a better job than you do at the selected task(s).

Before starting, do a detailed analysis of your current situation. This will help you focus on the important areas or tasks that need improvement, as well as to select a benchmarking partner, or source of information. Functional benchmarking should be seen as a future view, unlike competitive benchmarking or an industry survey which reflects the current status.

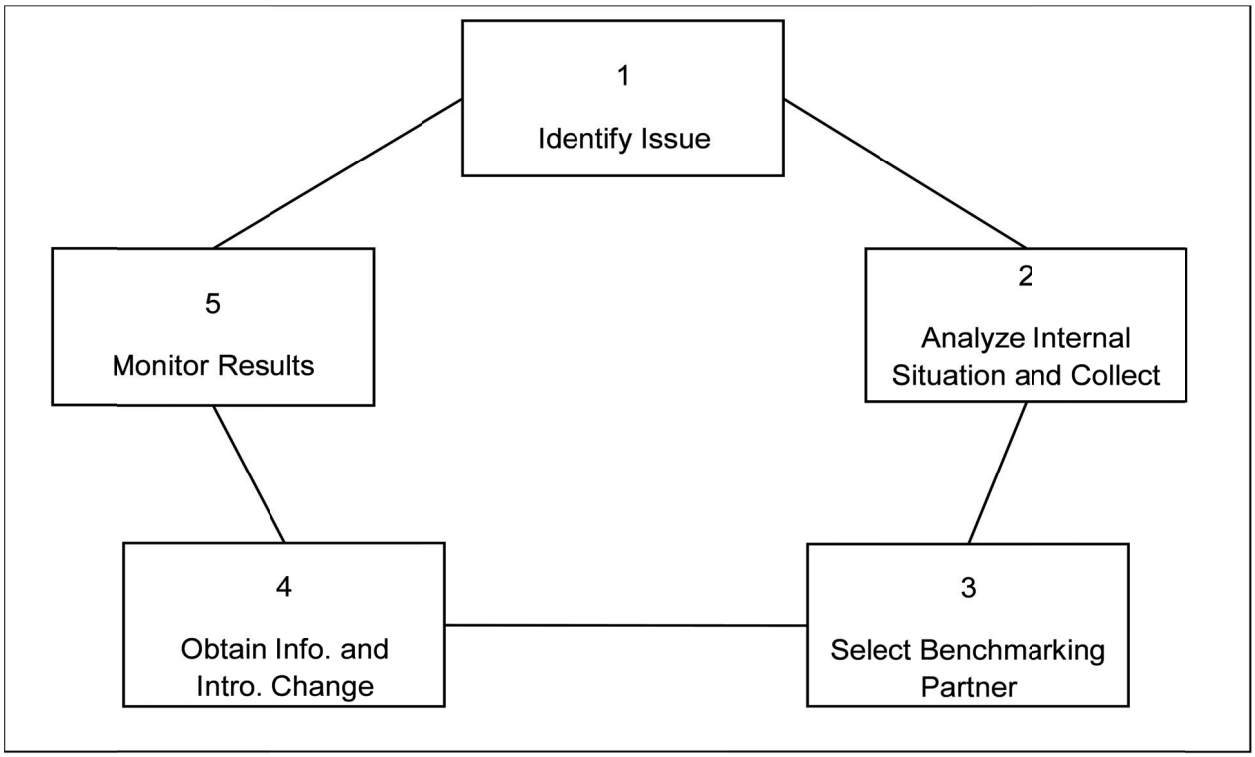
Functional benchmarking can provide insights into immediate improvements, as well as future opportunities (help you to beat competitors to an early implementation). This can include future core skills your organization will need to develop. Functional benchmarking can be performed in sequential steps as outlined in figure 3-2.

Potential sources of information for comparisons include:

- Trade and professional organizations.
- Suppliers and customers.
- Professional services currently used (accountants, attorneys, and so on).
- External experts.

Benchmarking requires a significant amount of preparation. The participants must have identified the specific task(s) they want to focus on and develop a follow-up procedure, to test if the changes actually improve their situation. It is a disciplined process. Benchmarking cannot be viewed, as we might, a conversation with a well-known business leader to discuss their general experiences. While enjoyable and somewhat enlightening, it is unlikely to result in specific actions to improve your organization.

Figure 3-2: Functional Benchmarking Sequence



Target Costing

The time between introduction to market saturation has been significantly reduced for a wide range of products. As competitors enter the markets, pricing pressures can stop a producer from achieving sufficient margins or market share.

Market shifts during a product's development can make it obsolete or inappropriate for its original target market, even before its introduction. Cost reductions by producers of similar or substitute products, can result in a new product being noncompetitive at an early stage in its life cycle.

Let us quickly review some old product failures:

- La Choy's introduction of frozen egg rolls.
- Ford's Edsel.
- RCA's VideoDisc player.

- Cadillac's Allante.
- BIC's $5 glass flask of perfume (Parfum BIC).
- Pontiac's GTO.
- Ford's Thunderbird.

La Choy's 1988 product introduction was terminated in 1990. The product could not be microwaved and took 30 minutes to heat in a conventional oven. Ford lost an estimated $250 million and RCA $500 million on the above products. Cadillac's 1987 launch was hoped to have Euro-styling aimed at younger buyers. Poor quality, an underpowered (170 horsepower) engine and a nondistinctive body doomed the vehicle. During the next five years the vehicle developed into a competitive car, although at a significant cost increase to customers. However, it was too late. BIC's 1989 perfume launch was terminated in 1990 at an estimated cost of $11 million. The product was designed to be sold in supermarkets and drugstore chains, where BIC had significant presence and distribution clout. However, it did not address the difference, from the customers' viewpoint, between purchasing disposable pens and lighters versus perfume. GM reintroduced the Pontiac GTO in 2004. However, despite its V-8 engine, the lack of sporty styling and perhaps, being built in Australia, doomed it to a short rerun. It was terminated in 2006. Ford attempted to build upon its huge success with the original Thunderbird (1955-1997), with a new version in 2002. But, the combination of weight and a weak engine ended the run in 2005.

In 2008, Tata Motors announced that there were some questions about the Nano's economic viability. The Nano had been unveiled at the Delhi auto show and was projected to be sold for about $2,500. However, rising raw material costs now threaten its future. Raw materials represent 23 percent of the Nano's pre-tax price, up from 13 percent when Tata began development, five years ago. This compares to about 7 percent of the cost of an average American car. In addition, for a series of reasons, Tata has invested (August 2008) $470 million in a plant, approximately double the amount expected at the project's start.

Today managers are faced with an increased number of new, nontraditional, nondomestic competitors. With the exception of industries which require large upfront investments and lead times to enter, these competitors can appear with little warning. New entries typically begin competing on a cost basis, but as experience shows, they can quickly achieve a position based on quality.

The environment necessitates that business activities are

- On time.
- On budget.
- On target

The market is unforgiving to poor concepts, delays, poor quality, and inefficiency. Target costing is a discipline process to address this environment.

How is a price set by a producer of a good or service? Typically, it starts based on the cost to produce and management's perception of the market. Is the value a product delivers to the user

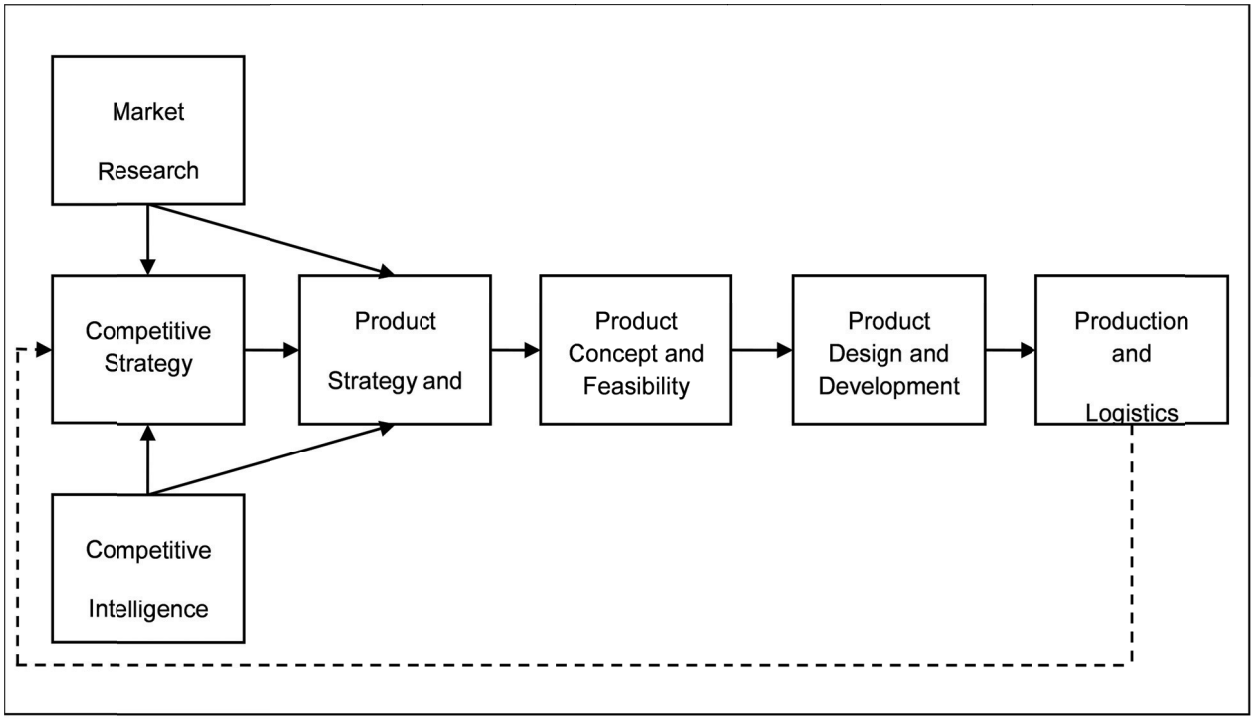
necessarily correlated to your cost? *No* – you may be inefficient or extremely efficient, and your product may contain values or costs to the user which are not obvious to you. In a perfect world, a product's price would be based on value delivered. Ultimately, a noneconomic product is replaced in the market. But that is an expensive way to learn.

Target costing provides a framework to continuously focus attention on the dynamics of the market, a product's features and production or delivery or service costs. It helps us to be customer-centered. Target costing begins with market analysis and R&D and continues through the complete life (disposal or service termination) of the product. It focuses on the lifetime cost of a product versus its purchase price. This forces management to address several key questions:

- Does the product meet a market need?
- Are there modifications to the product which would provide increased value to customers?
- Can or do we provide it at a cost which gives value to the customer?
- What products are we competing against; is our competition changing or improving?

Figure 3-3 provides a general series of steps in the target costing process. It begins with the customer and designing a product (good or service) which meets a current or anticipated need. The process focuses attention on the cost and value over the product's life, from design to disposal. For example, when we purchase a car battery there is a built-in cost for the disposal of the old (lead based) battery. The cost of a car not only includes its original price, but gas consumption, maintenance, and the ultimate trade-in (sale) value.

Figure 3-3: Target Costing



Target costing begins with the customer and immediately examines the design process.

Various studies indicate that 80−95 percent of the total cost of a product is determined by its design. Therefore, to be efficient we must focus on R&D and design efforts to achieve customer satisfaction and maximum efficiency. It is simply too late to wait until the product enters production.

An obvious benefit of this approach is that it fights the normal inertia in an organization's decision process. Since no individual or system can assure it will make the right decision at every moment, it is essential that an organization incorporate, as a visible part of its culture, a system where decisions are periodically tested and modified as necessary. There is a well-known law of inertia in physics which states that a body will stay at rest or in a uniform motion, in the same straight line or direction, unless acted upon by some external force. As discussed in chapter 2, this law also applies to decision making.

Once a decision is made, the activities initiated from this decision can take on a life of their own and be followed almost blindly to their conclusion, even if subsequent events have modified the desirability of that conclusion. In fact, poor long-term decisions can take considerate effort to modify since their early champions may attempt to protect the decision from continued scrutiny. In these instances, the original decision makers may feel threatened by changes and spend time hoping that future events will salvage their original decision, rather than identifying the needed modifications. Excellence demands that review processes enable management to overcome a poor decision's inertia.

Target costing provides the systematic approach needed to answer the four questions, asked earlier, concerning value to the customer and marketplace changes. It involves all members of the value chain (design through follow-up services).

Mapping

A number of analytical tools exist to help you understand the current situation, and identify potential areas for improvement. Discussed below are several tools that are simple and can be applied to virtually any situation. Frequently, they may be all that you need far into the improvement process and the benefits of mapping include:

- Gets people involved early
- Provides a picture of current process
- Allows for a process flow
- Affords reviewable processes (start point to end point or end point to start point)
- Offers time considerations needed for steps in process

A process map provides a picture of the current situation. In its simplest version, it shows the current flow of work including interfaces and bottlenecks. It must include all physical and technological flows (people, paper, and electrons).

Mapping is often done by a cross-functional team, where people map that portion of the process they know best. Be careful. Draw what actually happens, not what you think or want to occur. It is a snapshot of reality. Map the process while you are performing the tasks. Even if it takes longer than you originally planned (more cycles). Do not rely on your memory!

For best results, use a long roll of paper for the final map. Put it on the walls of a room so that the participants can see the picture and agree. Do not try to put it on a small screen or make it look good (pretty). Be accurate, simple, and visual. The use of stick figures, and so on, will assist in achieving this goal.

Work on the map until it captures all activities and then look for obvious inefficiencies.

These can or will range from double handling to excess waiting periods and unneeded investments in inventory. Follow the flow. Remember, all work must be organized around results. This requires doing activities once, minimizing paperwork, and removing variations (steady state).

After the map is complete, review it first from its starting point. Then trace the steps beginning with the end point, going back to the starting point. This will provide the perspective of the customer. This is the equivalent, in a factory, of going from the raw material pile to the truck dock, and then reversing the review starting from the truck dock. The process is helpful for locating inconsistencies between the customer's need for a good or service and the supplier's response. Remember, internally everyone is both a supplier and a customer.

While you are collecting information for the mapping effort, keep a record of the time it takes to complete each step in the process you are mapping. By tracking the steps in the process and adding the time estimates, you can identify which sequence will require the most time. This is the critical path. Therefore, if you want to put speed into the process, attack the actions that add to the critical path first. More about this follows.

Networking—PERT and CPM

Especially for large projects, you may want to consider the use of a PERT (Program Evaluation and Review Technique) or CPM (Critical Path Method) to help plan and manage implementation. These tools provide a system to monitor progress against your plan by focusing on the timing of each step required to meet the goal.

PERT and CPM were originally developed in the late 1950s to manage the extremely complex process of producing the Polaris missile system. It has since been adapted to a wide range of projects from construction to software design to planning campaigns.

The first phase is to identify each step, the sequence in which they must be performed, and the time required. This information is used to construct a network, showing the interrelationships among the steps. Use the time required to complete each step to construct the critical path. The critical path is the sequence of events which takes the longest time. Therefore, any delay along this path will result in a delay of the project.

Be careful to ensure that the activities and events in the network are in the correct order.

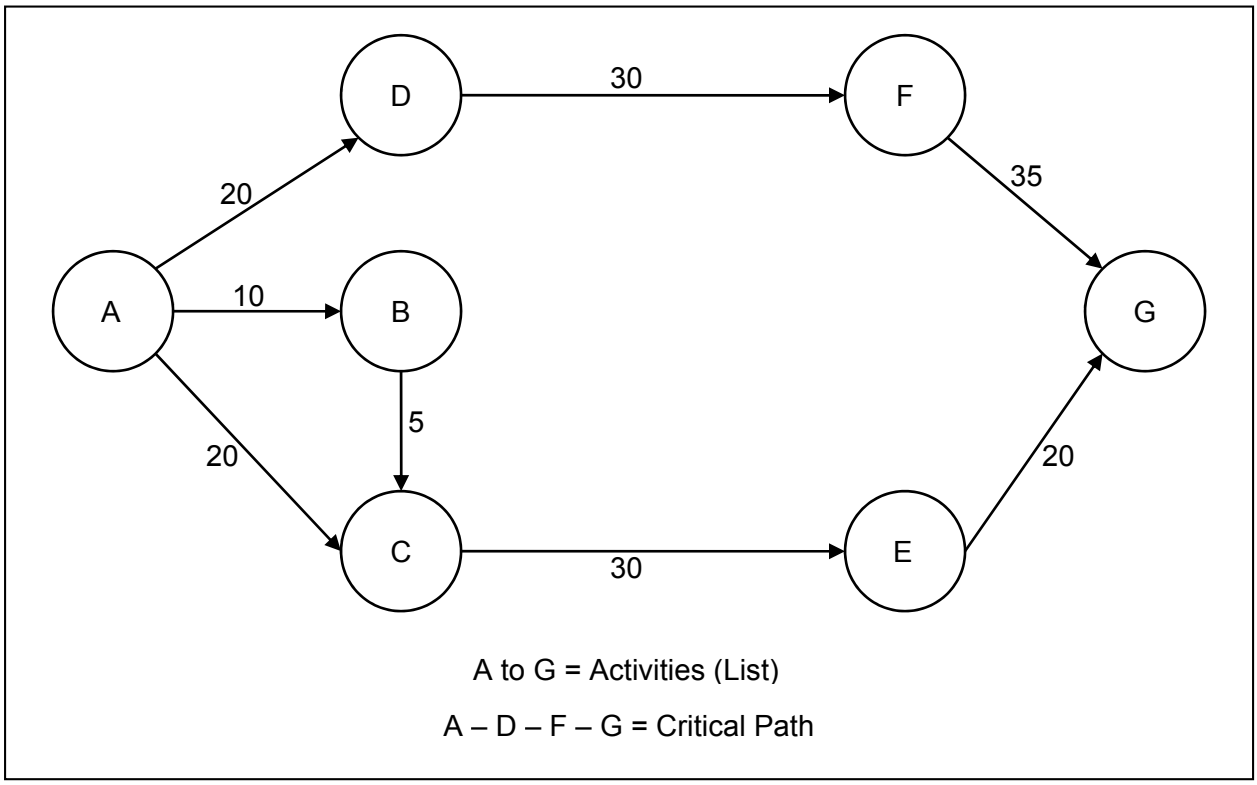
PERT includes collecting three time estimates for each step: optimistic, most likely, and pessimistic. CPM uses just one estimate for each activity.

PERT enables the user to calculate the variances in the times, thus incorporating probability. While this difference between PERT and CPM exists, for the vast majority of your activities the difference is probably not very significant. If you are introducing networking into a nontechnical group, keep it simple. Figure 3-4 represents an example of a simple PERT network.

Pareto Analysis

A Pareto Diagram is used to determine what characteristic is the major contributor in a process. It is a bar graph (frequency distribution) which ranks data in categories from largest to smallest based upon frequency of occurrence, cost, and so on. It helps to prioritize actions by showing the percentage of time that a problem is caused by a specific item or action, thereby graphically providing statistical evidence of the root cause of a problem.

Figure 3-4: Simple Example of a PERT Network



When constructing a graph, be specific concerning the process and each step. The answer to questions such as: What causes us to deliver a specific product late (?) or what causes us to miss our deadline for a financial closing (?) will identify a specific root cause.

The Pareto Principle is also known as the 80/20 Rule, or the Law of Vital Few. This Rule holds that for many occurrences the majority (80 percent) of the consequences stem from a small percentage (20 percent) of the activity. You have probably used this concept when discussing

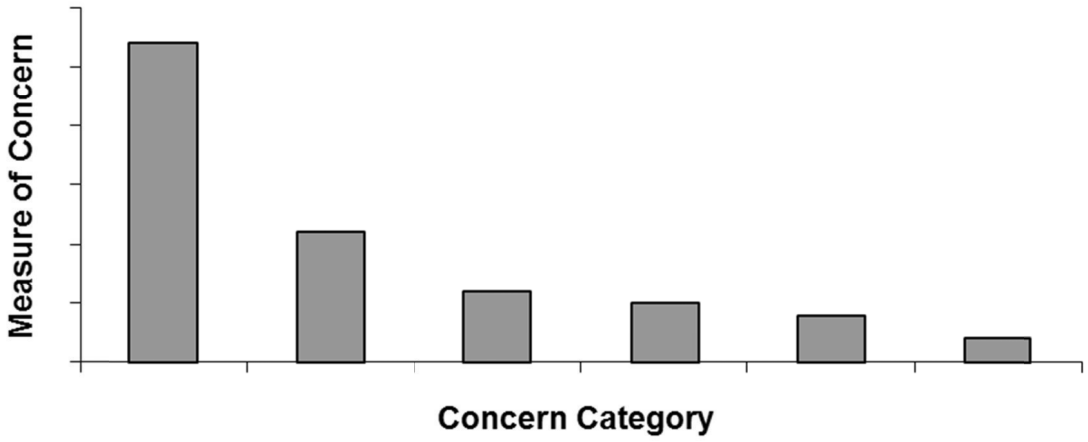
other topics, including sales and profits. For example, 80 percent of your profits can come from 20 percent of your customers.

Pareto, an Italian economist (1848-1923), made his observation when studying the distribution of income. He determined that 80 percent of the world's wealth was controlled by 20 percent of its population. The concept was expanded, and proven correct, for numerous activities. In organizations, it is not unusual for a significant amount of a result to be caused by a relatively small percentage of an activity.

Using late payments to vendors as an example, the "measure of concern," reflects the percent of time when a failure occurs (late payment) due to each specific problem. Therefore, the first bar could be late receipt of invoices. The height of the bar, assume 30 percent, indicates that when we pay our vendors late, 30 percent of the time it is caused by the late receipt of the invoice.

The combination of a mapping process, including developing a critical path, and, when necessary, a Pareto Diagram (figure 3-5), can provide significant insights into a process and uncover potential improvements. This will help you allocate resources as well as to take near-term actions consistent with long-term goals.

Figure 3-5: Sample Pareto Diagram



In addition to providing insights into a process problem, Pareto Analysis can offer valuable information concerning an organization's financial situation. Take time to do Exercise 3-1. You might be surprised by the results. Excel-compatible software is available (SPC XL).

Exercise 3-1

Conduct the following brief analytical exercise. Take the financial results of your organization and subtract your best customers (top 20 percent). Now, reduce the costs which can be quickly changed (variable). What percent of sales and profits are lost? Is your organization concentrating enough of its energy on these customers? How about the results from the other 80 percent and the cost or effort associated with them? Review the question at the end of the chapter.

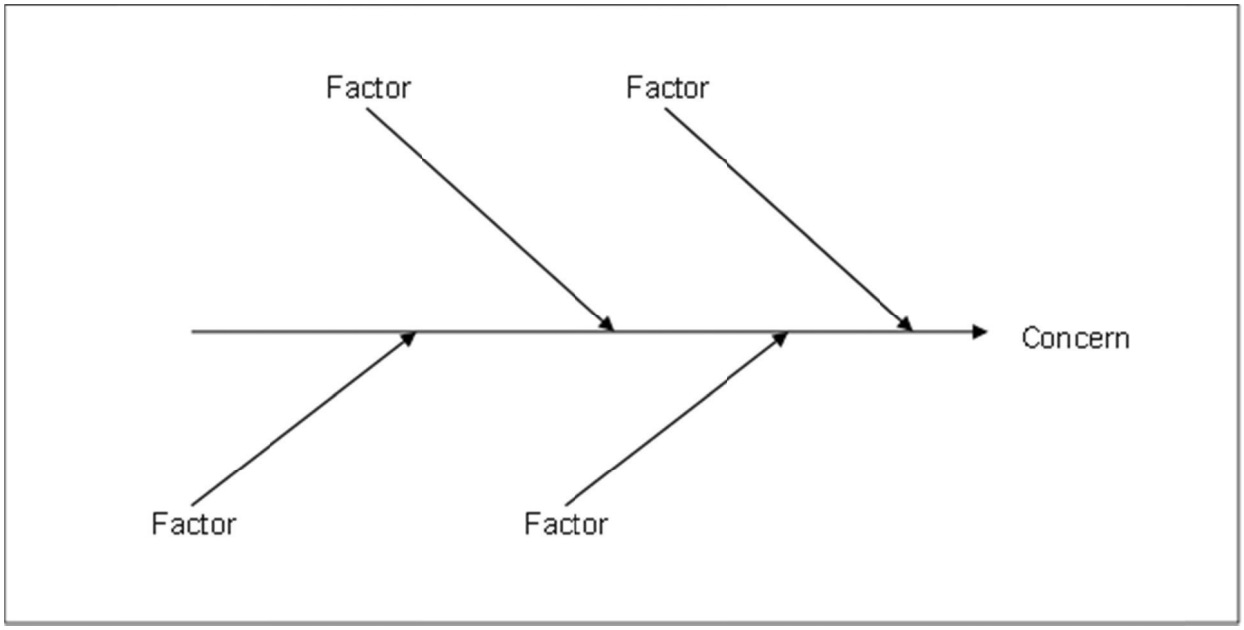
Cause and Effect Analysis (Fishbone) Chart

We have all experienced Brainstorming or other free-flowing idea generating techniques. Some people find them exciting and helpful for arriving at new answers to problems or identifying opportunities. However, others find them "a waste of time," since they do not appear to directly deal with the issues "at hand." Neither view is correct, nor do they reflect a person's dedication or ability. The reactions merely indicate if someone is a mental extrovert (willing to share unfinished thoughts) or an introvert (desires to share ideas after he or she has had time to work on them).

These sessions can provide insight into problems, opportunities, and, if properly managed, result in group cohesion. Therefore, a tool to foster participation can be helpful from time-to-time. A Fishbone Chart can focus these sessions, without reducing the hoped for creativity of the group. In addition, as it is developed, it will provide the findings in an easily understandable format.

Developed by Kaoru Ishikawa in the 1950s as a quality control tool, Fishbone Charts can provide a structure to help think through all the possible causes of a problem. A Fishbone Chart is a cause and effect diagram which basically is a pictorial display of a list. The design of the diagram looks much like the skeleton of a fish. Therefore, it is frequently referred to as a Fishbone Chart (figure 3-6). This technique is equally useful for problem solving as it is for exploring successful actions. Its value is to assist in categorizing the potential causes of problems or issues in an orderly way to identify root causes. As a detective, you are trying to learn from both the BOBs and WOWs.

Figure 3-6: Sample Fishbone Chart



Begin a group Brainstorming session and continue to ask questions concerning the problem or concern being addressed. Divide the questions into five major areas:

- *Procedures* – Performance criteria, standards, and so on.
- *Products* – Consumables used.
- *Environment* – Space, location, and equipment employed.
- *People* – Skills, abilities, motivation, and so on.
- *External* – Outside people or factors.

Continue to ask: WHY? HOW? WHO? HOW OFTEN?

Record the responses. Try to identify major and minor factors. Do not try to make it complicated. Remember, it is meant to provide discipline for problem solving without cutting off the flow of ideas.

As you identify potential causes (factors) to the problem (concern) being addressed, put them on the chart. Returning to the earlier example of late payments to vendors, delays in approval or receiving invoices could be factors.

Repeat this procedure with each factor (category) to identity sub-factors. Continue until no new information comes from the process. Analyze the results of these sessions. Identify those items that appear in more than one category. These are the "most likely" causes, and should be further reviewed to place them in order of priority. A Pareto Diagram may be helpful for this part of the analysis. If you are interested in exploring this topic further, XMIND is an available cross-platform software.

Theory of Constraints

Theory of Constraints (TOC) is based on the view that in any system there is usually only one factor that limits the overall ability or production of that system. Therefore, the entire system must be managed knowing where the constraint exists. Eliyahu M. Goldratt demonstrated this using an analogy of marching soldiers.

Throughout a system there are points with excess capacity (fast soldiers) and a bottleneck (slowest soldier). The overall marching pace of the troop is dictated by the slowest soldier. By not identifying the constraint, management frequently will enact policies which add to establishing groups or departments, and compensation systems based on their individual production. The system will become more imbalanced, leading to poor quality and increases in working capital. What is likely to happen, is that management will push the "fastest soldiers" to continue to produce. Therefore, each unit will produce to its capability and not to the constraint capacity of the system.

Assume you manage a nonbottlenecked area and rewards are based on production. What would you do? Produce. This would result in growing inventory (work-in-process). However, it would not occur in your area but farther down the system ("not your concern"). Even if sales falloff, you will produce.

TOC addresses several areas of waste identified by Lean:

- Overproduction.

- Waiting time.
- Motion.
- Underutilized people.

While we will discuss Lean further in chapter 6, let us make a few observations via TOC. First, goals cannot be established based on unrealistic assumptions. For maximum efficiency, we want to remove variations and operate at steady state. For decades, production facilities have addressed this situation by tying groups together. Mass production uses physical hardware, such as conveyor belts. Lean employs logistical ties.

In order to protect the output of the overall facility, buffers are established. Inventories are strategically located in front of the constraint point. Therefore, it will continue to operate at all times, maximizing the system's production. In addition, the constraint capacity (slowest soldier) is linked to earlier operations. The combination will result in steady state operations and maximizing production, with minimal inventory.

As discussed above, TOC focuses on total throughput. The following measurements are often used to capture this concept in a production environment.

$$\text{Productivity} = \frac{\text{Throughput}}{\text{Operating Expense}}$$

$$\text{Turnover} = \frac{\text{Throughput}}{\text{Inventory}}$$

However, TOC can be equally powerful in nonmanufacturing scenarios. Take a few minutes to think about the various financial processes in your organization. Could a clearer focus on throughput (TOC) be helpful in improving your current systems for financial closings, processing accounts receivables or payables, budgeting, reporting, and so on? Consider the following:

- Maximizing a system by areas or groups can reduce efficiency
- Steady state = balance between fast soldiers and the slowest soldier
- To maximize the total system:
    - Identify constraints
    - Set realistic goals
    - Link units (physical, logistics, rewards)
- Focus on system throughput
- Process management requires identifying bottlenecks
- Throughput requires continuous improvement in terms of productivity and turnover

The interested reader should read works by Goldratt. This author recommends you start with THE GOAL and THE RACE.

Chapter Summary

Think about your experiences. Would any of the tools listed below have assisted you in problem solving in the past? How about now?

- *Benchmarking*—Targeting world-class.
- *Target Costing*—Evaluating value streams and fighting inertia.
- *Mapping*—Uncovering hidden inefficiencies.
- *Networking*—Project planning and implementation.
- *Pareto Analysis*—Focusing attention on a few, key activities (Law of Vital Few).
- *Cause and Effect or Fishbone Analysis*—Disciplined framework for problem analysis, while encouraging group participation.
- *Theory of Constraints*—Provides the framework to maximize the performance of an entire system.

Chapter 4

Analytical Models—Decision Aids

Introduction

This chapter provides the necessary techniques to use higher-level statistical models for forecasting, optimization, and problem solving. Examples of forecasting include sales, costs, and balance sheet accounts. In addition, the use of higher-level statistical tools is introduced to address a number of typical situations organizations often face.

These tools assist us in identifying relationships which can be used to improve decision making. Remain an active detective. Spend time on Exercise 4-1 before going further. If you are part of a group forecasting effort, consider sharing this exercise with your team.

- The purpose of this chapter is to
- Examine the use of models for forecasting and problem solving.
- Review the process for identifying relationships and building statistical models.
- Demonstrate the use of regression analysis.
- Summarize the uses of linear optimization and inventory models.
- Explore an approach for estimating the "most likely outcome" for situations where a single answer cannot be calculated (Simulation—Monte Carlo Analysis).

Model Building

Model building is key to a scientific approach. Building a model helps us understand the relationship among a variety of activities or elements which influence an outcome or event. It is the technique we use to gain insights into reality.

The word "model" can have several different meanings. In this document, it will always relate to a mathematical, or generally analytical, representation of reality. The models we will use are simple. They are intended to provide examples you can readily develop and use in your organization. The key to using any model successfully is to be able to identify the relationships which exist among variables.

Our examples attempt to focus on direct relationships between activities. This will help the novice use the tools more quickly, on a wide range of issues. Also, by keeping the model straightforward and building upon what you already know, from your prior training, the techniques will be easier to explain to people with less analytical exposure than yourself. People will not use tools they do not trust, and trust comes from understanding. Armed with the data

management techniques discussed in chapters 1 and 2, as well as the improvement tools in chapter 3, you are now ready to move into model building.

First, clearly identify the elements of the problem or the existing relationships among the variables you are using to forecast an outcome. Your initial attempt may prove to be wrong, but it will enable you to begin to develop an approach to help discover actual interactions among the data. Detectives can be wrong in their initial conclusions. It is the discipline process they follow and their willingness to change, based on the evidence and their interpretation of it, that ultimately can lead them to the correct conclusion. As discussed in chapter 1, there is both an Art and Science portion to arriving at the correct answer. The goal of model building is to duplicate real world (discussed below) and a successful build will incorporate the following:

- A clear statement of goals
- Empirical data collection
- Isolation of relationships found within data collection
- Initial simple model build to be expanded upon

Duplicating the Real World

Establishing a model that reflects reality is vital for problem solving. An incorrect model or system will assure that we are consistently wrong. Just think of a stopped clock – it is correct twice a day. However, one that is fast or slow is always wrong.

Prepare a concise statement of your goal. For example, forecasting the next three years sales, a cost component, inventory levels, receivables, and so on. Be specific, including time horizons. Any model should be sufficiently detailed to capture the basis of the interrelationships among the data, but general enough to be readily used and provide solutions.

Do some testing. Start with obvious or seemingly obvious relations. For example, as sales increase or decrease we would expect both inventories and receivables to change in the same direction.

Exercise 4-1 can be helpful by stretching your mind before developing actual models. It demonstrates the type of questions you should ask early in the process. Take some time, either alone or with others, to try it.

Exercise 4-1

You are a senior manager of a major automobile manufacturing company. The president has requested that you prepare a one year sales forecast. Assume it is now November 1st, so you have ten months of actual data.

For simplicity, make the following assumptions:

- You produce only one car model.
- Market share will remain constant.

What variables would you be interested in prior to building a forecasting model? Make a list before to going further. Compare your answers with the suggestions below.

Potential variables could include

- Sales for the prior year and the last ten months.
- Estimates of DPI (Disposal Personnel Income).
- Forecast interest rates.
- Anticipated unemployment rate.
- Gas prices and changes in efficiency over the past several years.
- Number of people entering and exiting the driving population.
- Age of the existing fleet of cars.

We normally start forecasts from the current base, and confirm that nothing unique has happened during the base period to impact the future. For instance, massive price discounts to encourage immediate sales. This will obviously reduce next year's demand. We also should determine if our target market is increasing or decreasing, and at what rate.

Economic indicators provide a view of the population's ability to make a major purchase. The last item addresses the customers' potential return on investments. In reality, the most important variable tends to be the age of the existing fleet consumers are driving. If too old, inefficiencies and repairs tend to drive us to purchase replacements as long as we believe (other variables) we will be able to pay for them.

I know you will be able to identify several additional variables. Many of these impact, to a greater or lesser degree, automobile purchases. For our purposes, do not worry about weighting the factors. That is for another level of discussion. Play with this exercise as a start to finding relationships.

Through most of the 1990s, automakers sold about 15 million units (cars and light trucks) annually. In 2000, sales peaked at 17.4 million units, and remained at that level for 5 years. Industry executives openly predicted continued growth. In 2003, Toyota's head of North America sales forecasted the industry would soon sell 20 million units per year.

In 2006, sales started falling and are now expected to be at 1990's level (15 million units) for at least several years. This reduction is despite a growing population and higher gas prices.

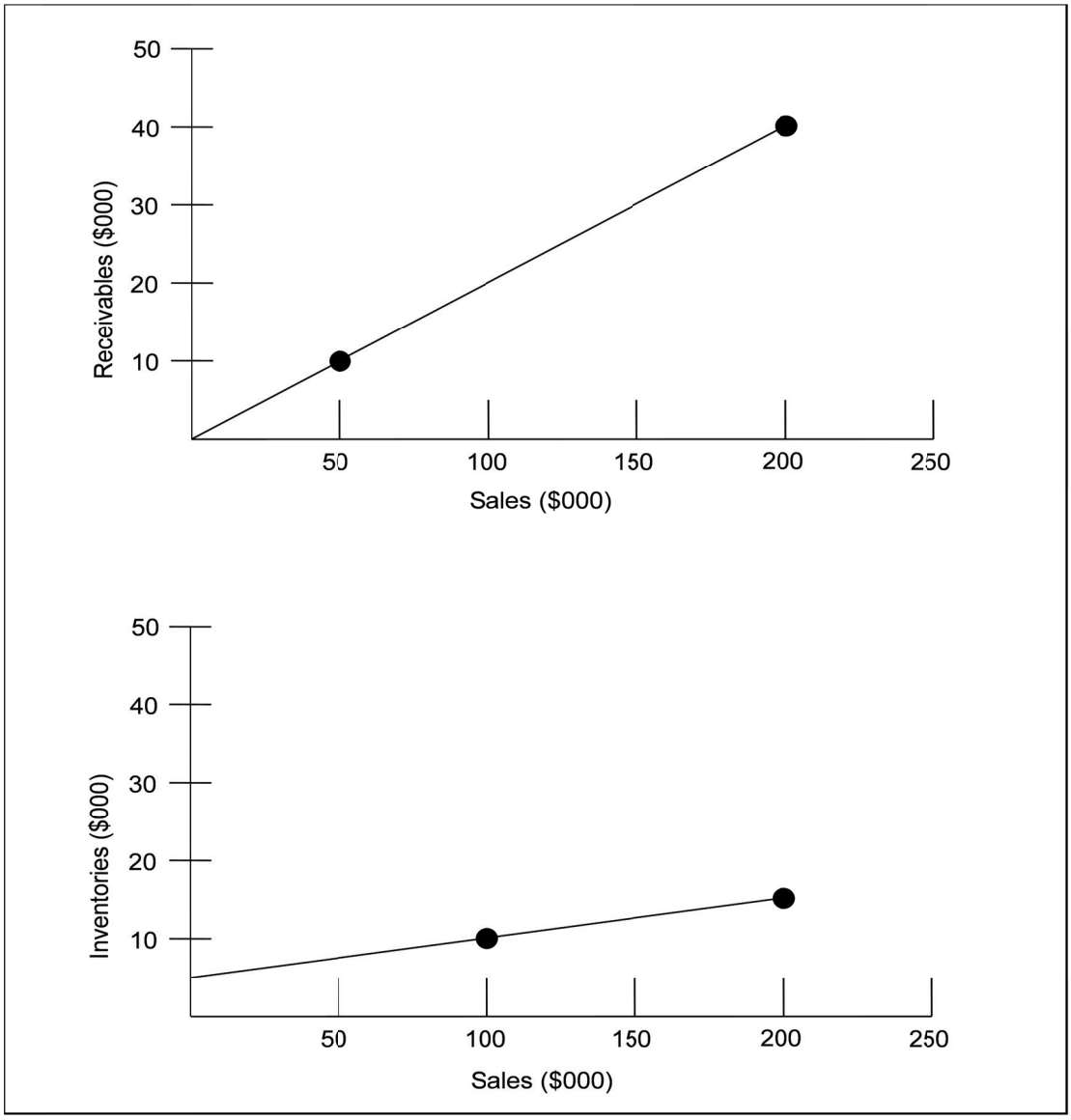
What happened? Review your list of previous variables, as well as identifying additional ones. If you were constructing a model, what variables explain this significant change in forecasts? After working on the above, refer to the Solutions section for a few ideas.

Forecasting Equations

Frequently, we classify costs as fixed or variable based on what they most act like. For example, department labor may be considered variable. However, what about environmental and safety personnel, security, and so on? In reality, most costs are not totally fixed or variable, but some mixture. The same can be said about Balance Sheet items. In some recent publications fixed is referred to as *non-* or *quasi-spontaneous*, and variable as *spontaneous*. Do not let the names confuse you.

To start, select items you believe will vary with activity. These can include receivables, inventories, payables, and so on. Figure 4-1 present a hypothetical case with two graphs. The first plots receivables vs. sales, the second inventory vs. sales. A straight line can be constructed by connecting two points. The example begins from that perspective.

Figure 4-1: Example Inventory and Receivables Graphs



We would expect receivables to move directly with sales. Therefore, the line starting at the zero point is not a surprise. In this example, $50,000 of sales results in $10,000 of receivables, and $200,000 of sales in $40,000 of receivables. Therefore, receivables are 20 percent of sales. If nothing changes, we can anticipate that as sales change so will receivables in the same ratio.

In the next graph, the two points used to construct the relationship between inventories and sales are: sales = $100,000 and inventories = $10,000; sales = $200,000 and inventories = $15,000. **Note**: the forecasting line crosses the axis at $5,000. Therefore, $5,000 of inventories is fixed. These could be stocks for sale to customers or repair parts. In this case, the points on the forecasting line can be calculated by starting at the fixed inventory level ($5,000) and adding the rate of change (slope) times a sales estimate to this point. The example below calculates the inventory levels anticipated for sales of $50,000 and $250,000.

$$\frac{\text{Change inventory}}{\text{Change sales}} = \frac{5{,}000}{100{,}000} = .05$$

$$\text{Inventory} = \$5{,}000 + .05(50{,}000) = \$7{,}500$$

$$\$5{,}000 + .05(250{,}000) = \$17{,}500$$

As you construct even these simple relationships consider two possibilities. First, if inventory values have significantly changed recently (up or down) you might also want to graph units of inventory, not just dollar amounts. Especially, if more price changes are expected. Also, be aware that often a lead-lag relationship can exist between sales and inventories. Inventories may be increased only after sales gains are obvious and be maintained at high levels, even after sales have started to slow. You should test for this when defining the relationship.

Identifying relationships between variables and using them to forecast the future is the basis for most statistical forecasts. Although the above examples use Balance Sheet items, the same process can be expanded to cost items and forecasting sales (chapter 5). Exercise 4-1 demonstrates how we can look for these relationships, prior to testing them statistically.

Scatter Diagram

Often, the relationships demonstrated in the above examples (and shown in figure 4-1) are not as obvious in the real world. When looking for relationships go back to one of the first techniques discussed and graph the variables.

The result of plotting two variables (independent and dependent) is called a scatter diagram. Figure 4-2 provides several different scatter diagram examples. From a scatter diagram it is frequently possible to visualize a smooth curve which approximates the data points. This curve is therefore called an approximating curve. The approximating curve represents the average relationship between the variables. It is often possible and sufficient, to draw a line visually through a scatter diagram. The curve attempts to minimize the distance between the points on the curve and the actual plotted data points. Therefore, it can act as an estimating curve for the dependent variable, given values for the independent variable.

A scatter diagram can quickly show if a relationship exists between the two variables and, if so, if it is described by a straight line or another curve. Our examples, except in chapter 5, will all

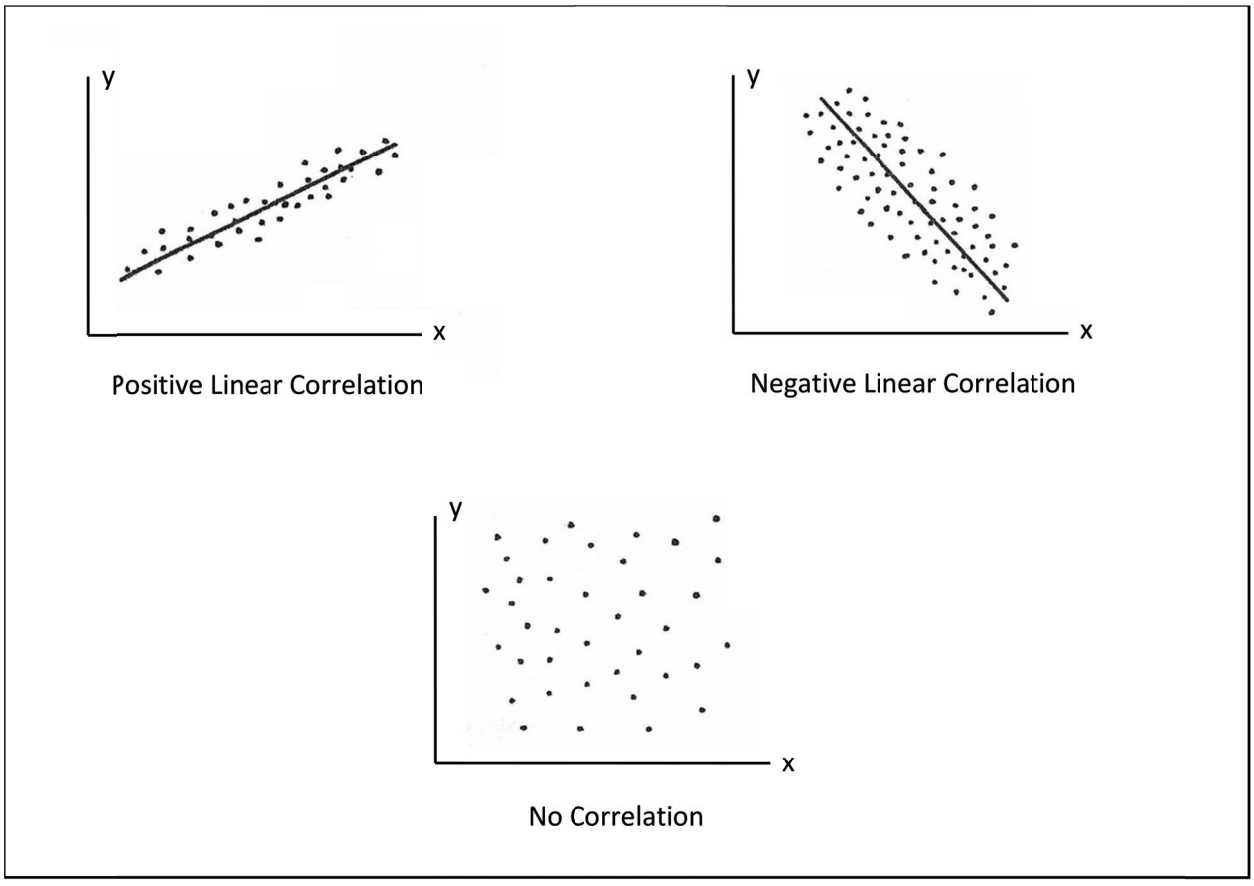
use a straight line. In fact, for the majority of estimates you will normally perform, a straight line will be appropriate.

Regression Analysis

Regression analysis is the next logical step for measuring the relationship between variables. It performs two functions. First, it provides an equation which describes or measures the relationship between the two variables.

In addition, it provides a statistically based measurement of how closely the two variables are associated. Therefore, if a strong relationship exists and you can estimate, or know, the value of the independent variable, the regression can provide valid estimates of the dependent variable.

Figure 4-2: Sample Scatter Diagrams



It should be noted that, regression analysis does not, nor does any other mathematical process, determine the independent variable from the dependent variable. There is no procedure to determine causality, only the degree of relationship between the two variables.

Based on a history of the relationship between the variables, regression analysis mathematically constructs a line that "fits" through the points of a scatter diagram. The line is fitted by a method known as "least squares." That is, the sum of the vertical deviations around the line equal zero.

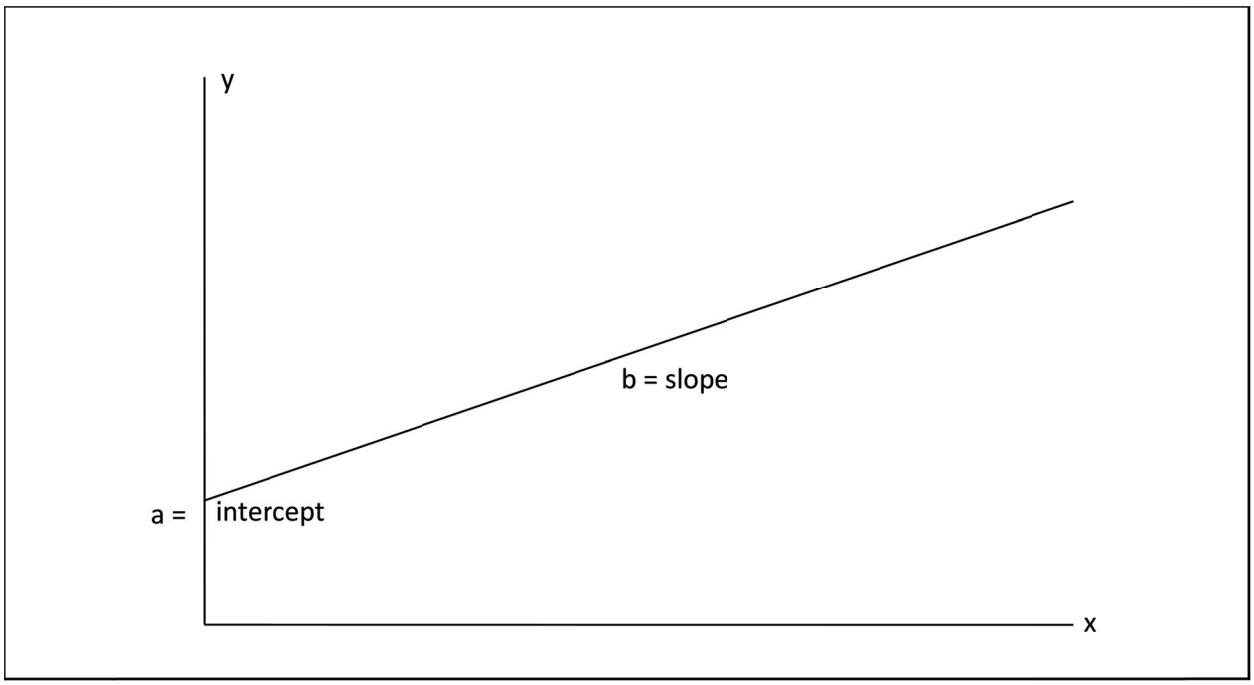
This customary description is used when the x-axis plots the independent variable and y, the dependent.

For now, let us focus on a simple regression (two variables) that fits a straight line. A straight line can be drawn using the following equation.

$$y = a + bx$$

The **a** variable represents the intercept of the regression line with the **y** axis of the graph, and the **b** variable the slope of the line. **y** is the dependent variable and **x** the independent. Therefore, if we were trying to forecast inventories or receivables, **x** could be sales. Figure 4-3 is an example graph of this type of simple regression.

Figure 4-3: Simple Regression Graph



Because we are using regression analysis to draw a line through a number of data points on the scatter diagram, we expect that some of the actual points will not be directly on the regression line. Therefore, we need to begin to determine if the regression line is a good fit to the data. The size of the deviations from the line determines the degree of fit.

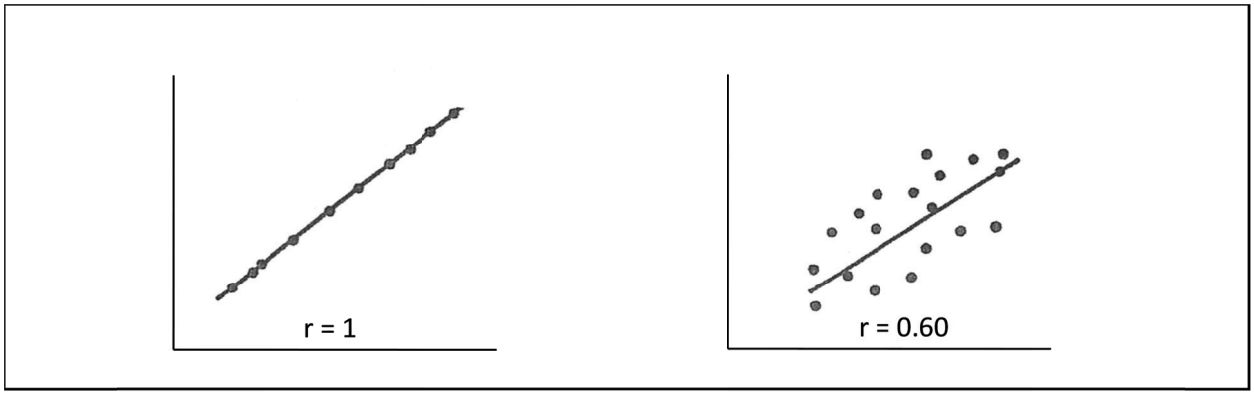
The standard error of estimate is used to measure the fit. If the deviations around the line are distributed normally, 68 percent of the data points will be within the distance of one standard deviation (above or below) from the line. Obviously, the smaller the standard deviation, the better the fit and the more useful the line. We will develop this further, in later chapters, when addressing variances and setting targets.

Key measurements of the relationship between the variables are the coefficient of correlation **r** and the coefficient of determination (R-squared). The coefficient of correlation can vary between

-1 to +1. The signs are used to indicate a positive or negative linear correlation between the variables. Figure 4-4 shows the difference in r values when r = 1 and r = 0.60. **Note: r** assumes a linear relationship. Therefore, a nonsignificant **r** value does not mean that no relationship exists, only that a linear relationship does not exist.

R-squared measures the ratio of explained variation to total variation. That is, it measures the amount of variation in **y** (dependent variable) explained by variations in **x** (independent variable). This ratio is always positive. For example, if the value is 0.85 it would indicate that 85 percent of the variations in **y** are explained by the variations in **x**. A ratio of 1.0 would indicate that changes in **y** are 100 percent explained by changes in **x**.

Figure 4-4: Plotting the Difference of r When r = 1 and r = 0.60



The information can be extremely helpful not only in measuring "fit," but as we try to construct relationships between activities (such sales, labor cost, transportation, receivables, and so on), R-squared is probably the most known or referred to measurement in regression analysis.

We will demonstrate day-to-day uses of regression analysis in chapter 5. These will include budgeting, measuring changes in cost behavior or structure, variance analysis, reporting, and sales forecasting.

Linear Optimization

Linear optimization models, also known as linear programming, recognize the interrelationships among decisions within an organization. It is designed to maximize the outcome of a situation based on a limited amount of resources, which can be used to produce various goods or services. The resources can be labor, parts, cash, or any asset required to produce, sell, and distribute an organization's products. It assumes that the relationship among the various resources is linear and a successful optimization will

1. maximize current operations;
2. identify areas for expansion; and
3. indicate fund allocation strategies.

In order to use linear modeling there must be four conditions to the problem:

- Linear relationship.
- Limited resources.
- Single objective (max. profits, and so on).
- Homogenous products – each product of a similar type is the same (not unique).

Because I live in Florida, let us try a simple example using citrus juice. Assume we have a citrus grove which provides oranges and grapefruits. We can pick 480 oranges per day and 240 grapefruits. It takes 10 oranges to make one quart of orange juice and 6 grapefruits to produce one quart of grapefruit juice. We sell orange juice (OJ) for $2.50 per quart and grapefruit juice (GFJ) for $2.00 per quart. If that reflected the total situation, we would simply produce at the maximum.

Now, let us complicate life, we can only sell 40 quarts of OJ per day and 25 quarts of GFJ. There is a third product – blended juice comprised of 5 oranges and 3 grapefruits per quart. This product is sold at $1.50 per quart, and the market will absorb all the production we can make. If you do not pick the citrus daily, it is lost. Also, the actual fruit has no sales value. Therefore, lost fruit (waste) carries a cost equal to the juice it would have made plus disposal. See the following.

Max. Highest Priced Products

	40 quarts OJ × 10 =	400 oranges
	25 quarts GF × 6 =	150 grapefruits
Produce	480 oranges	240 grapefruits
	−400	−150
	80 remain	90 remain

Blended product = 16 quarts and 42 wasted GF

Max. Profits

	33 quarts OJ × 10 =	330 oranges
	25 quarts GF × 6 =	150 grapefruits
Produce	480 oranges	240 grapefruits
	−330	−150
	150 remain	90 remain

Blended product = 30 quarts

After working on this example awhile, you will conclude that it is better to underproduce OJ (33 quarts versus the market demand). Therefore, maximizing profits does not mean maximizing production of your highest valued product. What happens to this example if prices or demand shift dramatically? You would need a model to again recalculate production.

You can begin to see how production problems of various types can be addressed by linear optimization. Just think of situations that require the same raw materials, including people. These problems lend themselves to this tool.

As you might assume, this technique has been widely used in solving operations type problems. However, it can also be applicable to financial problems. It can be applied to any situation which meets the four above criteria. For example, when building a new plant capable of producing a variety of products, linear modeling can indicate the "best mix" of production capabilities for the entire facility. How about allocating funds in the budgeting process? The funds can be used for a variety of things, but are limited in total. The objective of this process is normally maximizing profits. Therefore, a linear relationship and modeling may be possible.

Obviously, these models can become quite extensive. Therefore, once the need is identified, computers and software are the normal means to employ the technique. In this way, you need only identify the relationships and constraints (really the key issues); the software will perform the analysis. If you build a model to address a situation, keep it and update it from time-to-time. Demand, raw materials and other input or output relationships can change, sometimes very quickly, thus requiring you to relook at your earlier decisions.

Inventory—Economic Order Quantity

Like with any other part of working capital, inventories are normally maintained at the lowest possible levels. Of course, there are strategic reasons to increase them at times. In general, working capital does not generate income. It is there only to support sales. Therefore, management's goal is to minimize cash, inventory, receivables, and so on. Accounts payable is an obvious exception since it is free money to your organization.

Inventory is a direct link between production and sales. Even if a firm has no sales (start-up) it will have inventory-finished goods, WIP, raw materials, supplies, maintenance parts, and so on. However, the more inventory kept, the higher the investment and the lower the profits, and consequently return on investment. In addition, excess inventory can become obsolete, be damaged, or stolen.

The typical carrying cost of inventory may include storage, handling, insurance, security, rent, cost of capital, and opportunity costs. Also, in the real world, there can be a stockout cost. That is, the cost of not filling an order. Stockout can occur even for repair parts, since, if they are not available when needed, production is stopped, causing a stockout for customers. There is no single value or cost of a shortage. In fact, it can be different for the same company depending on different times. Running out of a "hot fashion" item can have a significant cost for a retailer during the Christmas Season. A few days wait for the same good at another time of the year may have no cost (customer waits or buys something else).

In addition to the normal holding or carrying costs, there can be an order cost. Due to transportation, production costs by your supplier, or paperwork required, an optimal order size can exist. By reducing the number of orders, economies may be possible. The total cost of inventory can be expressed as shown below.

$$\text{Total Cost} = \text{Purchase Cost} + \text{Ordering Cost} + \text{Holding Cost} + \text{Stockout Cost}$$

Simple Models

Inventory models start with the so-called two-bin approach, and progress to sophisticated models that incorporate numerous variables. Simulation can be used in complicated situations to

estimate demand, production or delivery times, and so on. The two-bin method assumes you hold two equal bins or areas for inventory. They are sized so that when the first bin is emptied you order replacements. The shipment is expected to be received prior to the second bin being emptied.

A second level conceptual tool is generally referred to as a sawtooth model (figure 4-5). Like the two-bin concept, it assumes that the lead time to fill an order is known, and is a constant. As shown below, Q represents the optimum order amount, R the order point and L the necessary lead time. This model can be modified to include a layer of safety stock, either on a permanent or temporary (seasonal) basis. This is frequently included if stockout costs are high. Q is determined by the following variables.

Q = Average demand for period + Safety stock – Current inventory (on hand or ordered)

Figure 4-5: Sample Sawtooth Model Graph

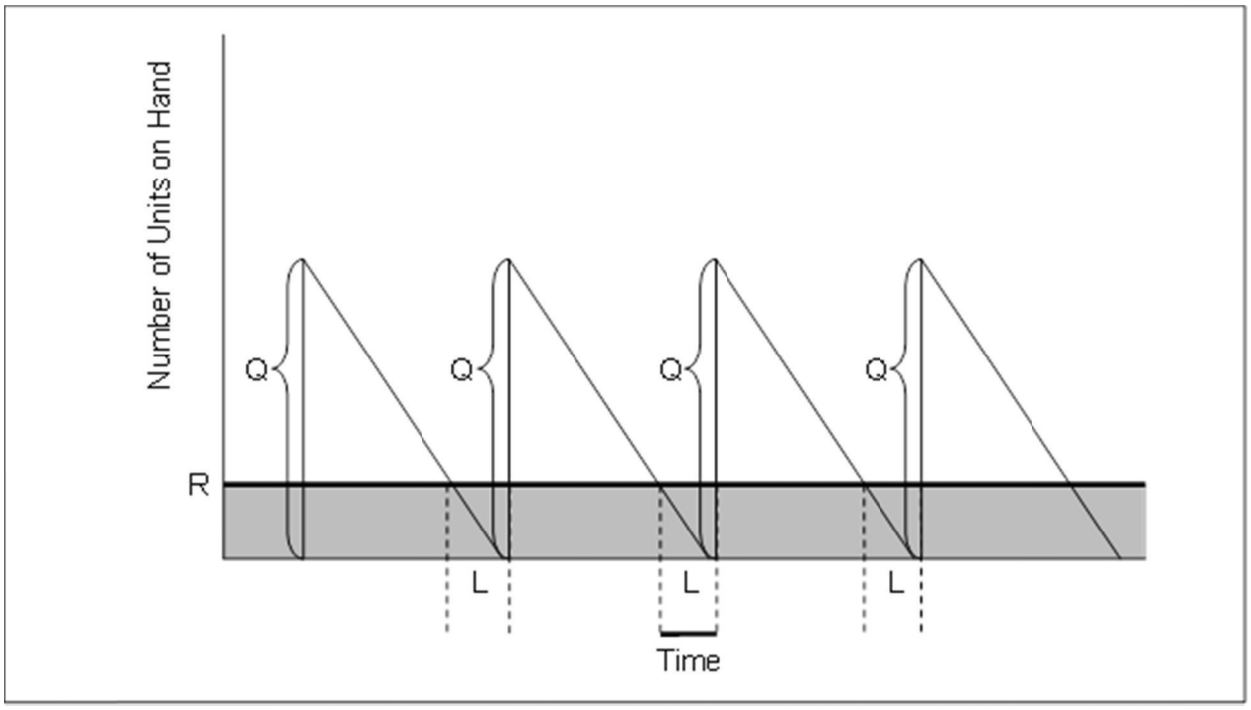
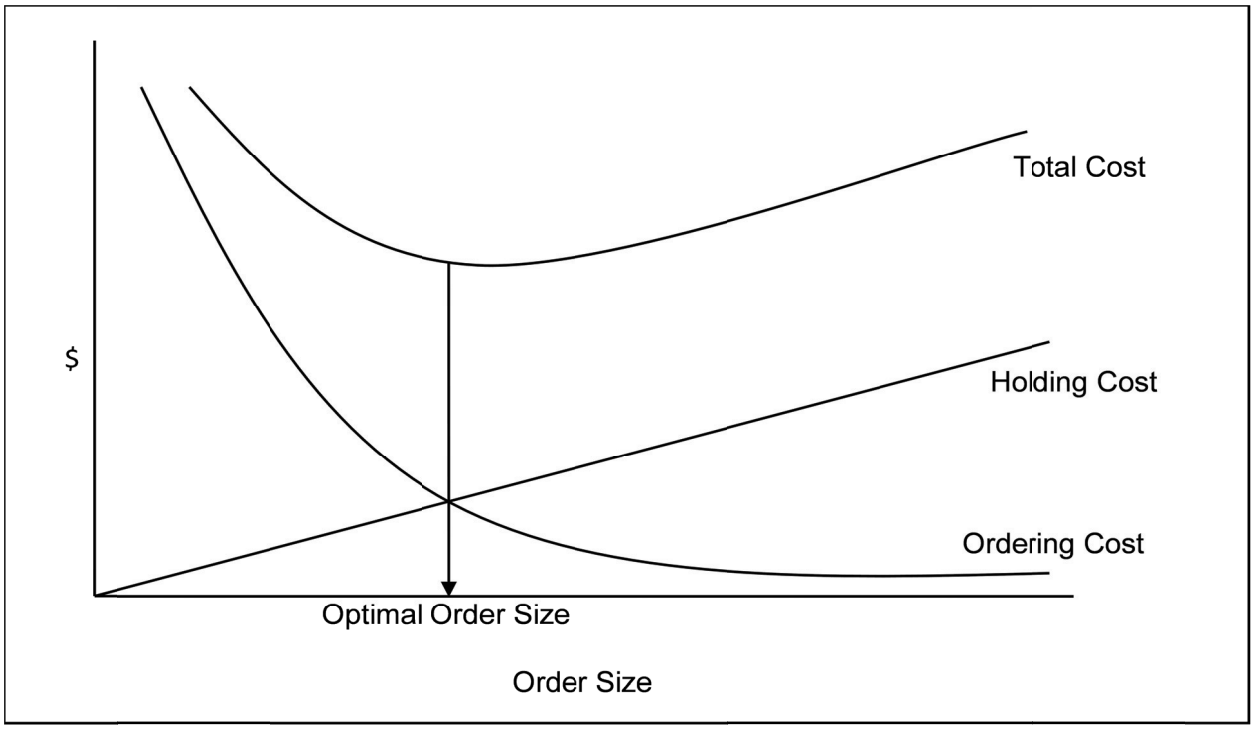


Figure 4-6 demonstrates the relationships among the various costs of holding inventory. Q is the optimal order size, as it reflects the lowest overall cost.

Look at your business model. Can you reduce inventories of any kind? Are stockouts a significant concern? If it is a service organization, how do you deal with stockouts? Airlines face this daily. They cannot add a few extra seats just when needed. They also know an unhappy customer will go to a competitor. Therefore, they "buy" volunteers with free flights, and so on. This has a high value to the customer, but not necessarily to the airline. The company needs the extra seat now, and flying a future passenger on a scheduled flight may have very little extra cost. This is a stockout issue.

Figure 4-6: Holding Inventory Cost Comparison



Review your overall inventories, by type, and build a simple model to periodically assure that you are not wasting money on this "asset."

Simulation—Monte Carlo Analysis

Managerial decisions can concern problems that are too complex or large to be solved by a simple model. Actual experimentation may be the only means to gain sufficient insight in these situations. However, that is likely to be costly, time-consuming, or just not feasible. Simulation is used to address these situations.

To obtain statistical accuracy for reliable decision making, a significant number of simulation runs are often needed. This would be impossible, in a reasonable period of time, if not for computers. Auto makers use test dummies to estimate how people would fare in an accident. This is a type of simulation.

Not too many years ago, simulation was only possible on expensive mainframes. Today, software can be purchased for your laptop. Probably, the two leading general simulation packages are

- Crystal Ball – Decisioneering
- @ Risk – Palisades Corporation

I have used Crystal Ball numerous times, but never Risk (but I have reviewed its output). However, I am told, by good sources, it is about the same level of difficulty to use. It should be noted, that the author has no economic interest in either. Assume they are only somewhat more

difficult to use than the most popular tax preparation software (not too difficult). Both function in an Excel environment, so you can use your existing knowledge base.

These packages require the user to provide a probability distribution for unknown values. Therefore, instead of running an analysis using a single value, the software will randomly select from the distribution as it runs multiple passes. The user then needs to determine the outcome he or she wants to calculate. For example, sales, profits, capital expenditures, cash flow, and so on. Once the input distribution and target or output has been selected, hit simulate and let the software play – go have coffee!

As previously discussed, the important task is to provide the model with all valid inputs, thus reproducing the real world situation. Basically, the software tests all potential combinations of values, for the inputted variables, to arrive at all potential outcomes.

In concept, simulation is a game which attempts to mirror actual conditions. Unfortunately, we are not able to measure these conditions sufficiently to allow us to calculate a single answer. Therefore, we "simulate" the real world. The situation is played thousands of times by allowing the software to randomly select sets of values from the probability distributions we provide, thus the term "Monte Carlo simulation." This results in a table of outcomes each with its probability of occurring based on the actual results from the trials.

In concept, the software is testing all valid combinations of the values of the input variables to simulate all possible outcomes. Think of it as running thousands of what-if analyses with your spreadsheet.

There are many uses for simulation. A short list would include

- Financial forecasting.
- Scheduling – production, communication systems, services, distributions, and so on.
- Enterprise models.
- Product testing.
- Facility location and layout.
- Inventory.
- Training.
- Natural resource exploration and development.
- Weather forecasting.

The resulting printout provides a table of outcomes, each with its probability of occurring based upon the results from the multiple trials or runs. It also offers graphic options to help visualize the analysis and results.

The next time your supervisor asks you for a "Best," "Worst," and "Most Likely" scenario, think about using simulation. Typically, when faced with such a request, several people discuss the

important variables to arrive at the answers, agree upon the two extremes and pick (average) a mid-point as the "Most Likely." Reflect on this process and go back to the earlier discussion concerning averages. What do you realistically think are the odds of this approach being correct?

Simulation provides a disciplined, analytical approach. Be prepared. Like most tools (physical or mental), do not wait to be asked a question to try the tool. Get it early and play with it. You will be surprised at its potential uses.

Simulation has several advantages, but it is not a system that provides the "right answer." The output cannot be proven. As noted above, the answers are based on the results of many runs of a model, which attempts to mirror the real world. It does not provide the single best answer. If that were possible to calculate, you would not use simulation.

However, some of the primary advantages of using simulation include the following:

- Building the model will provide insight into the situation.
- Time can be compressed – years of experience can be gained in minutes.
- Simulation can be adapted to numerous situations which would have been extremely difficult, if at all possible, to otherwise model.
- You can use it to gain experience and insights into an existing operation, without interrupting the actual process. Therefore, changes can be tested.

Chapter Summary

This chapter brings together the techniques required to construct analytical models. Always begin with a simple model (approach) and escalate it, if and as required. This will help you to ultimately select the correct tool for the task.

The following list may help to provide discipline to your problem solving efforts:

- Forecasting equations – basic relationships.
- Scatter diagrams – visual aid.
- Regression analysis – forecasting or dividing data into its components.
- Linear optimization – maximization.
- Economic order quantity – inventory.
- Simulation – Monte Carlo – game theory.

Chapter 5

Forecasting and Budgeting

Introduction

The chapter identifies specific areas where analytical techniques can assist in budgeting. In addition, it provides a series of steps to systematically introduce these techniques into an existing process. Prior to preparing a forecast, it is essential that the relationships between internal and external variables and results are understood. Analytical tools can help, as well as reducing the amount of iterations and paperwork which can accompany building a budget.

As organizations become larger and more complex, trends can be hidden in the aggregate data, thus resulting in decisions being made using the wrong assumptions. While goals may be clear and well communicated, a poor measuring process can lead management to make decisions that are not consistent with the organization's goals. This is demonstrated in the latter part of this chapter.

The purpose of this chapter is to

- Examine the typical budgeting process and its goals.
- Discuss techniques to increase the accuracy of your forecasting efforts.
- Provide a series of steps to improve the budgeting process through the use of analytical tools.
- Demonstrate, by example, the development and use of a cost forecasting model.

Goals

Generally, accounting can be viewed as a process for writing the economic history of an organization. Unlike a novel, this history is written primarily in numbers and quantitative terms. It is made up of a series of documents including periodic reports, plans, budgets, forecasts, and data files. These data or information sources share one primary purpose, i.e., to provide a disciplined process, resulting in timely and appropriate information for making decisions regarding the organization.

All too often, the budgeting process still closely resembles the steps followed for decades. A massive data collection and updating effort, followed by numerous iterations, and finally concluding in a document which is viewed, by many, as belonging to the "Finance Department." While even this procedure does introduce disciple, it can fall far-short of providing actionable information.

By incorporating analytical tools or techniques into budgeting, selecting, and measuring critical factors, the process can be expanded to provide a series of strategic benefits. These include

- Gathering inputs throughout the organization.
- Testing alternatives.
- Identifying opportunities and threats.
- Allocating resources.
- Assuring the outcome is consistent internally and with the external environment.
- Maximizing results.

Typical Budgeting Process

The typical budgeting process is shown in figure 5-1 on the following page. It begins with the organization's objectives, goals, and strategies. This provides the direction for the process. Since sales drive capacity and production, both short and long-term, it's the first variable to be forecast. Costs are then projected based on history and the outlook for changes to significant inputs. At this stage, a series of iterations are begun to refine the initial "first-cut" budget. This is considered a "Top-Down" approach.

An alternative process, "Bottom-Up," begins with each group constructing an expense budget, which is then compiled into an organizational expense budget. In this case, as in the Top-Down approach, a series of iterations are used to refine the initial outcome. The hope, in both cases, is that the iterations will update relationships and uncover slack or cushion which was built into, either intentionally or unintentionally, the budget or forecast.

All those who have experienced these events know that it can consume months of time. Even with the assistance of existing software packages, you run the risk of creating excessive amounts of paperwork. Nothing kills innovation or slows down a process like mountains of paperwork. Also, there is no assurance that the final product will be accurate, or even a solid benchmark for comparisons

Introducing Models

Let us examine the budgeting process to determine where the use of regression techniques can provide value. Initially, we will focus on Balance Sheet Accounts and expenses. It is not expected that your organization will immediately change its budgeting process. However, introducing a few simple techniques can significantly streamline the process and increase its accuracy. Give yourself and others an opportunity to see the value these techniques can add.

Balance Sheets Accounts and Costs

Develop a series of two-point lines (use the same months) showing the relationship between sales and selected Balance Sheet Accounts, during the past several years. An example can be found in figure 5-2.

Figure 5-1: Financial Budgeting Process Flow

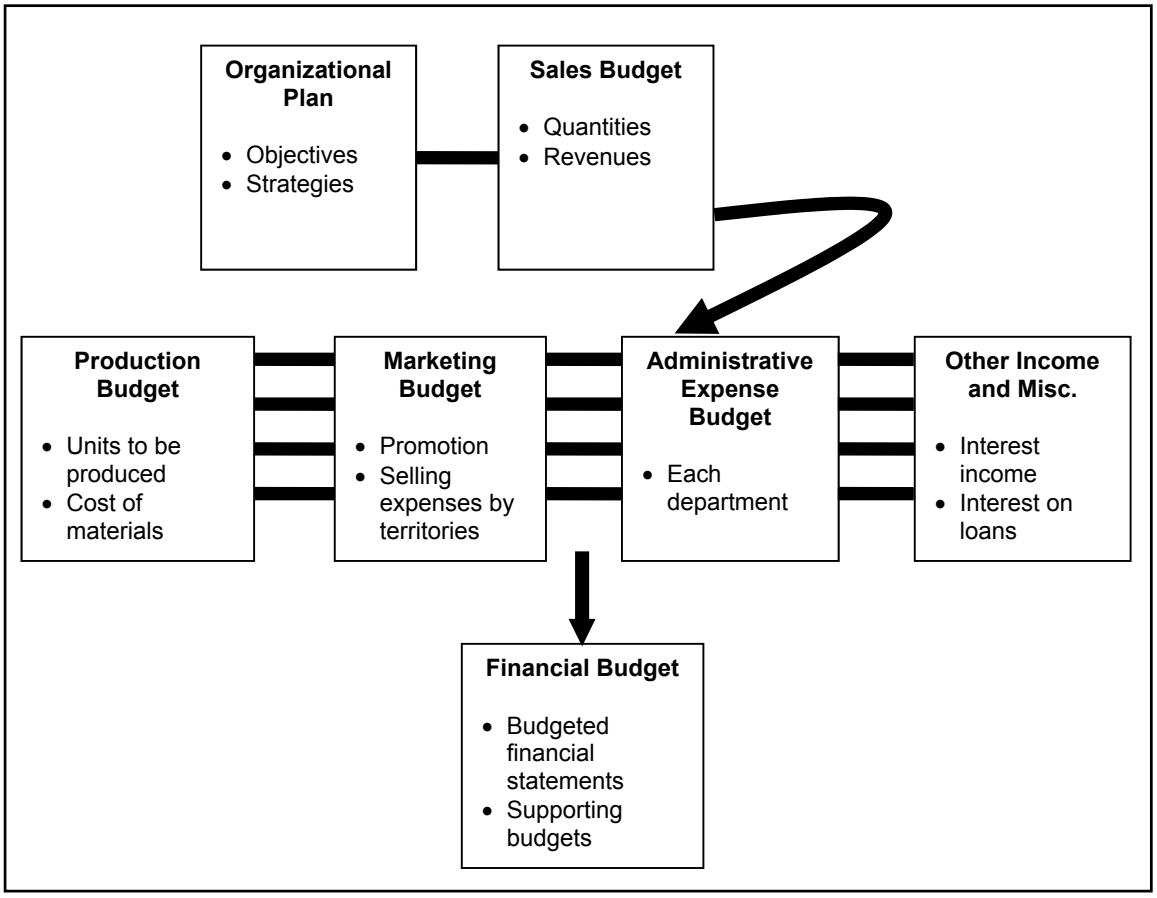
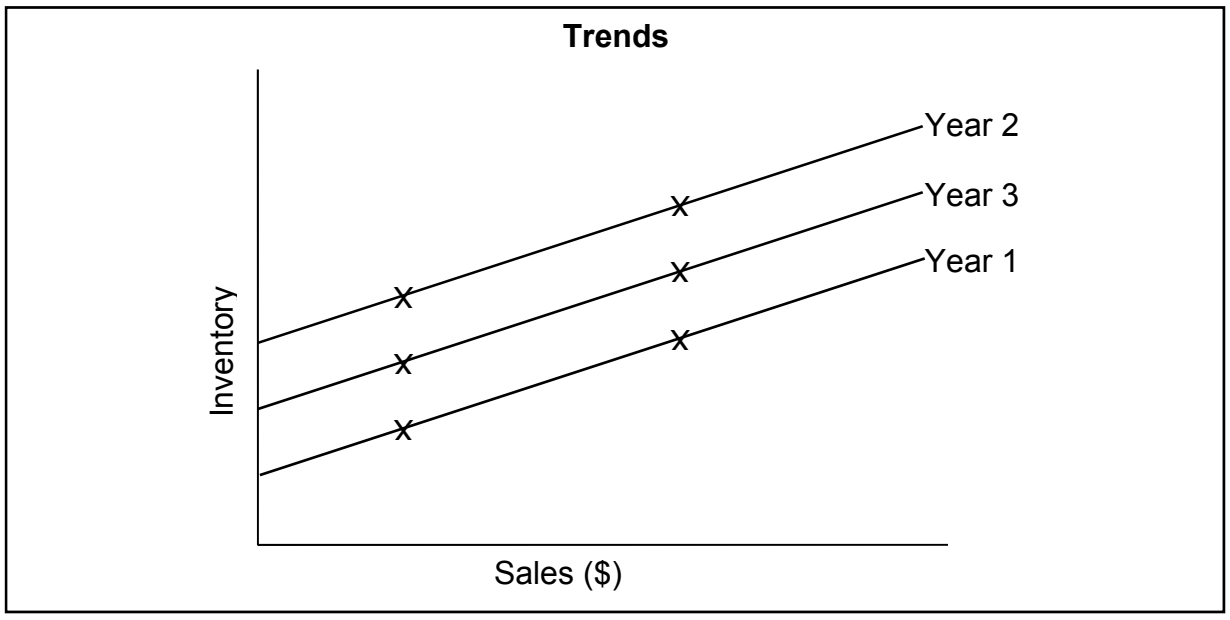


Figure 5-2: Sample Sales Versus Inventory Trend Graph



By plotting these separate lines on a graph you may expose trends. The example found in figure 5-2 can raise several questions. For example, is the fixed level of inventory too high? How does the relationship in the current "first-pass" budget compare to these trends? When sales declined in Year 3 did inventories stay too high? Shouldn't the organization be looking to lower (all things being equal) inventory?

Continuing with inventory, break it down into its parts – finished products, raw materials, repair parts, and so on. Look for trends in each area. Totals may hide trends in segments. For example, if repair parts are increasing it may be a sign of: poor purchasing practice, increasing breakdowns, aging equipment, too many types of equipment or having too many facilities. It is probably worth looking into. Check maintenance costs; trends there could help to identify which of the above are the problem(s).

Receivables and payables are easy and worth graphing. They may give you insights into the effectiveness of your credit and payment policies. Construct several of these simple graphs; then compare preliminary budget data with recent trends. This will shorten the iteration process and validate relationships incorporated into the budget. Make sure you prepare a few charts for expenses. Break the costs down into small units; such as labor in an area or department. Find the variable that drives costs. Often, it is production, units sold, or customers serviced.

For relationships that either appear to need further analysis or are important in the organization, prepare select scatter diagrams, including drawing an approximating curve. Here too, construct separate curves for each year. Remember, we are looking for trends and changes. Have the curves shifted? If so, why? What do the current trends mean for your costs and investments (working capital)?

Armed with the information gained from the above activities, determine which areas could benefit from constructing a regression model. At first, do not overdo. If this is new to you or your organization continue to be selective to gain knowledge and support.

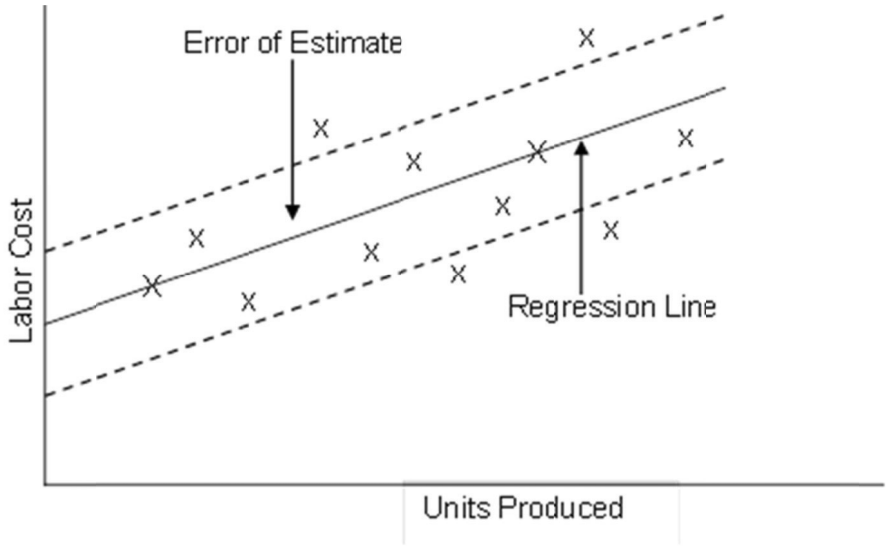
Focus on the R-squared and standard error of estimate. If you are satisfied with the fit, look for data points outside the error of estimate. By selecting these "outliers," you may be able not only to gain insights, but also to reduce the number of variances analyzed. Remember, in a "good fit" you expect actual data to vary from the regression line. An example of this type of error estimate analysis is presented as figure 5-3.

Sales Forecasting

As discussed in a previous section, traditionally management has used two approaches for budgeting and forecasting sales (Top-Down and Bottom-Up). In the first case, management establishes sales goals which are consistent with the overall company's goals. A reward system is frequently used to "drive" performance. This approach contains several potential problems.

First, the people responsible for achieving the sales had, at best, a small role in setting the targets. In addition, the goals can be overly influenced by optimism, overconfidence or a tendency to follow the herd. Rewards can also drive performance in an unintended direction. Even well-run organizations can fall prey to poor reward systems.

Figure 5-3: Sample Error Estimate Analysis



Dell moved its toll-free service and tech support to India in 2001. In 2004, it returned customer support for business clients to the U.S. Dell has since added 2,000 people to its U.S. call-centers, increased training for 5,000 other reps., and spent $100 million to improve customer support service. The stated goals of the original changes were to save costs and improve customer service. The first target was accomplished, but at a significant cost to the second. Obviously, this had a negative effect on sales.

Recently, Dell's management has openly discussed the resulting problems.[1] Training has been improved, focusing on customers' needs and increasing the responsibility of higher-end techs. Measurements were changed. A key measure of efficiency had been "handle time" per call. A representative could decrease his handle time, by transferring a call to another representative. At Dell's worst, more than 7,000 of the 400,000 customers calling each week suffered transfers more than seven times. The overall transfer rate hit 45 percent of total calls.

The Bottom-Up approach is primarily based on customer contacts. Customers' expectations are collected over a period of time and used as a basis for the organization's forecast. Not only does this introduce the potential influence of traits such as optimism, but the risk that the objectives of some of your customers may not be the same as yours. It is usually in a customer's best interest to have more products or raw materials available. This provides scheduling flexibility, as well as overall lower cost. This can be particularly important if it takes time for suppliers to ramp-up production. Customers' sales forecasts are subject to an optimistic bias.

The potential problems associated with both of these traditional approaches necessitate analytical assistance in forecasting sales. I know that for many financial professionals, getting involved with sales projections or planning can be uncomfortable. However, let us begin to address what analytical techniques can do. Go back to chapter 4—Exercise 4-1. In that case, the group

[1] *BusinessWeek* 10/29/07.

attempted to identify the variables that could impact next year's auto sales. If changes in costs and Balance Sheet Accounts can be modeled, why not sales?

Approach sales data the same as any other data. Go to chapter 2 regarding the use of graphing, moving averages, exponential smoothing and time series analysis, as well as the techniques discussed earlier in this chapter. After gaining insights into the data, you will be better able to construct higher level models to support the organization's forecasting efforts.

Determine what variable(s) are used, in your organization, to forecast sales. Use the same tools previously outlined, do you see a strong relationship? Might other factors be important? While you should start with a simple regression model, it is likely to expand into a more complex (multiple regression model). While costs and other factors *may* also require multiple variables, sales *frequently* do.

Begin this process in a similar fashion to the simple model. Look for variables that explain sales and test them. There is one significant difference. As you add variables, make sure that they are not related (correlated) to each other, for example, Disposal Personal Income and Gross Domestic Product. By adding related variables you will get a false R-squared (too high). This potential problem is called multicollinearity. If you have questions about the correlation between variables test them against each other. If a high correlation coefficient results, toss the least related variable. Continue with this process of elimination.

By using this type of systematic approach you may add discipline to sales forecasts, which often drives the entire budgeting process. It is also a means to expand the use of scientific methods throughout the organization.

Let us quickly review an actual scenario, which I have simplified. A friend of mine owns a company that sells floor and wall coverings. It includes a retail outlet and a production facility, as well as available outsourced production capacity. The latter is used for extra capacity, and for products his plant cannot make.

Each year, he forecasts sales for the next 12 and 24 months. Over the past several years, he believes sales have been closely related to new housing construction in the region. Forecasting a slowdown in new construction for the upcoming year, he reduced production and elected the lower-end of his external production contract. Although the slowdown occurred, his volume has not fallen to the same extent. Now he fears his sales will be constrained by capacity, or at least his costs will increase as he ramps-up. What might be the cause? Pause here and do not go further until you have thought about the situation.

First, my friend did several things well. He understood a driving force in demand (construction). Also, new home builders were much more optimistic about the outlook for new construction. He was right not to be overly influenced by their optimism. However, he didn't look deep enough. In reality, he has two markets—new construction and upgrades. The second is comprised of weekend warriors, contractors doing alterations and investors with rental properties. As people stay in their homes longer, demand in these areas increases. In fact, the longer they remain in their current homes the greater the demand. Although new construction is the primary activity driving sales, this second market is significant. Its importance had been hidden by a robust housing market. A single regression of new construction and his company's sales would have helped to demonstrate this relationship.

$$y = a + bx$$

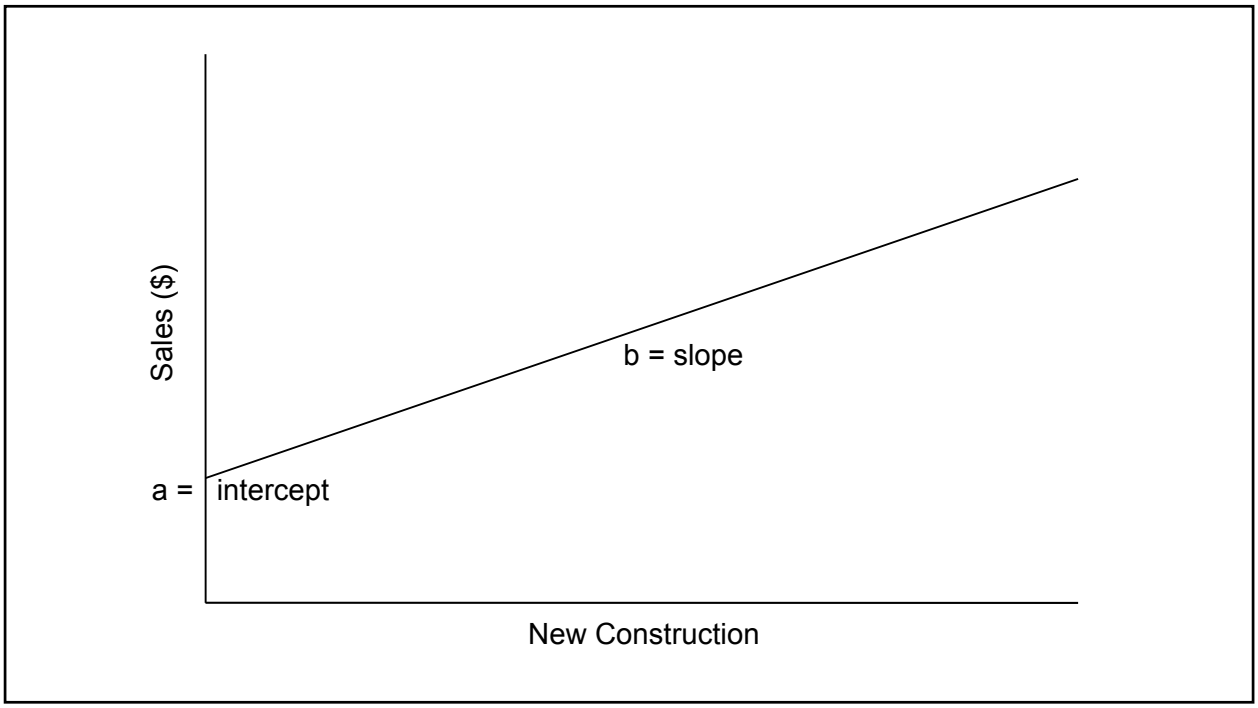
Where

a = fixed demand
b = slope
x = new construction (units)

In figure 5-4, the intercept (a) estimates the fixed demand (existing homes). As noted, over time this intercept would probably move upward to some degree.

The slope (b) indicates the average sales dollars per new construction unit.

Figure 5-4: Sample Regression Analysis



By performing a regression analysis of total sales and new construction units the general equation ($y = a + bx$) produces the following results:

Expected sales (y) = 202,000 + 5,230 (new units)

Fixed demand (a) = $202,000

Revenue per new construction unit (b) = $5,230

Although the above example has been simplified, it demonstrates several factors. First, it provides the level of demand from existing homes. This is valuable for estimating total sales, and can be helpful in planning specific product demand. In addition, since the slope (b) estimates the average revenue from each new construction unit, it can be used to forecast total revenue, as well as monitoring changes in market share. All other factors being constant, changes in the average may indicate changes in market share, as potential customers select among this store and others.

Dow Jones Index Versus Home Runs

To date, we have limited the measurement of fit to a selected group of key indicators. Let us consider a problem given to me when I was working toward my MBA degree.

The Professor had performed a regression using the Dow Jones Index and the number of home runs hit by the NY Mets during that summer semester. The R-squared, using weekly data, was .85. Did that mean if you tracked one of the variables the other could be forecast, .85 is pretty high? Were Met players or fans big stock investors? If so, which was the independent variable: home runs or the stock market?

Later in this chapter, we will discuss other measurements that assist in identifying chance or random events. Remember, events are sometimes random—always use judgment.

Regression Model—Example

Let us look at a slightly more complex model. This will demonstrate that even this level of analysis is reasonably easy to use in the real world. Also, it can provide insights into a number of areas that otherwise might stay hidden.

A trucking company (ABC) has been changing the way it handles cargo at one of its four depots. After three years, management has decided to change the other locations to match the "test site." Prior to undertaking this effort, management has asked you to conduct a final review and recommend the conversion.

The data listed below shows the number of tons transported from the test depot, by month, during the past three years, as well as the costs management has used to come to their conclusion. What do you notice from a brief review of the data? For this analysis assume the price you receive (charge customers) is the same for each ton loaded or transported.

Summary of Loading Platform Operations

Tons Loaded

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	1148.0	840.0	812.0	544.0	561.0	595.0	620.0	660.0	720.0	945.0	1190.0	1365.0
2	1239.8	907.2	877.0	587.5	605.9	642.6	669.6	712.8	777.6	1020.6	1285.2	1474.2
3	1314.2	961.6	929.6	622.8	642.3	681.1	709.8	755.6	824.2	1081.8	1362.3	1562.7

Unit Cost

1	$28.35	$29.02	$29.15	$33.51	$33.32	$33.02	$32.81	$32.60	$32.05	$28.89	$28.31	$27.97
2	28.29	29.12	29.13	33.20	32.96	32.78	32.61	32.28	32.01	28.76	28.25	27.92
3	28.18	29.09	29.11	33.05	32.80	32.71	32.31	32.10	31.15	28.55	28.16	27.05

A few things become obvious:

- Volume has increased each year.
- Volume is seasonal, with a slow period during April through September.
- Unit cost has declined in each year.

Volumes do not appear cyclical, based on the available data. However, since you know the organization's activities, you are aware that volumes are related to the Gross Domestic Product (GDP). Therefore, you assume that during a down-cycle, volumes will decline (cyclical). You then calculate the average tons moved per month for each year. You notice that volumes grew 8 percent in Year 2 and 6 percent in Year 3.

Based on your observations you decide to build a model to exam the data further. The goal of the model is to enable you to forecast future costs and to isolate changes in the composition of the costs during the past three years.

Since the output will be unit cost, you expect that the cost curve will not be linear. Unit cost is made-up of fixed and variable costs. Therefore, with each unit produced, the amount of fixed cost declines, moving toward, but never reaching zero. Thus, the curve will have a somewhat hyperbolic shape. Your software will help you select the correct curve, but "reason-it-out" prior to getting into constructing the model.

Multiple Regression Analysis

Multiple regression is used to develop models for more complex relationships. In these situations, the dependent variable (y) is forecast based on its relationship with more than one independent variable (x). The equation below represents a typical linear multiple regression.

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 \ldots + b_nx_n$$

y = Dependent variable

a or b_o = Intercept

$b_1 - b_n$ = Slope associated with each independent variable

$x_1 - x_n$ = Independent variables

The degree of relationship existing between three or more variables is called multiple correlation. The basic principle involved in problems of multiple correlation is similar to those of simple (two variables) correlation. Therefore, in the above equation, (y) varies partially because of variations in each of the independent (x) variables.

These models are used to forecast more complex costing relationships, longer term trends, sales, and so on. Go back to chapter 4 and review the number of potential independent variables in Exercise 4-1. Each of those listed, as well as perhaps others, could impact the dependent variable (car sales).

Because there is more than one independent variable, the slope (b) associated with each is called a coefficient of partial regression. These can be interpreted as the average change in the dependent variable associated with a unit change in the appropriate independent variable. For example, a slope of 3.18 for an independent variable means that for each unit change in the corresponding independent variable, there is, on average a change of 3.18 units in y (dependent variable), if the other independent variables are held constant. Therefore, the slope provides a clear indication of the degree of relation to the dependent variable.

There are a few risks associated with interpreting the output from a multiple regression model. Multicollinearity can develop resulting in an exaggerated indication of an equation's fit. This occurs from using independent variables that are highly correlated with each other. For example, attempting to forecast GDP (y) using independent variables, including total electrical production, as well as electricity produced by coal. Since coal-based production is part of the total, multi-collinearity will result.

An adjusted R-squared will be provided with the regression's output. By adding additional independent variables to an equation, the R-squared will increase. Again, indicating an exaggerated fit. The adjusted R-squared compensates for this occurrence.

When developing a multiple regression model continue to use judgment, and question the variables used and the indicated results. As with the earlier models, keep it as simple as possible. Before moving to a more complex model, attempt to address your needs with the approaches or tools discussed in the text.

Some understanding of multiple regression analysis can prove to be helpful in certain situations. Software systems are available to assist the interested user. Among them are REGRESSION in SPSS and PROC REG in the SAS Software System.

Constructing the Model—Interpreting Results

In addition to forecasting costs, the analysis can provide insights into the structure of the costs (fixed vs. variable). Unit cost can be expressed using the equation below.

$$Y = A + \frac{B}{X}$$

Where

Y = Total unit cost
A = Unit variable cost
B = Total fixed cost
X = Volume

A change to any of the equation's variables, unit variable cost (A), total fixed cost (B), or volume (X) will affect the total unit cost. In a dynamic environment any or all of the variables may be changing. Simultaneous changes can camouflage alterations in unit cost composition.

It should be noted, that the above cost data includes costs for all inputs. Since some equipment is owned and others rented, adjustments were made to the normal accounting data. For example, rental expenses have been reduced by an imputed interest expense. Thus, making rented and owned inputs comparable (no financing costs). Financing costs will become important in our conclusions.

The output of the regression model is shown below.

Years	Unit Variable Cost (*A*)	Total Fixed Cost (*B*)	Avg. Monthly Volume (*X*)	Avg. Monthly Fixed Cost	Avg. Monthly Unit Cost
1	$23.23	$5,729.12	833.3	$6.88	$30.11
2	23.45	5,890.17	900.0	6.55	30.00
3	22.97	6,443.28	954.0	6.75	29.72

The initial results show the declining total unit costs and increasing volume (already noted), but a not previously seen increasing total fixed cost. In fact, when growth slowed (Year 3) to 6 percent, unit fixed cost increased. The decline in unit variable cost in Year 3, demonstrates that variable costs are being traded for fixed costs. Now before going further, let us determine if the model does an adequate job of duplicating reality.

Shown below are resulting measures of "fit" from the regression.

Years	Coef. of Determination (R^2)	Avg. Est. Error [Unit Cost (%)]	F Ratio	P Statistic
1	0.945	0.88	76.913	0.000
2	0.945	0.79	76.848	0.000
3	0.960	1.24	108.150	0.000

The consistently very high R-squared value accompanied by the low estimating error offers strong evidence that the model has captured the relationships. The R-squared indicators that are approximately 95-96 percent of the change in costs are due to changes in volume. The small estimating error shows the tight fit of the regression curve through the actual data, therefore making it valuable as a forecasting and analysis tool.

The remaining statistical measurements (F and P) address potential problems which could hamper our use of the model (chance and multicollinearity). Remember, the earlier example using the Dow Jones Index and home runs by the NY Mets. We need to assure ourselves that the fit, even as good as it appears, is not by chance. The F ratio or value tests if the outcome of the model could be related to chance. The results need to be compared to tables indicating significant (probability that the outcome is not a chance occurrence) F values. The Significant – F is normally provided, for comparison, in the regression output. For this analysis, the F far exceeded those needed for any level of assurance. Thus concluding, the relationships were statistically significant and not by chance.

P provides a further check on the significance of the outcome. The smaller the P value the higher the confidence level. The high R-squared, F ratio and zero P values (residual of 1-P = probability of statistical significance; 1 = 100%) provides significant evidence that there is a strong relationship between the variables that is not a result of chance.

Now that we have confidence in the analysis, what can we conclude from the model's result?

- Volumes are seasonal and cyclical.
- Lower costs have resulted from volume increases and a move to increased fixed costs.
- If debt had been used for new equipment or facilities, costs are even more fixed than shown.

- At growth below 8 percent, unit fixed costs increase.

Your organization may want to reconsider the transition of all their locations. If growth slows or flattens (Business Cycle), the organization could be in for a tough financial period.

To further support the findings, we could graph the curve resulting from the regression equation for each year. This would demonstrate that for all volume levels experienced in year 1, it cost more to move a ton of payload during years 2 and 3 than in year 1. The curves for years 2 and 3 intersect at a volume of 1,152.3 tons. Therefore, at greater volumes unit cost during year 3 was lower than year 2. But, only at volumes above the intersect. Participants are encouraged to take time and plot the curves. The equations below are provided to demonstrate the point of intersection for years 2 and 3.

$$Y = A + \frac{B}{X}$$

$$\text{Year 2} = Y = \$23.45 + \$5{,}890.17/X$$

$$\text{Year 3} = Y = \$22.97 + \$6{,}443.28/X$$

$$O = 0.48 + 1/X\,(-553.11)$$

$$X = 553.11/0.48 = 1{,}152.3$$

$$X = 1.152.3 \text{ tons}, Y = \$23.45 + \$5.11$$

$$Y = \$28.56$$

Chapter 6

Improving Accounting Information and Analysis

Introduction

This chapter continues to introduce new management and statistical tools for decision making. In addition, it draws from earlier chapters, by demonstrating expanded uses of several statistical techniques.

Significant time is spent discussing how to begin to modify a traditional accounting function, by introducing concepts from Lean or Activity Based Costing (ABC). The results should provide improved measurements, reduced paperwork, expanded participation, and an early warning system to detect future problems. Make sure you take time to do Exercise 6-1.

This chapter will

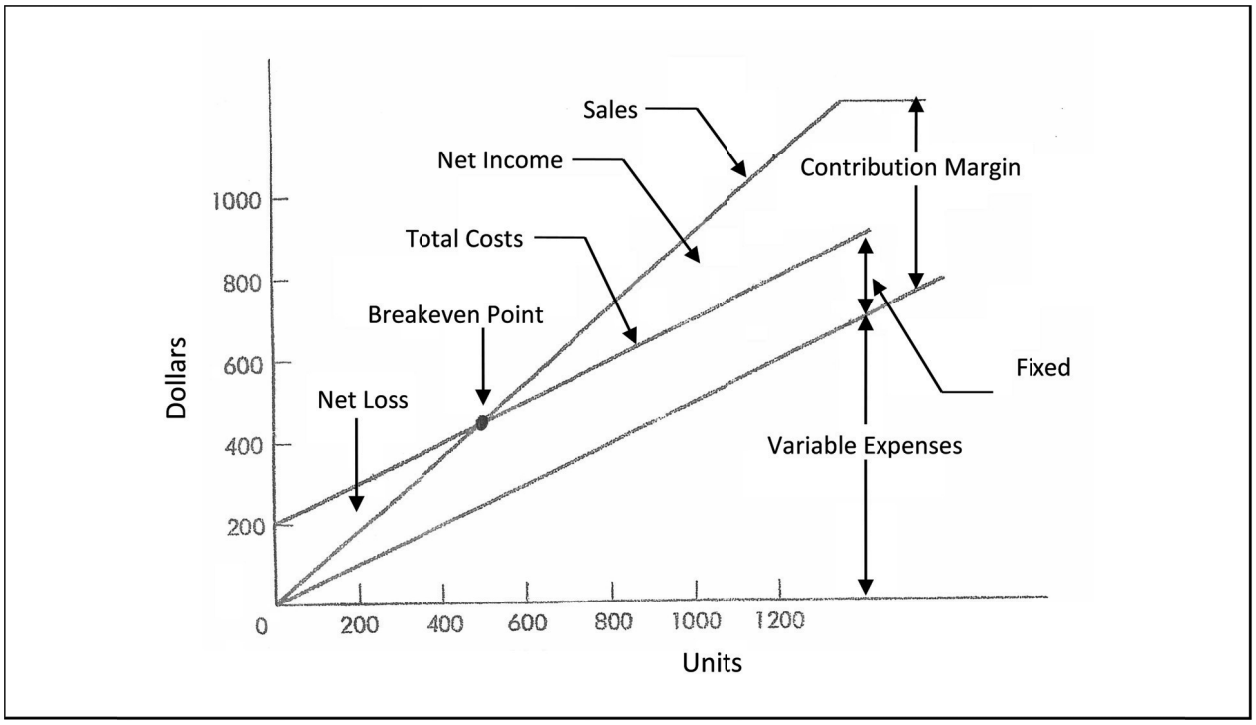
- Demonstrate the use of breakeven analysis.
- Outline an approach for introducing basic concepts of Lean and ABC into the traditional accounting function.
- Introduce the use of a Balance Scorecard and several other techniques for goal setting and reporting.
- Explore the uses of Life Cycle Analysis and Z-Score to identify future failures.

Breakeven Analysis

Breakeven analysis provides a measurement of the relationships among cost, volume, and profit. The actual breakeven point is frequently incidental in the analysis. The focus is normally placed upon the changes in income due to decisions affecting sales and costs. Figure 6-1 provides a graphic example of such an analysis.

Obviously, the breakeven point is where sales revenues equal all costs (fixed and variable). The above contribution margin indicates the amount of revenue in excess of variable costs. While it cannot be a successful long-term strategy, often when a business is faced with excess capacity and relatively high fixed costs, it will choose to price incremental production or sales at a level covering all variable and a portion of fixed costs. The practice is as widespread as: airlines, resorts, movie theaters, and so on. This is known as “making a contribution to fixed cost.”

Figure 6-1: Sample Breakeven Analysis



Assumptions

Before further discussing the uses of this tool, let us review some key underlying assumptions.

- Costs can be divided into fixed and variable.
- Fixed costs remain fixed over a significant relevant range.
- Costs can be modeled by a linear curve.
- Input costs remain unchanged.
- Management knows its market(s) and their ability to sell products over a relevant range.
- Analysis covers either a single product or stationary product mix.
- Inventory changes are insignificant.

Uses

Breakeven analysis is a simple technique for reporting actual results, as well as versus budgets or plans. As noted previously, it is often easier to see relationships graphically than via a table of data. It also aids in showing cost composition (fixed and variable). A standard accounting report may not do this as well. Long-term breakeven analysis can assist in summarizing operating conditions relating to planned capital expenditures.

Use the tools demonstrated in earlier chapters to identify current fixed and variable costs. In addition, they will enable you to measure the impact management decisions have had, or will

have, on costs. By blending these tools (two-point plots, regression and breakeven analysis) you can develop a dynamic approach which can be used for decision making and reporting.

Linear programming can also be applied to breakeven analysis. For situations when organizations produce multi-products or a variable product mix, linear programming can enable the user to identify multiple breakeven points.

Applying the Basics of Lean to the Accounting Function

In concept, Lean is fairly easy to describe, but often difficult to practice. It requires a mindset change, often including abandoning long-held paradigms. Lean is customer-focused with a bias toward continuous improvement. Therefore, over time, tasks will change, including providing information for decision making.

Hopefully, by now, the reader understands that a magical "TO DO LIST," to solve any problem, cannot be compiled. However, as with other improvement processes, we can question existing practices and establish a framework to provide guidelines for the future.

Structure—A Delivery System

Within any organization everyone is a supplier to some customer, and everyone is also a customer to some supplier. Therefore, the role model for relationships in a Lean System is one-to-one. This reduces the chance for misunderstandings, focuses on needs (value-added) and speeds the implementation process.

It can be expected, that the amount of time and effort spent in activities commonly referred to as *politicking* are inversely related to the strength and clarity of an organization's structure. Activities such as "empire building" and "protecting yourself" from various power groups within an organization are not only a waste of time, and therefore resources, but are destructive. For an organization to successfully implement plans and attain its goals, a clear structure must exist in which people understand their own, as well as others' authority and responsibilities.

When establishing or reviewing an organization, it may be helpful to think of its structure as a large delivery system for goods and services which begins from within the organization (internal customers) and ultimately leads to external customers. In the past, competitive advantage was gained by technology. In the future, speed is likely to be a major source of competitive advantage in designing and manufacturing new products, as well as delivering them in a timely manner to customers. As "just-in-time" systems grow, the organization which can repeatedly deliver a quality product will build a major competitive advantage versus its current competition, and a barrier to entry against potential new competitors.

Technology can be acquired or copied by competitors, but a culture that simplifies communications and increases speed can take years to acquire, if at all. This is a real competitive edge. For example, many organizations have attempted to copy the Toyota Production System by drawing upon numerous sources of information including visits to Toyota plants, literature, by people with first-hand experience, and consultants. Even those having made measurable progress would admit they are still students, and implementation was more difficult and early results bumpier than anticipated.

Successfully incorporating such a culture provides the organization with the most powerful competitive position: increasing overall quality and decreasing costs by a means which cannot easily be copied. Structure is a vital part in developing and maintaining this position.

Given the acknowledged role of speed as a means of competition in the future, a considerable amount has been written about generic structures such as flat versus tall organizations. Flatter organizations offer several advantages. Only a part, often a relatively small part, results from the reduced compensation cost. Fewer layers force management to be more selective regarding where they concentrate their efforts. This helps to focus on areas with the greatest payback and reduces or eliminates less important tasks. Also, the nonproductive efforts of "protecting or expanding one's empire" by adding staff are curtailed. By reducing staff and management layers, organizations are less likely to get caught up in a syndrome known as "paralysis from analysis," that is, to make excuses for delaying decisions far too long while analyzing "potential alternative actions."

Project Versus Process

The primary task of a CPA is to protect the assets of their organization. This can lead to a series of internal controls which stress "precision," at the expense of timeliness, and result in excess paperwork.

We often measure those things which are easiest and take measurements after-the-fact. Remember, a fire siren never puts out a fire. But a siren warning of an oncoming severe storm does save lives and property.

In general, we have been trained to view work as a series of projects. That is, things have a start, middle and end. This is true in most business activities. The concept of mass production, which is a basis for much of our individual training, demonstrates several of these characteristics:

- Long production runs
- Similar products-no or limited variations
- Produce to sell or inventory

At the end of a production run we change to a new product and start again.

The Toyota Production System (Lean System) looks at the same situation differently:

- Short production runs
- Variety of products
- Produce
    - What is needed
    - When needed
    - Amount needed

The difference could be summarized as viewing production as a project (mass production) versus a process (Lean System).

For a moment think about the average American's private life. Many of us have been on a series of diets over much of our lives. Once our weight hits an outer acceptable limit, or worse, we take on the project of losing weight. Even it we are "successful" and reach our target, how often do we slip back, gain weight, and repeat the events? This is a project. Wouldn't it be easier and better for us to lose the weight slowly, change our lifestyle and keep it off? This is a process.

Now let us look at our business lives. How many organizations have announced cost reduction plans with targeted savings? They always seem to achieve their stated goals, but a few years later many of these organizations announce a new cost savings plan – which is again successful. Why? Often, over time, some of the previous gains are lost. This is a series of diets, not a lifestyle change. Perhaps, management is measuring the wrong items? We manage what we measure. Therefore, if we measure the wrong things, we can work hard and became very good at relatively unimportant (non-value-adding) activities. How does your organization approach the closing process, budgeting, planning, and reporting? Is it a project or process? The grid below outlines the core differences between project and process.

Project	**Process**
• Start • Middle • End	• Ongoing • Adapts to needs
Examples: Diet, traditional cost reduction program, mass production	*Examples*: Lifestyle change, learning, production on demand (JIT)

Too often, reports or controls focus on reporting variances from: prior periods, budgets or forecasts. However, the existence of a variance often provides little actionable information. For example, higher raw material costs, while resulting in an unfavorable variance, may lead management to the wrong conclusion. The variance does not mean the purchasing or production departments are failing to perform. Perhaps it results from a market shortage of the product or unnecessarily tight specifications. It could, however, be due to poor purchasing practices or lower production yields. Different causes result in the same variance.

Take an unscientific, but revealing, poll of financial professionals you know. Ask what activities consume the largest amount of their department's resources? Typically – closings, reporting, and budgeting or planning are at the top of the list. Now ask, what role these activities play in helping the overall organization achieve its goals? Do these activities successfully allocate resources and provide a system for control and improvement (?), or do they result in a large amount of reports and variance summaries? The areas which consume a major portion of our resources must generate major improvements. If an analysis results only in the collection of data, without playing an integral part in decision making, it is a waste of resources.

Exercise 6-1

An interesting exercise is to review how companies describe themselves in public reports and in recapping recent significant events. Reviewing Annual Reports and other published information for the last several years, of a number of organizations, will show the programs management thought were important and their outcomes. This may provide insights into management's commitment to its stated strategy(ies) or programs, as well as their reaction to changes in the environment. This exercise also helps to reflect upon your own organization.

Make a list of key programs in your organization. Does this review reflect a project or process view?

Traditional Accounting Practices and ABC

Activity Based Costing (ABC) is built upon a simple relationship.

Activities Consume Resources and Resources Have a Cost.

Therefore, the process seeks to assign costs based on the resources consumed by an activity. In an organization producing a series of products (goods or services) costs, in a traditional accounting system, can become "blended," thus providing incorrect information to management. This can be especially likely when by-or co-products are being produced.

The primary objective of ABC is to divide indirect activities into representative pools of costs. The pools can then be more accurately assigned to activities. For example, when expanding production, by introducing a new product, at an existing facility, do not automatically allocate costs based on total volume. Despite a general level of excess capacity, the new product may require some extra processing steps. These costs must be applied to the product. Otherwise, the existing product will absorb a portion of the costs. This can easily lead to a situation where management makes poor asset allocation or pricing decisions.

ABC attempts to uncover the casual factors (cost driver) which determine the demand for each overhead activity. Since costs are based on activity, they are not necessarily confined to a single department. Actual ABC systems are rare in practice, both due to the time required and the need of traditional systems. However, we can improve routine information by adapting viable concepts, and using selected techniques for decision making.

There are a number of valid accounting techniques which, if practiced incorrectly, can have significant negative impacts. While I do not expect the reader immediately to change or challenge all his organization's policies, this may begin the questioning process. Questioning is the first step to improvement.

Much of cost accounting, as we know it, started in the early 20th century. During that period, it was normal for materials and direct labor for a production facility to each average around 40 percent of total cost. The remaining cost (20 percent) was more difficult to measure or track by product. Therefore, allocation techniques were developed to spread those via the identified costs.

Remember, products were homogeneous and the majority of labor costs were for what has become known as “make and move” activities. The majority of employees today are considered “knowledge workers,” and product lines and associated activities have become extremely diverse.

It is worth remembering, that although accounting practices are continuously reviewed and revised the world has, and continues to change at an increasing rate.

- Service sector growth.
- Technology.
- Globalization.
- Environmental concerns.

These, and other forces, have resulted in a rapid increase in indirect costs, and an explosion in the number of products offered. As a result, direct costs can be used in a traditional system to allocate a larger, and growing, indirect cost pool. Obviously, this can result in poor measurements and decisions.

The reporting systems of a number of organizations have not caught up with today’s environment. The invalid use of the practices below, especially if combined with a compensation system, can create an environment where employees spend time “gaming” the system rather than improving it. Let us focus on three valid practices which deserve extra attention.

ALLOCATIONS

While it may be helpful to allocate a number of shared costs, it can distort measurements. In a perfect world, there would not be any allocations. All costs would be assigned based on the resources consumed by an activity. Be careful with the costs you allocate. Do not hold people responsible for allocated costs they cannot control. This not only destroys the usefulness of the measurement, but creates a nonproductive environment.

Remember, you cannot manage what you do not measure. A poor measurement will assist management in making poor or incorrect decisions.

STANDARDS

Standards can be very helpful both as measurements and in streamlining recurring activities, such as financial closings. However, unless they are carefully established, standards can help maintain the status quo and built-in waste. Standards must be constructed from a zero base. Beginning from actual past data can incorporate existing waste into the measuring system. Existing inefficiencies can be passed along via standards. Longer term, a false sense of security is a serious enemy.

INTERNAL TRANSFER PRICING

Internal transfer pricing, attempts to measure value-added at specific spots in the production process. While the intention is valid, this practice can consume considerable time and energy, as

well as create an overly competitive internal environment. Remember, no organization ever made a profit selling to itself. Go back to chapter 3 and review the Theory of Constraints.

Internal pricing can lead to an environment which creates internal conflict. It is often aimed at maximizing output at each unit throughout a company. Thereby, it may reduce overall efficiency, due to potential imbalances in the organization. Focus your organization's competitive forces versus its actual competitors. If your organization uses this process, be careful.

You are probably trying to measure value-added for a partially developed product or service that does not have an actual market value. Reconsider the appropriateness of your measurement. Lean keeps you focused on the actual market or completed product.

Beginning Steps to Lean

The purpose of this discussion is not to provide the reader with the 5S's of Lean or a list of categories of waste, but to help him or her to begin to focus on how Lean can impact accounting or measurement practices. The tools discussed earlier – mapping, Pareto analysis, target costing, and so on, can help you in your transition. A few steps to be considered include the following:

- Train personnel as to the basics of Lean and what you plan to accomplish.
- Standardize all activities.
- Eliminate variations in activities; strive for a steady state environment.
- Reduce the number of transactions.
- Consolidate or eliminate the number of reports.
- Focus measurements on key issues or areas.
- Provide decision making information – timely and accurate.
- Reassign resources to highest value-added activities.
- Continuously streamline the organization focus, use of technology, and so on.

Establishing Targets

Historically, management may have seen information regarding production, costs, market share, efficiency, and overall financial results as their property. However, if we think about other organizations we belong to such as clubs, community groups, charities, and so on, it becomes clear that people cannot follow goals of which they are not aware. Nor can they make improvements in product quality or costs without sharing sufficient data for them to understand the situation. As members of these other organizations, we take for granted our ability to have access to information. Yet, this may not be as true in the business arena.

These groups are also considerably better than the average business organization at communicating goals, both in measuring and reporting them to members. Charities routinely breakdown what a contribution can purchase – units of meals, medicine, clothing, shelter, and so on. In businesses, we often state goals in terms of total dollars or a percentage of expenditures to

be saved. Can you visualize a goal of saving $1 billion? Probably not. So how can this motivate an employee? It cannot!

For a goal to be valuable it cannot represent a wish or desire, nor can it be the result of an organization attaining its objective. A goal must result in directing action. Therefore, those trying to achieve it must be able to visualize the goal and see it as achievable.

It is vital that a limited number of measurements are used to monitor activities, thus focusing attention on key items. By employing the statistical techniques discussed in chapters 2 and 4, the user can often significantly reduce the number of items (variances) which require attention. Variances that are not statistically significant should not be allowed to create clutter which requires time and resources to address. Go back to the various measurement techniques in chapter 2 (arithmetic averages, weighted average, median, mode, moving average, and so on) and the statistical tests, especially estimating error, incorporated in regression analysis (chapter 4). Refer to these tools as you develop targets and measurements.

Balanced Scorecard

It is only by establishing standards that variations in the organization's process can be eliminated. This is essential for improvement. Improvements cannot be made if a baseline of performance is not established. Variation adds noise to the measurement process.

The first step is to identify key potential measurements. Earlier sections began to provide the basis for this selection process. Remember, we want to routinely capture data that measures where we are, and are going. The next step is to provide this information to those who need it. This is usually further down in the organization than most managers initially think.

To assure that problems are discovered and addressed quickly, controls must be built into the process. This requires sharing information and responsibility or authority. Access to measurements helps the individual better understand the direct impact his activities have on achieving goals. Obviously, all information cannot be shared equally throughout the organization. But, to the degree data is available, it will help to focus peoples' efforts on key areas.

If the reporting or control system becomes overly bureaucratic, you are likely to lose, via reduced performance, more than you gain. It is essential that you measure activities which are significant to the organization. To do this, the system needs to include both financial and nonfinancial information, as well as leading and lagging indicators.

Leading indicators forecast where the organization is going, while lagging indicators confirm where it is or has been. Example – market share is a leading indicator, while ROI is a lagging. As noted by Robert G. Eccles in his article *The Performance Manifesto*, "tracking measurements such as quality and market share is one thing. But giving them equal or even greater status in determining strategy, promotions, bonuses and other rewards is another." A successful measurement system must be trusted.

For an organization to provide the correct signals, it must have a clear view of its goals and the necessary steps to achieve them. This overall view is then broken down into discrete activities for all levels within the organization. The process is often complicated by the fact that most large

organizations have more than a single business unit. Each will have a series of goals which can be quite different and require specific compensation schemes.

While each industry or organization will have differences regarding what is important, outlined below are examples. The basis of this technique is taken from work by Professors Kaplan and Norton in developing The Balanced Scorecard. This approach helps to relate key measures, both financial and nonfinancial, to the organization's goals. It identifies those select indicators that are directly tied to the success or failure of the enterprise. Thus, it focuses management's attention (from all disciplines), on what has been previously agreed to be essential for success.

The Measures are to be aimed specifically at the organization and its industry. However, the Areas of Performance should be treated as fixed, as they focus attention on the four key areas for any organization – Financial, Customers, Efficiency, and Learning or Innovation. The actual measurements selected in each area need to be linked to the organization's overall financial objectives.

Reports must clearly link performance results with the organizational processes that drive results. Let us return to the example of Dell's experience in customer service through its call-centers. The measure of "handle time" resulted in poor customer service, as a high percentage of customers were transferred without being helped. However, the relocation of the call-centers and reduced staffing resulted in the targeted cost savings. Cost savings are measured every day. Therefore, short-term feedback to management was positive. Longer term, as businesses and individuals purchased new equipment the impact of poor service was seen in lost market share. Management can be unaware of a serious problem if it does not measure the right activities.

As previously noted, the transfer rate for customers hit a high of 45 percent under the above system. Dell's management replaced "handle time" with "minutes per resolution" as a key measurement. This action, with the necessary training dropped the transfer rate to 18 percent. Today, the mantra is "resolve in one call." As a benchmark, Apple claims to resolve 90 percent of customer problems in one call.

Examples of Performance Measures	
Areas of Performance	**Possible Measures**
Financial	Cash Flow Quarterly sales growth Earnings ROE, ROI, ROA Shareholder value
Customer Relations or Market	Market share Percent of sales from new products On-time delivery Customer base
Efficiency	Productivity New products—time to market Yield
Learning or Innovation	Quality improvements Development of new products Number of patents New product launches

The Balanced Scorecard was developed as a bridge between an organization's budget and its strategic plan. However, it can be equally successful as a tool to introduce strategic thinking or planning into a company. The development of a Scorecard forces management to identify the organization's vital activities and routinely measure them versus established goals. It also can be used to reduce the number of reports and "measurements" being produced. Thus, it provides increased focus.

Economic Value Added

EVA attempts to measure the economic results due to the organization's operations for a specific period of time. It includes the cost of all capital (all invested capital × the cost of capital).

Net Operating Profit After Tax – Capital Charges = EVA

Simply stated, if you were given $100, with a borrowing cost of 5 percent, and returned $106 at the end of a year, you would have created $1. If you returned $104, you would have destroyed $1.

This measurement is typically viewed versus investors' expectations for a specific investment. EVA is calculated above or below the shareholders' expected return.

While used as a measurement, it is probably fair to state that its use has been reduced over the last few years. The aim of this measurement is to reduce the capital used, as well as to focus it on higher returning projects. Care needs to be taken when using EVA not to make false comparisons between or among groups, divisions, or companies. Organizations at different points in their life cycle and those in transition may show poor short-term EVA results when compared to other organizations. Age of capital assets can also skew results.

EVA can be a useful measurement tool, when used as designed and it focuses on the cost or use of capital. However, EVA is typically less applicable to new firms and turnarounds then established firms with long-term data to analyze. It is often valuable to remind an organization's management, at various levels, that the resources they are using have a real capital cost.

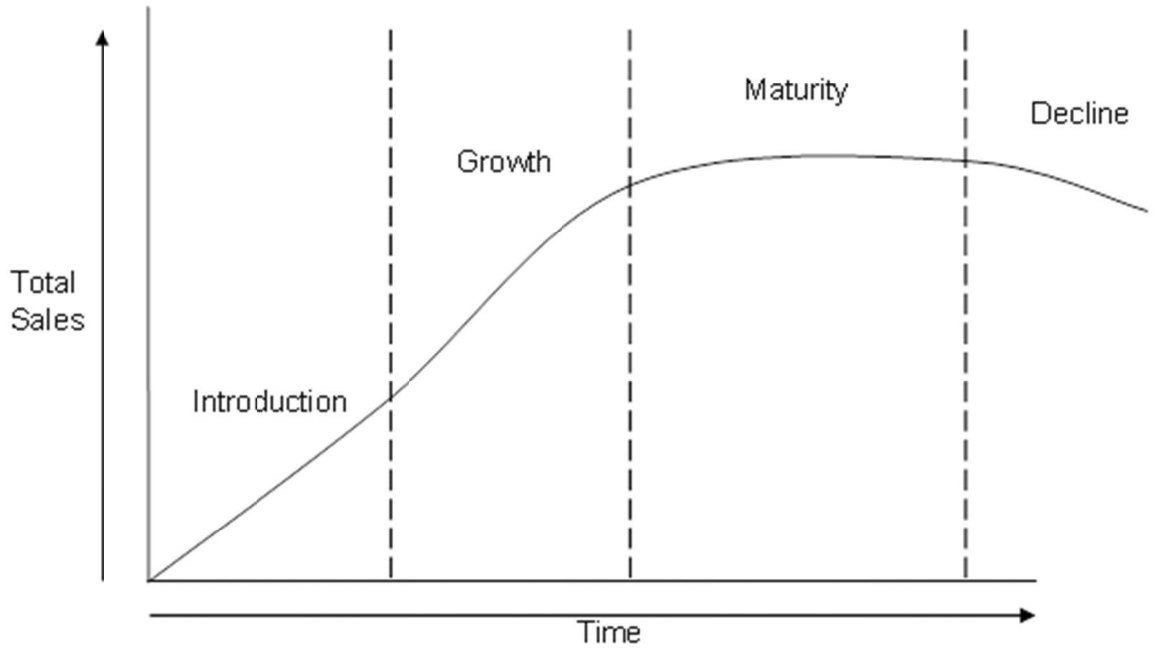
Identifying Future Failures

The globalization of the overall economy has increased the need to continually focus on our organization's future. Too often, managements appear to be caught by surprise by changes in their competitive position. The later management recognizes the problem, the more limited are its potential responses. It is of no value to tell someone they must increase sales or cut costs "overnight" to save the company. The following sections provide guidelines for competitive analysis, key measures, and a model for identifying future failures.

Markets—Competitive Forces

Markets are dynamic, and therefore are constantly in a state of change. Even if your organization has not changed any of its activities in the marketplace, the marketplace will be going through a series of changes. The typical Product Life Cycle graph (figure 6-2) traces the stages of a product from its introduction through market saturation and decline. Such a graph tends to make us think of this process as gradual, and one in which it is easy to identify the particular point in the cycle any product is currently at. Unfortunately, nothing could be further from the truth.

Figure 6-2: Typical Product Life Cycle Graph



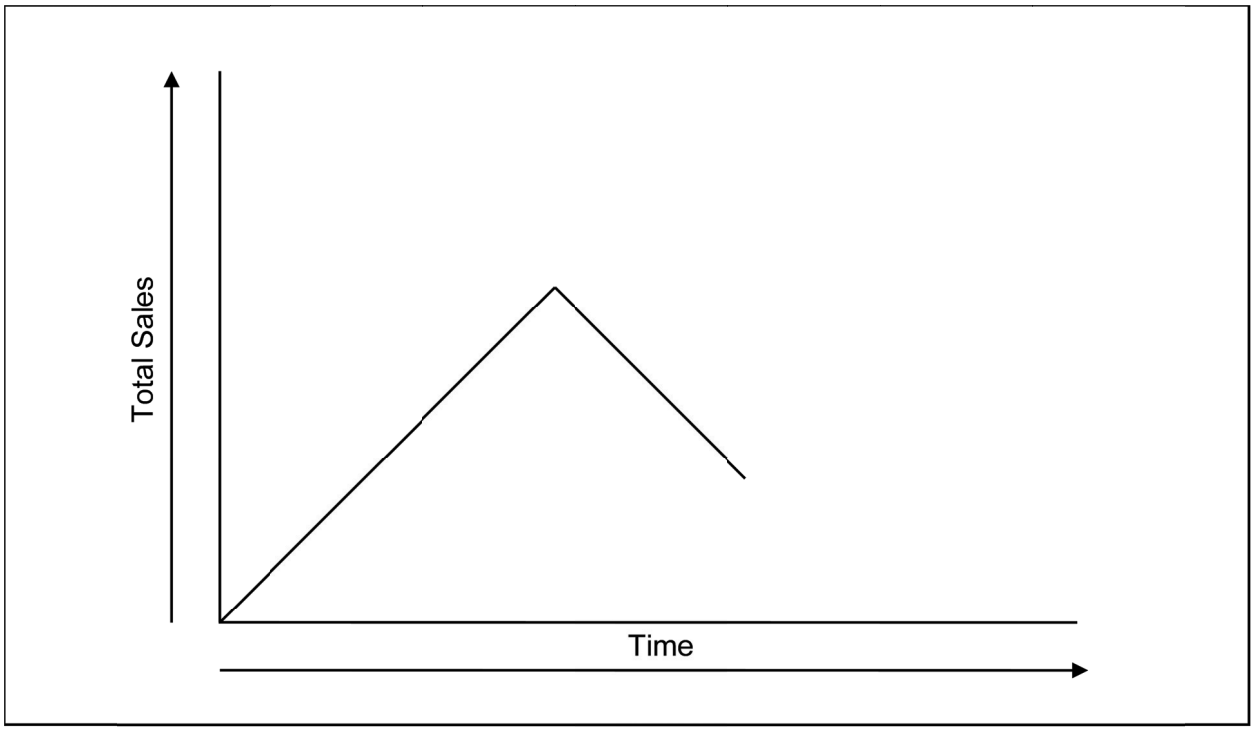
As a result of the increasingly global marketplace, the time between product introduction to saturation has been significantly shortened for a wide range of products. Furthermore, as competitors enter markets faster, pricing pressures can stop a producer from achieving either sufficient margins or market share. Figure 6-3 on the following page outlines a shift from the typical product life cycle (figure 6-2) to more of a global product life cycle.

Despite articles and books to the contrary, products normally move to become commodities. This process has been accelerated. Test it yourself. How much did you pay for a calculator, laptop, clothes, furniture, or a television several years ago? How about today for a comparable or even better product?

Recognizing where a product is in its life cycle is not always easy, for example, the history of the home video game industry. This industry ran through the introduction and growth stages of the cycle very quickly with the entry of new competitors into the marketplace throughout this period. As the market reached maturity, competitors dropped out and, within a relatively brief period, the market had hit saturation – leading to strong price competition among the survivors.

More recently, improved technology has enabled the current players, including new entries, to move the primary battleground from price to quality. This established a new basis for competition, with added emphasis on visual quality, marketing and advertising, and speed to market of new offerings. Even if you had survived the first wave of company exits, if you remained focused solely on costs, your organization would have been gone shortly thereafter.

Figure 6-3: Global Product Life Cycle Graph



Despite the rapid initial growth followed by consolidation, a redefinition of the product, brought about by a quantum jump in technology, gave birth to a new version, or an extension, of the original industry. Today's video games have become a core part of the entertainment industry. More than half of American households have some version of a game machine. Microsoft's recent introduction of "Halo 3" had first-day sales of $170 million. This is greater than any movie opening in history.

As a result of several factors, including changes in lifestyle and consumer tastes, new businesses can result from a product which has hit maturity or even market saturation. Dress jeans and sport shoes are extensions of such mature products as blue jeans and sneakers. Also, dying product lines or so-called ghost brands can often be revitalized by a change of strategy ranging from pricing, merchandising, advertising, packing, or focusing on selected geographic areas.

Failure to identify where a product is located in its life cycle and when the battlefield has changed, can lead to serious errors. If management believes a product is in its growth phase, when in reality it is in its early stages of maturity, management may elect to expand capacity and add personnel to meet anticipated growth. In such a case, the organization can spend funds through what should be the cash generating years of that product, thereby committing further resources in the false search of growth. Conversely, if management is unable to identify a product's growth stage, it can freeze capacity and take actions to retrench its position, thus allowing current or new competitors to take market share. This process can be even more complicated in large diversified organizations that are likely to simultaneously have businesses and products throughout the various stages.

Things to Watch

Pay attention to the general environment, as well as particular information about your organization or competitors.

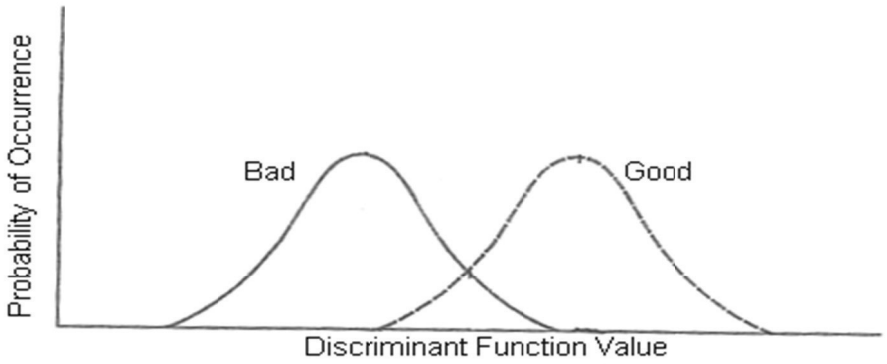
- Competitive situation – New entries, substitute products, and so on.
- Lead time for new capacity. Is anyone adding capacity? When will it hit the market?
- Costs of inputs – Labor, raw materials, and so on.
- Ability to pass cost increases to customers.
- Impact of technology on demand and costs.
- Changes in demand and inventory.
- Margins – Be careful, this measurement can lag market changes.
- Routinely review key ratios, particularly liquidity ratios to assure sufficient resources, safety-net, to address unforeseen future problems.

Discriminant Analysis—Z-Score

Discriminant analysis is a statistical tool that has been successfully used to forecast future financial problems. It has been primarily used to select creditworthy accounts or companies. The analysis is similar to regression. However, it assumes that observations come from two or more different universes. The goal is to separate the universes, for example, good (creditworthy) and bad accounts.

Figure 6-4 represents a typical graph from a discriminant analysis used to establish a company's credit policy. The actual analysis would be based on financial information (ratios or other measurements) that have historically shown a relationship with an account's ability to pay. For example, quick ratio to net worth or cash flow to debt or profit margins.

Figure 6-4: Sample Discriminant Analysis Graph



Ideally, there would not be any overlap between the two universes, therefore, the smaller the overlap area, the better the ability of the analysis to predict good versus bad accounts. This technique has been used in consumer credit and installment lending for decades. In the above graph, people or companies falling into the overlapped area would be further analyzed, in greater detail, to better assess the level of risk versus your organization's risk profile.

Professor Edward I. Altman developed the practice of using financial ratios to predict corporate bankruptcy via discriminant analysis. Based on the work of Professor Altman, and others, financial ratios have been demonstrated to be accurate forecasters of a firm's financial future. Financial ratios of failed firms differ significantly from nonfailed organizations. In addition, history demonstrates that key financial ratios deteriorate significantly in the last five years prior to a failure.

In an article in 1968, Professor Altman demonstrated the use of the Z-score measurement, developed using discriminant analysis. From the 22 financial ratios tested he selected five that demonstrated the best predicative capability. The resulting equation is shown below. Note that the variables are computed as a percent. Therefore, 15.5 percent is to be represented as 15.5, and so on.

The formula for the Z-Score is

$$Z = (1.2 \times X1) + (1.4 \times X2) + (3.3 \times X3) + (0.6 \times X4) + (0.999 \times X5)$$

Where

X1 = Working Capital/Total Assets
X2 = Retained Earnings/Total Assets
X3 = Earnings before Interest and Taxes (EBIT)/Total Assets
X4 = Market Value of Equity/Book Value of Debt
X5 = Sales/Total Assets

Compare to the following table:

Z-Score	**Probability of Bankruptcy**
1.8 or less	Very High
1.81 – 2.99	Not indicative of bankruptcy
3.0 or higher	Not likely

The above formula for public companies has been adapted to private companies. The sum of A-D is the Z-score.

Private Company Z-Score

- A = [(Current Assets – Current Liabilities)/Total Assets] × 6.56 = _____.
- B = (Retained Earnings/Total Assets) × 3.26 = _____.
- C = (Earnings before Interest. & Taxes/Total Assets) × 6.72 = _____.

- D = (Equity/Total Liabilities) × 1.05 = _____.
- The sum of (A + B + C + D) equals the Z-score.
  - 0 – 1.09 = Bankruptcy Imminent
  - 1.10 – 2.60 = Questionable
  - 2.60+ = Bankruptcy Not Imminent

The Z-score is an easy to use, predictive tool. It can be used in a variety of situations including

- Determine if an account is creditworthy.
- Internal measurement for your organization.
- Analyze large suppliers or customers.

Consider making the Z-score part of your internal measurements or reporting; if it is predictive for others, why not yourself? It provides a financial measurement, which can be easily understood by nonfinancial personnel. Focus on important suppliers and customers. A bad experience by a key supplier or customer can have a severe impact on you, particularly, if you are not prepared.

As with all ratios, the Z-score needs to be routinely performed. You are looking for trends. A firm with a current good Z-score, which in trending downward, can be of greater concern, than one with a lower, but increasing score.

While other tools have been developed to predict failure, based on discriminant analysis, the Z-score has several significant advantages:

- Long history of success
- Easy to apply
- Considerable documentation concerning its use

Chapter Summary

The tools below can assist in improving information and analysis, as well as identifying future failures:

- Breakeven analysis
- Lean concepts
- Activity Based Costing
- Balanced Scorecard
- Economic Value Added
- Product life cycle analysis
- Z-score

Chapter 7

Acquisitions and Divestitures

Introduction

This book began by addressing the fact that decisions are a result of the entire organization. Decisions are not made in a vacuum. Mergers and acquisitions (M&A) activity clearly demonstrates this. Therefore, while we have, and will continue, to focus on analytical evaluation tools and techniques, this chapter identifies the factors that significantly influence decision making and have changed the general landscape for M&A.

The activities required to successfully buy or sell and run or cut-loose a business are unique. Often, even the most experienced operating managers have very little, if any, experience in this process. As a result the consistent application of some previously discussed techniques, as well as a few new ones, can add significant value to the outcome. Dust off your detective's mindset.

This chapter will

- Establish the background and framework for managing M&A activity.
- Identify key steps in the process.
- Describe the role of in-house financial professionals in this endeavor.
- Explore valuation tools and techniques.

M&A Activity

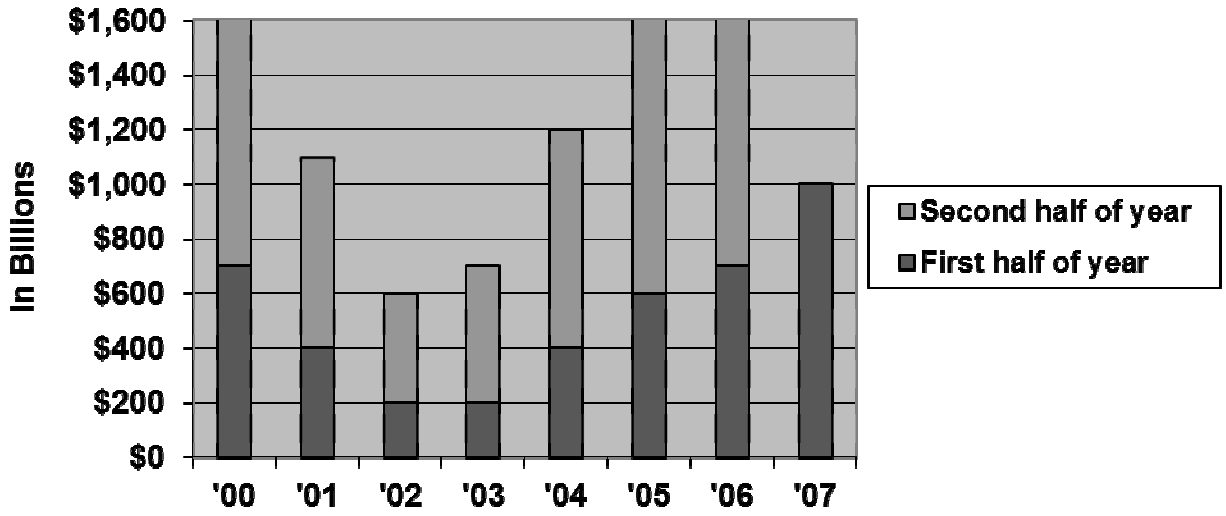
During the first six months of 2007, U.S. companies announced a record $1.01 trillion in M&A activity. High levels of liquidity from available financing expanded the role played by private equity firms and other financial buyers. According to estimates, up to one-third of all funds came from these organizations during the first six months. Of course, this activity level does not reflect the tightening of credit that began in the second-half of 2007, and worsened in 2008. Figures 7-1 and 7-2 provide indications of activity in early 2007, as well as later in the year.

The value of M&A activity in recent years has continued to increase. Global M&A transactions are estimated at $4.7 trillion in 2007, topping the prior record of $3.9 trillion in 2006. This was fueled by several trends, including

- Strengthening economy.
- Historic levels of available liquidity at low interest rates.
- Industry consolidation, typical in maturing industries.

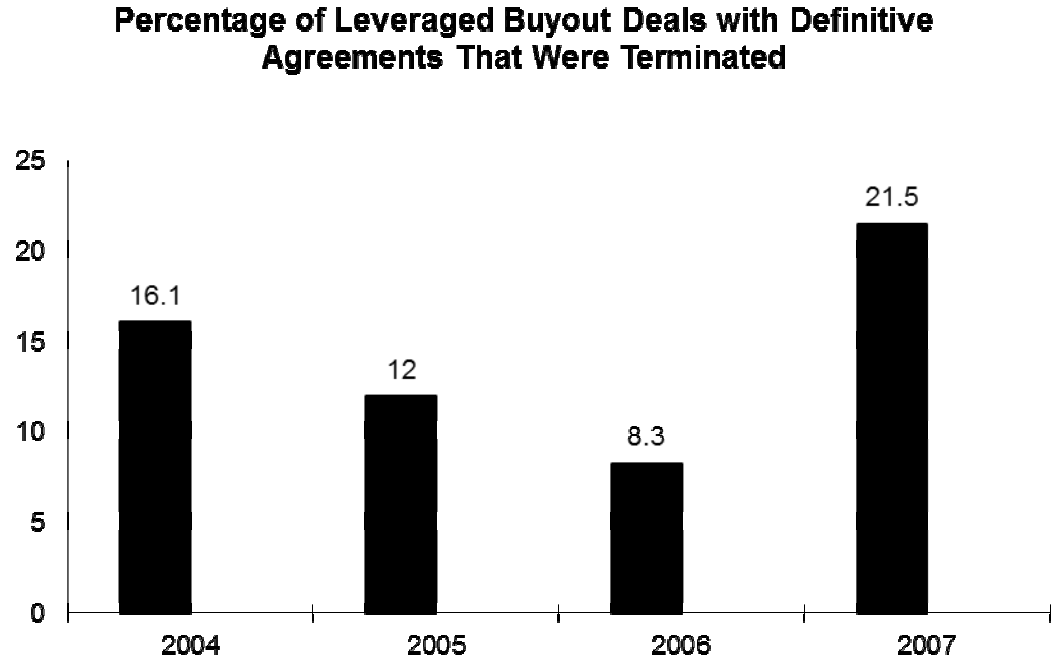
- Economic globalization.
- Weakening U.S. dollar.

Figure 7-1: Value of Mergers and Acquisitions in U.S. Companies



Source: Dealogic

Figure 7-2:



Source: *The Wall Street Journal*.

It has been estimated, that in the first-half of 2007, global private equity firms had almost $2 trillion of purchasing power. More than $600 billion a year was moving to oil-producing nations, and total Sovereign Wealth Funds were estimated at $2.5 to $3 trillion and growing.

The impact of the weakening of U.S. dollar was clearly visible during 2007. As the dollar weakens, versus other major currencies, U.S.-based assets become increasingly less expensive to foreign buyers. For example, in the third quarter of 2007, GE sold its Plastics business to Saudi Basic Industries for $11.6 billion (cash plus assumption of liabilities). During the period August – November, petroleum-based funds also acquired

- 9.5% of MGM Mirage.
- 20% of NASDAQ Stock Market Inc.
- 8% of Advanced Micro Devices Inc.
- 5% of Citigroup.

Others were seeking U.S. assets. Companies from the United Kingdom invested $46 billion in acquisition deals during 2007. This compares to $34 billion in 2006, and was greater than any other single source of foreign investment in 2007.

In November 2006, Evraz Holdings, Russia's largest steelmaker acquired Oregon Steel for $2.3 billion. Other smaller transactions by Russian steel producers have also been completed. In 2005, IBM sold its then failing PC business to Lenovo, a publicly traded company on the Hong Kong Stock Exchange.

The near collapse of the credit markets starting in late 2007 had a significant impact on acquisitions. First, the number of transactions slowed dramatically. In fact, a number of announced deals never closed.

In addition, the types of transactions changed. Strategic transactions, compared to equity investments, became the primary driver. An obvious example is the announced merger between UAL and Continental Airlines. The following are a few examples (2008-2010) of strategic transactions:

- InBev's purchase of Anheuser-Bush Cos. for $52 billion.
- Pfizer's purchase of Wyeth for $60 billion.
- Merck's purchase of Schering-Plough for $41 billion.
- Dow Chemical's purchase of Rohm & Haas for $19 billion.
- Altria's purchase of UST Inc. for $11 billion.
- Comcast's purchase of a majority stake in NBC Universal for $14 billion.
- Kraft's purchase of Cadbury for $19 billion.
- ExxonMobil's purchase of XTO Energy for $31 billion.

Of course these are just a small sample of the larger transactions. Other deals such as ConocoPhillips' purchase of 50 percent of Origin Energy's Australian gas assets, Intel's purchase of McAfee, Hewlett-Packard's purchase of Palm, Stanley Tool's purchase of Black & Decker, Teva's purchase of Barr, Ford's sale of Volvo to the Chinese automaker Geely and Phillips-Van Heusen's purchase of Tommy Hilfiger from London's Apax Partners continue to demonstrate this trend. It is worth noting the number of non-U.S. companies involved in the above deals. I have intentionally omitted examples of the consolidation of several banks or financial institutions during 2007-09. First, the reader is likely to be aware of them. Also, this process was influenced by governments' actions. However, in each instance, industry consolidation has been the overall driving force.

During the current recession, private equity and corporate buyers continue to pick up orphan brands. These include companies or assets such as Eddie Bauer, Polaroid, Linens N' Things, and Folgers.

Without attempting to forecast M&A activity, it is reasonably clear that it will continue to be driven by some of the above factors and has become international. This has increased the importance of selecting the correct analytical tools, and the overall role of the financial professional.

Reasons for M&A

There is a long list of potential "stated reasons" for M&A activity. The one below was compiled from several sources. Often, there is more than one key reason for an action:

- Obtain product market synergies
- Enter new technologies
- Strengthen financial position
- Gain portfolio balance
- Pre-empt competition
- Alter market image
- Increase economies
- Gain market share
- Open new market
- Reduce risk of internal start-up
- Accelerate growth
- Increase earnings
- Acquire undervalued assets

Two points should be noted. First, many lists would include obtaining or retaining management. While I have seen this on several lists, I cannot remember ever seeing a deal done for this purpose. Normally, you do not have to buy a company to get management. It may be a collateral benefit, but not a primary reason. Perhaps, the exception would be to acquire uniquely skilled scientists, and so on. Second, while never stated, unfortunately, personal prestige and egos can play a significant role. This is not good economics.

Obviously, for every buyer there must be a seller. Understanding your reason(s) to divest is equally important as a reason to buy. This list is usually much shorter.

- Purchase premium.
- The parent company needs cash, and this is a saleable asset.
- The business requires future investments the parent cannot or is not willing to make.
- The business needs noncash resources the owner does not have, or is not willing to allocate.
- Questionable business outlook.

Do not allow management to use terms such as “lack of strategic fit” internally. This may be a satisfactory external (public) reason, but internally be specific.

Role of Financial Professionals

M&A activity combines a number of nonroutine activities, typically under a high-level of stress. The stress frequently results from time pressures, management’s expectations, inability to quantify future risks or returns, and conflicting egos.

Organizations hire outsiders experienced in M&A both prior to and during a transaction. They normally provide guidance or coaching through the process. However, the ultimate responsibility for a deal and its long-term success stays with management. Therefore, management must be extremely active in the entire process.

Financial professionals can add significant value to this process in several ways

- Establish parameters, in advance to identify potential targets.
- Continue to ask key questions to keep the process focused.
- Select appropriate evaluation techniques.
- Conduct due diligence to confirm inputs and discover potentially “good” or “bad” news.
- Review execution plan.

While the above appears to be from an acquirer’s view, the same is true from a seller’s viewpoint.

- In order to successfully complete the acquisition and integration of a new business, an evaluation must consider a wide variety of potential risks. These can include the following:
- Market
- Financial
- Personnel
- Process
- Technological
- Infrastructure
- Political

Establishing the Environment

Corporate America has extensive experience in merging with or acquiring firms. However, its track record of being able to unify an acquired firm with the acquirer and provide a single organization with increased growth potential has been somewhat shaky. Too often, major portions or all of an acquired company are resold several years after the acquisition. It is worth remembering, that frequently the acquired company is relatively the same size as the acquirer and in similar or related businesses. Also, the acquiring company usually has a significant body of data regarding the target organization prior to the acquisition.

As in most endeavors, getting agreement early as to the criteria to be used to select acquisition targets or units to be divested is essential. A retired corporate Chairman once told me, that the most important thing he did in his 8 year tenure was to get the Board to agree to criteria for potential targets 2 years before one appeared. Since the management was in agreement, they were able to act quickly (he believed this reduced competition for the business) and focus on a selected number of key issues.

Obviously, the more specific the criteria are the better. Also, once agreed, continue to revisit them to assure commitment. It can be easy to agree in the "abstract," but harder in a "specific instance." Routinely revisiting the criteria can increase commitment and your reaction speed when opportunities occur.

> **Tip:** Use the budgeting and planning process to increase understanding and commitment of or to criteria for acquisitions and divestitures.

Continue to Ask Questions

The buying or selling of a business or assets, at some point, frequently results in a high level of emotion by the management. Earlier, we listed the most often stated reasons for an acquisition, as well as noting that ego, buying or selling, can play a role in the process. The higher the emotional pitch, the more important it is for the in-house financial professionals to attempt to establish a disciplined procedure throughout the evaluation.

Clearly identify the reason(s) for the acquisition. Management must agree on this prior to beginning an evaluation. Throughout the evaluation and negotiation process, ask questions such as those below:

- Are the assumptions used internally consistent?
- Are the assumptions used consistent with the environment?
- Is this action appropriate in view of our available resources?
- Does it involve an acceptable degree of risk?
- Do we have an appropriate time horizon?

Since the total process is likely to take considerable time, the above questions need to be asked periodically. Be certain to internally obtain responses to two key additional questions:

1. Does this transaction continue to meet our stated objectives?
2. If we cannot successfully complete this transaction, what is our next best alternative?

The answer to the second question can often help establish a "walking value." If other opportunities exist, this is likely to reduce or limit your offer. However, if a competitor obtaining this business could seriously limit or eliminate your business, a significant premium may be justified.

While no series of actions can assure the elimination of the clashing of egos, or the drive for personal prestige, an open or questioning process will help. In this case, the finance professional is both a detective and a police officer.

Valuation Approaches

In concept, a potential acquisition is the same as any other proposed investment (chapter 8). The major difference is that the final acquisition cost is subject to negotiations and therefore, unknown until late in the evaluation process. The framework, for analyzing the expected return and risk accompanying an acquisition, is basically the same as for any capital project. The actual number of "unknowns" may or may not be greater than for other investments.

Prior to going further, let us discuss a few measures that are sometimes talked about and used, but require extra care:

- Book value
- Payback period
- Rules of thumb
- Replacement cost
- Present value
- Internal rate of return (IRR)

Book value reflects the historical cost of the business less (net) cumulative depreciation. Therefore, it is unlikely to provide an insight into the business's current value. Assume years ago, you paid $200,000 for your house. Today, houses in your neighborhood are selling for $300,000. Would you sell me yours for $200,000 (book value)? Whether buy or selling, be careful not to worry too much about history to establish current values. However, do not underestimate the emotional role this number can play.

Payback period provides the number of years required to recover the initial cash investment. It is the ratio of the initial fixed investment divided by the annual cash inflow for the recovery period. The obvious adjustment is needed if the cash flow is not even over the period.

In concept, if the payback period is equal to, or less than, the target (maximum) period, the acquisition is done. This tool has several shortcomings:

- It does not measure returns after the payback period.
- It does not account for the possible dispersion of results.

The present value of the cash drains and flows should be addressed both when calculating the returns and in setting the target payback period. Most often, **payback** is used as a measure of risk – the faster the payback, the lower the risk. However, since it only measures one set of cash flows, it cannot provide an adequate measure of risk. The risk of variations in the cash flows is ignored. As with the next two tools (**rules of thumb** and **replacement cost**), this technique is typically used as one of several evaluation approaches. It is important that only the costs or returns from the acquisition are included in the calculation. This point is discussed in detail later in the chapter.

Rules of thumb are valuable as a starting point for comparison after you do a preliminary evaluation. However, the business you are buying may not be typical versus previous transactions. The rules are normally expressed as a multiple of sales, earnings, or cash flow ("multiples"). Be aware, just because you pay under the average rate does not assure a bargain.

These comparisons are available from several sources including: external experts, brokers, lists of businesses being sold (print) and via the internet such as www.bizbuysell.com.

Replacement cost can be an excellent tool for comparison. For example, if I can buy an oil company with known reserves for $20 a barrel of oil, in the ground, I can compare this to my recent costs of finding oil. However, when used inappropriately, it can lead us to exaggerated valuations. Just because it would cost more to build an asset than buy it does not assure success. Look at the condition of asset, including its image. Maytag believed it could fix the quality problems at Magic Chef. After years of failing, the entire company was acquired in financial distress. In addition, ask yourself if the business is needed (viable). It may be less expensive to buy, but do you want it?

It is generally accepted that **discounted cash flow** calculations provide a more objective basis for evaluating investments. This approach accounts for both the size and the timing of forecast cash flows throughout the acquisitions life. The two techniques are **present value** and **internal rate of return (IRR)**. We will discuss IRR in chapter 8. However, the general approach between these methods is similar.

In forecasting the value of an acquisition, or any investment, the calculation strives to isolate the effect of that action. Therefore, cash flow estimates should be done based on the results "with" and "without" the acquisition. This provides a more accurate picture of the value of the cash flow, from the specific action, versus a "before" and "after" view. The "with" and "without" approach directly attempts to isolate the impact of the acquisition from other factors that may influence the results. Increases or decreases to cash flow that would have occurred without the acquisition are easier to see. This can be helpful when identifying changes in both scenarios for future capital spending, working capital, and so on. In addition, it provides a more accurate basis for measuring the value of synergies that result from the transaction. This is a key point, since potential synergies play an important part in the ultimate evaluation and negotiations.

The basis for the *present value method* is to test whether the present value of the cash inflows is greater than the present value of cash outflows. The time value of money is a basic concept in finance. The earlier the cash flow the more its value. Therefore, the timing of anticipated cash flows is extremely important.

The future value of a present sum of money invested at a fixed rate can be calculated using the formula below.

$$F_n = P\ (1 + r)^n$$

Where
F_n = future amount (n-period)
P = present amount
r = rate of interest (5%)
$1,000 = $1,629 (n = 10 years)
$2,653 (n = 20 years)

Therefore, $1,000 invested at 5 percent compounded annually would grow to approximately $1,629 in year 10 and $2,653 in year 20.

By turning the above equation around, the present value of future cash flows can be calculated. As shown below, $907 today is equivalent (5 percent rate of interest) to $1,000 in two years.

$$P = F_n \times \frac{1}{(1 + r)^n}$$

$$P = \frac{1}{(1.05)^2} = \frac{\$1,000}{1.1025} = \$907$$

5% annual rate
n = 2 years

Using the *present value method* all cash flows are discounted to their present value at a selected rate of return. If the sum of the discounted cash flow is equal to, or greater than zero, the acquisition, in concept, is accepted. The selected rate of return is the return expected to be achieved from investments.

The impact of discounting can be demonstrated by the following simple example.

Investment = $100,000
Discount Rate = 10%

Cash Flows	PV Factor	PV
$40,000	.909	$36,360
$30,000	.826	$24,780
$25,000	.751	$18,775
$25,000	.683	$17,075
$25,000	.621	$15,525

Payback = 3.2 periods
PV Payback = 4.2 periods

Given the sensitivity to timing, several calculations should be run to test the durability of the answer. It is normal to have a terminal value assigned at the end of the cash flow stream. This represents the then current value of the business. While this value is pushed out, and therefore its impact gets reduced, do not be too aggressive in assigning the value.

Acquisitions contain considerable risk. Therefore, the use of several of the above techniques can be helpful to estimate value. Remember, despite your best efforts, numerous assumptions in an evaluation are normal. Be careful not to overstate (value or time) synergies. Stay disciplined and use the tools.

Parting Thoughts—Due Diligence

During due diligence, financial professionals become part of a team of detectives where the basic job is to confirm the information used in the evaluation. This includes everything from the existence of "hard" assets to agreements, patents, and so on. Especially given normal time pressures, a plan must exist to address this phase of the acquisition activity.

In my experience, a senior financial manager is often put "in-charge" of managing this phase. Regardless, if you manage this function or not, review the plan for your group's activities, and assure that a master or control plan exists with sufficient resources.

Two points are worth specifically noting. First, due diligence is an excellent time to use some of the techniques previously discussed to exam the proposed new business. Two-point plots, regression and time series analysis, as well as others, can help you better understand the business your organization is planning to acquire. While I assume you will do this, during the earlier evaluation, due diligence may provide more detailed data. Confirm previous relationships and look for points to question. As some people will paint a house without fixing existing problems before marketing it, management may dress-up a business before trying to sell it.

In addition to confirming earlier information and looking for hidden problems, due diligence can uncover new benefits. These can range from specific agreements to tax credits. Be alert! It's not always bad news that is discovered.

Execution Plan

Obviously, before getting very far into evaluation and negotiating activities, your organization will have a vision or plan as to how it will incorporate the new business into its structure. In

addition, be sure that a shorter term execution plan exists. This is a detailed game plan of what activities need to be done, including their sequence, resources required, and ultimate timing. When building an execution plan, consider the following:

- Have one
- Include needed resources and a timeline
- Establish a team
- Move fast

Experienced management often establishes a team to execute this plan. If needed, include experienced outsiders. The process followed in the early stages of uniting organizations frequently is the difference between success and failure. Remember, while you may be dealing with duplication of assets and people, you are always going to be addressing different cultures.

Informing employees of what to expect, unifying operating procedures or systems, contacting key customers and suppliers, and providing assistance if people are displaced, needs to be done quickly. Review the forecasts used in the evaluation to assure that sufficient resources – money, people, and time have been included.

If you are a seller, realize that as soon as employees know that their unit or business is for sale, many of them will functionally stop being your employees. That doesn't mean they will not perform their tasks, but, in the absence of any incentives, they will begin looking for their next career move, and so on. Every potential buyer now becomes their next employer. Consider this when addressing short-term management needs.

Chapter 8

Capital and Other Long-Term Investments

Introduction

As noted in chapter 7, the financial evaluation of an acquisition or project is very similar. Both require addressing unknowns, as well as specific management skills. Often, they represent options available to an organization-buy versus build or develop. Therefore, many of the topics covered in the earlier chapter can be applied. However, there a few key differences.

Better-managed organizations view all long-term programs (capital and noncapital) in a disciplined environment. Therefore, we will explore some of the unique issues concerning budgeting and evaluating, financing, and managing a variety of activities.

In addition to typical capital projects, expenditures such as R&D, IT, advertising, training, and even planned builds in working capital can be viewed as long-term programs. These all consume cash in anticipation of future payouts.

- This chapter will
- Compare evaluating long-term projects with an acquisition.
- Discuss the role of budgeting.
- Examine the impact of capital projects on cost structure.
- Explore IRR as an evaluation tool and compare it to the present value approach.
- Introduce the basic concepts of financing and hedging.

Budgeting

A budget is a disciplined process to allocate resources and establish an organization-wide plan to manage resources and activities. It enables competition for resources (capital, people, time, and so on) to be constructive. If left unmanaged, competition for resources would result in destructive conflict or suboptimization of limited resources.

Cash Budget

A first step for organizations with significant capital (cash) expenditures is to prepare both a standard P&L budget and forecasts accompanied by a cash version. While balancing total cash inflows and drains over a budget period is obviously important, the actual timing is essential. Cash must be available when needed. Planned or unplanned increases in working capital and operating costs reduce funds available for capital projects.

A cash based budget or plan will assist in identifying the imbalances of cash, thus allowing you to plan actions in advance. It will also help establish a project selection process, by setting a total capital cap on the organization. Although, an organization may have several "good" projects, often trying to do all of them will increase costs (financing), strain management's abilities or resources, and increase risk (financing, actual timing of project start-ups, and so on).

Project List

As part of the process, a list of proposed projects needs to be identified. These should have already passed some evaluation (first-cut) and are now being considered for funding.

The goals of capital projects include

- Replacement.
- Expansion.
- Rationalization – Productivity.
- Development – New products, process, or markets.
- Mandatory – Contractual or legal requirements.

Grouping potential programs into categories can sometimes help in the evaluation process. The next step is to assure that the assumptions used in each case are consistent. For example, the same inflation estimates, raw material cost escalations, and so on, have been incorporated in each. Next, determine if the potential projects are independent of each other.

Projects can be mutually exclusive; the funding of one stops the funding of another. For example, competing technologies. Also, projects can be dependent on each other. Be certain that you have identified all required expenditures for any proposal. These not only include purchasing and installation of equipment and construction of facilities, but more subtle modifications such as changes in working capital. Go back to the discussion in chapter 7 concerning analyzing acquisitions from a "with" and "without" viewpoint. This will help you find less obvious changes during the evaluation. You do not want to discover halfway into construction that your new technology requires a major upgrade to the water system, and so on. Scaling-up a technology or project often comes with this risk. Remember, the projects are competing for the organization's limited resources.

Although somewhat obvious, let us specifically discuss a few key issues concerning evaluating a group of projects. First, the required return or hurdle rate is likely to vary by project type. Projects required by law or to assure safety don't rely on returns. In these situations you are seeking the lowest cost, effective project. The project will get done even if it has negative returns. Of the remaining categories, hurdle rates for replacements will be the lowest, since they are needed to maintain activities and should have the least risk. Consequently, development projects will require the greatest returns (more unknowns).

Other factors, such as location (political risk), sources of raw materials, and so on. need to be addressed. The concept of residual or abandonment value should also be considered. The capital committed to some investments may be reasonably flexible, while others are fixed. An

investment in a single-purpose facility (aircraft) is considerably more fixed than an office building in New York City. The two proposals may have the same present value and IRR. However, if your business activity declines, the aircraft is likely to be a sunk cost (unrecoverable), while the office space can be sold or rented.

For simplicity, the examples provided in this document assume the independence of cash flows from one period to another. However, for most investments the cash flow in one period depends, at least in part, on the cash flow in the previous periods. Poor early results increase the potential for disappointing future returns. In addition, due to the reality of present value, the project's overall returns are likely to suffer.

Project planning includes identifying, in advance, those key short-term activities that are directly related to the desired long-term results. Failure in one of these select activities must trigger an immediate planned response. When reviewing investments it is important to determine the degree of correlation of cash flows among a group of projects. If the correlation is high, you may be introducing a hidden level of risk. Just because you spread expenditures over a number of projects doesn't assure diversification.

Suppose I invested all my savings in the common stocks of 5 companies, all of them in the same industry, would I be achieving diversification? While I may be reducing specific company risk, my investments would not be diversified.

The **Kelly Criterion** is a risk management strategy which has been used to allocate investment funds. This approach has gained some recognition as part of a process for reviewing or selecting capital projects. The technique was developed by John Kelly in the 1950s at Bell Labs. However, it did not become popular until Edward Thorp wrote his book "Beat the Dealer," in 1962.

The goal is to maximize the long-term growth rate of investments. It can be used as part of a dynamic approach for capital allocation. The **Kelly Criterion** establishes boundaries for investing as results become known and avoids over-betting on an outcome. The basic thrust is to avoid "gambler's ruin," where you lose everything by over-betting. It is the opposite of the "double down" or "all-in" approaches, which attempt to regain losses by risking increasingly larger sums.

In a trading or investing situation, you would determine the percentage of your total funds to be risked on each alternative. Following the outcome of the investment, the earnings or losses would be added or subtracted to or from the total funds, and the same percentage risked on the next trade, thus maintaining a disciplined and diversified portfolio.

While there are unique reasons for projects to be approved, establishing a disciplined framework can be helpful when allocating overall resources. Dividing capital expenditures by project type (including technologies used, and so on) is a necessary first step. Employing guidelines based on this approach can be valuable not only in allocating funds initially, but also as information is gained during development or implementation.

Bill Gross, the famed bond investor and head of PIMCO is a disciple of this approach. Despite the fund's size, it reportedly does not have more than 2 percent of its total holdings invested in any one credit.

Exercise 8-1

Would you make the following investment? The original cost of a unit of new equipment is $22,500. Using the forecast cash flows below and a 10 percent discount rate should it be purchased? Calculate the present value factor for each year.

$5,000; $7,000; $8,000; $10,000.

Alternatives

The budgeting process is an excellent time to look for alternatives to capital projects. Whether or not the availability of funds is a current problem, renting facilities or outsourcing activities needs to be considered. As a result of the escalating cost for developing new drugs, Eli Lilly helped to start a lab in Shanghai during 2003. This has significantly reduced their development costs. Companies routinely outsource both staff and production needs. View all long-term commitments as you would capital projects.

At times, conditions that are intrinsic to an industry are better addressed by not owing the capacity. Ask at least the following questions:

- How accurately have we historically forecast demand?
- Is demand seasonal?
- Is demand cyclical?
- Is the work flow lumpy (projects or continuous)?
- Are noncapital alternatives available?

By introducing this brief review you may find both a better solution to your operating needs, as well as additional funds for other worthy projects.

Valuation—IRR Versus Present Value

According to the internal rate of return **(**IRR**)** approach, an investment should be accepted if the internal rate of return is greater than the cost of capital. When selecting among several projects, the IRR would be calculated for each and the projects ranked by their rates of return. The internal rate of return is the discount rate which equates the present value of cash flows to zero.

The typical criterion for accepting a proposed program is to compare the internal rate of return to a preset hurdle rate. If the internal rate of return is equal to or greater than the hurdle rate, the project is normally accepted.

IRR solves for the discount rate that equates the present value of the cash inflows with the present value of the outflows. This is then compared to the required hurdle or cut-off rate. The present value method (chapter 7) solves for the net present value of the forecast cash flows given a required rate of return. Therefore, any investment with a net present value greater than zero, in theory, is acceptable. While these techniques approach the same question from a different view, they tend to lead to the same conclusion (acceptance or rejection).

There are two differences in the evaluation approaches. Since IRR results in a percentage, the size of the investment is lost. This can result in insufficient attention being paid to potential risk. It also can obscure the reality that for an organization's financial results, an acceptable (lower) return on a large project may be better than a higher return on a very small one.

In addition, IRR incorporates a reinvestment rate for intermediate cash flows, equal to the internal rate of return. The present value approach uses a rate equal to the required rate of return used as the discount factor. Be aware of the above built-in assumptions and select the tool that best fits your situation. The net present value approach is usually viewed as the more reliable.

The following illustration demonstrates the relationship between the present value and IRR approaches.

An opportunity requires an up-front investment of $18,000 and is forecast to generate annual cash flows of $5,600 at the end of each of the next five years. The net present value of this investment, using a 10 percent required return, is $3,228.

$$\text{NPV} = \$\text{-}18{,}000 + \frac{\$5{,}600}{(1.10)} + \frac{\$5{,}600}{(1.10)^2} + \frac{\$5{,}600}{(1.10)^3} + \frac{\$5{,}600}{(1.10)^4} + \frac{\$5{,}600}{(1.10)^5}$$

$$\begin{aligned} \text{NPV} &= \$21{,}228 \\ &\quad \underline{\text{-}18{,}000} \\ &\$\ \ 3{,}228 \end{aligned}$$

Using the same example, we can calculate the rate that when multiplied by $5,600 (cash flow for each year) equals the original investment of $18,000. The equation, below, is obviously similar to the prior equation, and will provide a rate (IRR) of 16.8 percent.

$$\$\text{-}18{,}000 + \frac{\$5{,}600}{(1+r)} + \frac{\$5{,}600}{(1+r)^2} + \frac{\$5{,}600}{(1+r)^3} + \frac{\$5{,}600}{(1+r)^4} + \frac{\$5{,}600}{(1+r)^5}$$

$$\text{IRR} = 16.8\%$$

Financing

The next two sections are meant only to introduce basic concepts to participants. These areas require considerably more attention. However, a clear understanding of the basics is essential in many instances, and helpful in all cases.

The cost and availability of capital is a key component in setting caps on expenditures. In general, organizations have greater desires (potential programs) than resources. Certainly, this is true for growing companies. The method of financing needs to be consistent with the company's cost structure.

Cost of Capital

The cost of capital for any company is in direct relationship to the size and predictability of earnings or cash flow. The simple model demonstrates this.

$$R_e = R_f + \beta\,(R_m - R_f)$$

Where

R = return
e = expected
f = risk free
β = beta – volatility
m = market

The greater the volatility of results, the higher rate of return demanded by investors. While management cannot influence overall market returns, it can manage its beta, as well as planning financing efforts to maximize the market conditions.

Several factors can make a company's earnings more volatile:

- High level of fixed costs.
- Single-purpose assets.
- Lack of diversification.

A company having these characteristics may not be able to carry as much debt financing versus other companies. It is dangerous for a company with a high level of fixed operating costs (economies of scale) to also maintain significant amounts of fixed financing costs (debt). While this combination may provide above market results during periods of high product demand, it can be disastrous if demand slows.

Be aware that each project modifies the cost structure of your organization (go back to chapter 5). Be sure to measure the cumulative impact of all projects, not just each individually. Excess capacity increases fixed cost. Capacity is expensive to establish, maintain and reduce or eliminate. Also, it usually is not available in exactly the amount immediately required.

Debt and Equity

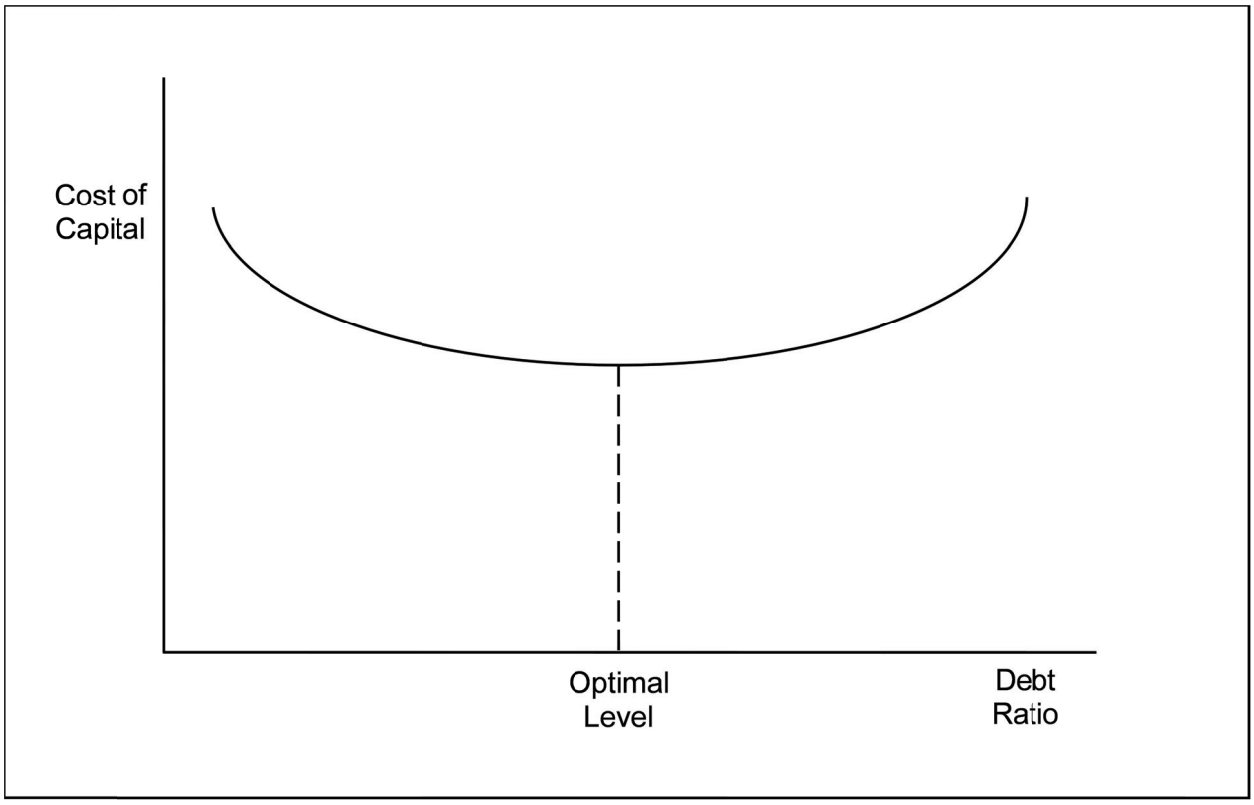
A company's value is frequently described as the present value of its future free cash flows discounted at the cost of capital. The cost of capital being the weighted average of the after tax cost of debt with the cost of equity.

Debt can be the least costly financing alternative for an organization. A company with limited amounts of existing debt may be able to acquire new funds for growth, via additional debt, at favorable terms for the following reasons:

- Interest payments by the company are tax deductible.
- Dividends (equity) are not tax deductible.
- Debt holders are in a preferred position to owners (equity holders) if a bankruptcy occurs.

In addition, management or owners may prefer increasing debt, since it does not give the holder a position in future earnings. Debt becomes more expensive when it is at a level which increases the risk of the business (growth or survival). Figure 8-1 illustrates changes in the cost of debt at varying levels.

Figure 8-1: Example Cost of Debt Chart



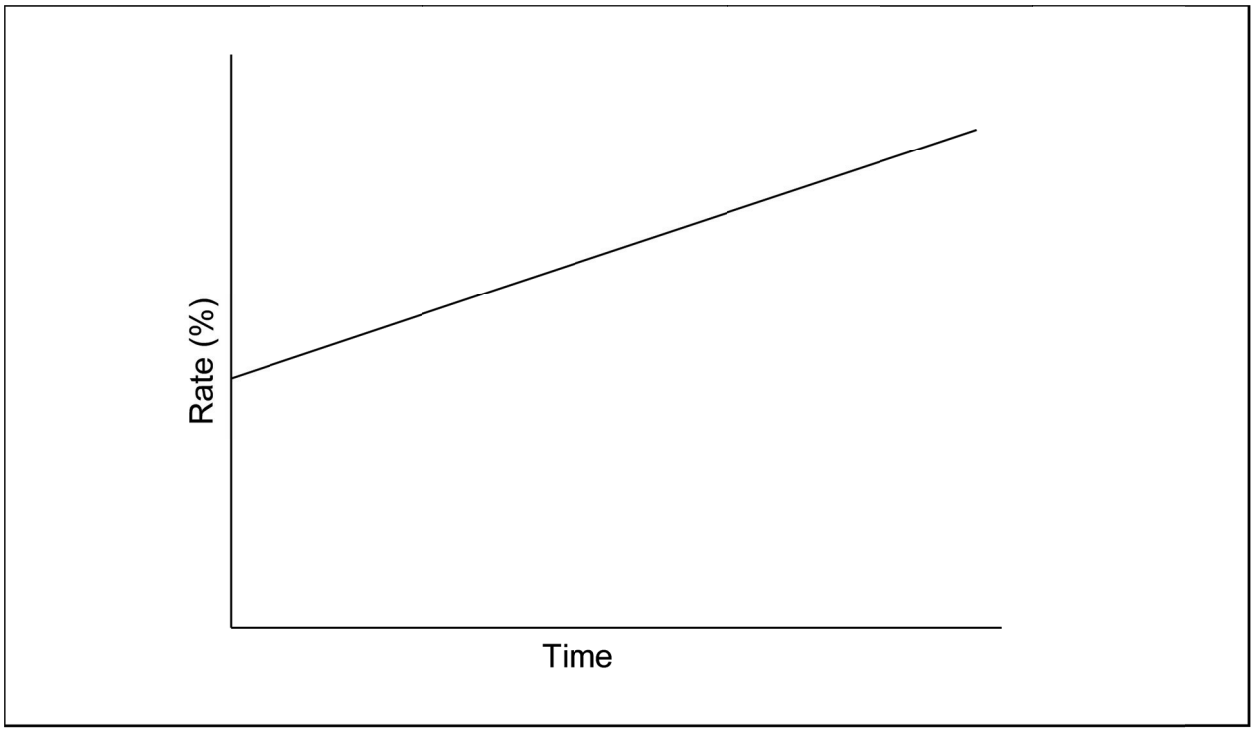
There are several concepts concerning the use of debt financing, based upon the historic shape of the interest rate curve. The historic interest rate curve has an upward slope. Therefore, at a point in time, short-term rates are expected to be less than long-term rates. This is due to increased risk and inflation expectations. Increased risk results from the potential for default over longer periods of time. Given the reality of present value, inflation erodes the value of funds paid in the future; the higher future expectations for inflation (reduced purchasing power), the higher the interest rate. Figure 8-2 shows the relationship between historic interest rates over time.

As a result of the historic shape of the "rate curve" some people tend to "play" the curve. That is, they finance a disproportionate amount of their debt needs in short-term maturities and replace them as they mature. They hope, over time, to reduce interest expense. This has two potential problems:

1. The entire rate curve could shift higher prior to your renewal. This will increase expenses versus earlier available rates.

2. The company may have suffered lower or poorer financial results. Even if this is temporary, your condition at the time of debt issuance is what matters.

Figure 8-2: Historic Interest Rates over Time



Others use more long-term funds to assure availability, and reduce the risk of short-term fluctuations in the markets or their company's financial results. The third approach (which I admit I favor) is to match the economic life of what is being financed, with a financial vehicle of similar length. Since the asset is expected to generate cash to pay the debt, why not match both? For example, a retailer financing inventory for the Christmas Season would use a revolver (line of credit). If you are constructing a production facility long-term debt or equity would match the facility's economic life.

There have been periods this curve was flat or even inverted. As with all planning, pay attention to movements. You also might want to consider whether the growth in offshore funds might have an influence on the curve's future movements.

Returning to the cash budget discussed earlier, be sure to include the timing of cash needs. Managing capital projects requires forecasting and addressing cash needs early. If unplanned, you allow the organization to be subject to changes in the markets, as well as internal events. Obtaining funds, particularly if needed quickly, during the second-half of 2007 was a different experience from only several months earlier.

Hedging

The term hedging comes from the phrase "hedging your bets" used in gambling. Hedging, as discussed here, is making an investment to reduce the risk of adverse price fluctuations in an asset. In general, a company enters into a transaction whose sensitivity to changes in prices offsets, all or partially, the sensitivity of its core business to these fluctuations. It is a risk management tool. However, in practice, it is not a simple exercise and the explosion in the variety of available instruments continues to increase its complexity. It is not an action to be

taken without serious planning. Therefore, it should be addressed, as appropriate, in an organization's strategic plan.

Capital projects require significant outlays of funds prior to start-up and cash generation. There are two sources of risk which a well-designed hedging program can address.

First, is the risk that construction costs, prior to start-up, will increase. Obviously, a fixed-cost contract, if available, can address this risk. However, depending on the length of time and the size of the project, contractual coverage may not be possible. In addition, prices for the finished products, may decline, or input costs increase.

By establishing a position (contract) in the market an organization can, at least, reduce risk. The market provides an organized environment for the buying and selling of commodities at some specific future date. A buyer, of a commodity, agrees to purchase it at a fixed volume and price, at a specified future date. A seller obviously, agrees to the sell side of the transaction. Formalized contracts for specified commodities are routinely traded in the futures markets.

This mechanism has been or is used by a variety of industries. Farmers commit to sell products in advance of the harvest. Natural resource companies do this, at least for some of their future production, during development or expansion projects. Airlines, establish positions (hedge) fuel prices. Large construction companies hedge some of their future materials needs. When discussing its efforts to control costs, McDonald's management noted that it hedges some ingredients. Organizations purchasing or selling goods in other countries often establish foreign exchange contracts to cover contractual commitments. This sets the currency exchange rate, thus locking in the actual costs or prices.

When planning a capital project, management may want to explore the use of hedging to protect them from otherwise uncontrollable events. Hedging should be viewed as an insurance policy. Future positions are not available for all commodities. In these cases, you may be able to establish a proxy by taking a position in a commodity or financial vehicle that tends to offset changes in the one you want to hedge.

Be careful, imperfect hedges can go bad. You may select the wrong proxy, or past relationships may change. As a simple example, assume you purchased an equity position in an integrated oil company as a hedge against rising prices "at the pump." The company's stock value could decline, despite rising retail prices, due to company specific issues. Also, time frames are a risk. For example, while interest rates and equity prices tend to move in opposite directions, there have been periods of time during which they have moved in parallel.

Remember, from the perspective of a capital program, hedging is to be seen as an insurance policy. Do not increase overall risk while attempting to manage it.

A Financial Decision Maker's Worksheet

Environmental Forces

1. Discuss the roles of "science" and "art" in decision making.
2. Identify several ways bias can be seen in decision making.

Turning Data Into Information

1. Calculate the arithmetic average, median, and mode for the following data:

   2,3,5,6,8,10,15

2. Identify each of the following in time series analysis:

   T =

   C =

   S =

   R =

3. Why might the median or mode be more appropriate than an arithmetic average in measuring the life expectancy of a product?

Problem Solving Tools

1. Assume you are the President of a chain of fast-food restaurants. Your CFO has just completed a Pareto Analysis of your sales. The analysis indicates that 60% of total sales are generated by 20% of your customers. Briefly discuss what you would do, and/or the questions to be addressed.

Analytical Models—Decision Aids

1. In the citrus juice example, why was the goal of maximizing profits not achieved by maximizing the production of the highest valued product?

Improving Accounting Information and Analysis

Measuring the Right Things—We Care Air (WCA)

As I prepared to board, the agent announced that since the plane was full, carry-on bags had to be checked. Like others, I allowed my bag to be tagged to its final destination. I checked to assure myself it wouldn't be left at the next stop, (my connecting city) and went abroad.

When it became obvious that all the passengers were aboard, I noticed that more than a few overhead compartments were empty. Next, the pilot announced that our destination city was experiencing severe weather and we were going to be delayed until 5:30 pm – 45 minutes from now. Since I had a 90 minute layover, I still felt reasonably comfortable about my next flight.

Given the delay, the pilot further announced that people could leave the plane, but he warned "Don't go far, we expect to leave promptly at 5:30 pm." A number of passengers left.

Nothing happened until 5:28 pm, at which time the pilot announced "We are clear for take-off and will leave as soon as all the passengers return to the airplane." At 5:55 pm all had returned and were safely seated and by 6:05 pm we were off. Of course, the crew behaved frantically boarding the returning passengers, some of whom obviously had gone to eat.

While in the air, the pilot apologized for the weather delay, which he reminded us was beyond WCA's control. He stated that the ground crew at the arriving airport would help those with connections, including seats on the next available flights if needed. He also noted that many passengers had close connections and thought that some flights "Might delay their departures to wait." He asked the passengers without connections to let those making connections exit first. This was repeated two more times (at landing and deplaning).

Running off the plane I was greeted by an agent who explained I was rebooked on tomorrow's first flight out. I noted I had 10 minutes before my flight's departure and she assured me I could not make the flight, since it was at the other end of the airport. Also, it had already stopped boarding passengers. It appeared everyone was getting the same message. I later learned that no one made a connection. One passenger tried to open a locked jet-way door, since the plane was still there. Rather than opening the door, a nearby agent called security.

After more than an hour of lines (Special Services and Baggage Claim) the following was clear. The airline took no responsibility for the mess – "weather related." I missed my flight, but my bag had made it and would be waiting for me in Florida, tomorrow morning.

I got a hotel room, left the next day and have avoided the carrier since, even once, when its schedule was slightly better than a competitor's. Also, I have told all my friends about this experience, at least one of whom took another airline on a vacation trip to Europe.

1. Based on this experience does WCA view its service as a process or project?

2. What are the sources of WCA's failed service? Was it all weather and/or passenger fault?

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Glossary of Controllership and Financial Management Terms

Absorption Costing – A costing method that treats all manufacturing cost (direct materials, direct labor, variable overhead, and fixed overhead) as product costs. It is also referred to as full costing.

Accept or Reject Decision – Decision resulting from a relevant cost analysis concerning whether to accept or reject a special order.

Accounts Payable Turnover Ratio – A liquidity measure that shows the number of times on average that accounts payable are paid during the period; calculated by dividing net credit purchases by average accounts payable during the period.

Accounts Receivable Turnover Ratio – A liquidity measure that shows the number of times on average that accounts receivable are collected during the period; calculated by dividing net credit sales by average accounts receivable during the period.

Action Analysis Report – A report detailing the costs that have been assigned to a cost object, such as a product or a customer; it also shows how difficult it would be to adjust the cost if there were a change in activity.

Activity – An event that causes the consumption of overhead resources within an organization.

Activity Cost Pool – A "bucket" in which costs that relate to a single activity measure are accumulated within an activity-based costing system.

Activity Measure – An allocation basis within an activity-based costing system which, under ideal conditions, measures the amount of activity that drives the costs in an activity cost pool.

Activity-Based Costing (ABC) – A costing method that focuses on individual activities as primary cost objects and uses the costs of these activities as the basis for assigning costs to other cost objects such as products and services.

Activity-Based Management (ABM) – A management approach that focuses on managing activities as a way of eliminating waste, reducing delays, and minimizing defects.

Administrative Cost – Any executive, organizational, and clerical cost associated with the general management of an organization.

Amortization – The process of allocating the cost of an intangible asset over its estimated useful life.

Asset Turnover Rate – The sales divided by the average operating assets figure. It represents the amount of sales generated from each dollar invested in operating assets by an investment center.

Average Age of Inventory – The number of days on average that a company holds inventory before it is sold; calculated by dividing 365 days by the inventory turnover ratio.

Average Collection Period – The number of days on average that an account receivable remains outstanding; calculated by dividing 365 days by the accounts receivable turnover ratio.

Average Payment Period – The number of days on average that an account payable remains unpaid; calculated by dividing 365 days by the accounts payable turnover ratio.

Balanced Scorecard – An integrated set of financial, customer, internal business processes, and learning and growth performance measures that is derived from and supports an organization's strategy.

Benchmarking – A study of organizations considered to be among the best in performing a particular task. Involves establishment, through data gathering, of targets and comparators, through whose use relative levels of performance can be identified.

Bottleneck – Any machine or other part of a process that limits the total output of an entire system.

Break-Even Point – The level of sales, in units or dollars, where profit is zero. It can also be defined as the point where total sales equals total fixed and variable costs, or the point where total contribution margin equals total fixed costs.

Budget – A detailed plan for the future acquisition and use of financial and other resources over a specified period of time, usually expressed in formal quantitative terms.

Business Process – The series of steps followed when carrying out some task in a business.

Capital Budgeting – The process of planning significant outlays on projects that have long-term implications, such as the acquisition of new property and equipment or the introduction of a new product line.

Capital Lease – A long-term agreement that allows one party (the lessee) to use the asset of another party (the lessor) in an arrangement accounted for like a purchase.

Cash Budget – A detailed plan showing the primary sources and uses of cash resources over a specific time period.

Cash Debt Coverage Ratio – A measure of solvency that can be calculated by dividing cash provided by operating activities by average total assets.

Change Management – The process of coordinating a structured period of transition from one situation to another in order to achieve lasting change within an organization. It can be of varying scope, from continuous improvement to radical and substantial change involving organizational strategy.

Chief Financial Officer – Top management team member responsible for providing timely and relevant data to support planning and control activities and for preparing financial statements for external users.

Committed Fixed Cost – Any fixed cost that is considered to be difficult to adjust because it relates to the investment in facilities, equipment, or the basic organizational structure of a firm

Common Cost – Costs that are incurred to support a number of costing objects but that cannot be traced to any one of those costing objects individually.

Constraint – Any limitation under which an organization must operate, such as limited available raw materials or machine time, that restricts the organization's ability to satisfy demand.

Contribution Margin – The difference between total sales and total variable cost, or the difference between unit selling price and unit variable cost. It represents the amount contributed to covering fixed costs and providing a profit to the organization.

Contribution Margin Ratio – The ratio of total contribution margin to total sales, or the ratio of unit contribution margin to unit selling price. It is used in cost-volume-profit analysis.

Control – The process of establishing procedures and then obtaining feedback in order to ensure that all parts of the organization are functioning effectively and moving toward overall company goals.

Controller – The manager in charge of the organization's accounting department.

Controlling – Ensuring that a plan is actually implemented and appropriately modified as circumstances change.

Conversion Cost – Costs of converting raw materials into finished goods. It is the sum of direct labor costs plus manufacturing overhead costs.

Core Competencies – A bundle of skills and technologies that enable a company to provide a particular benefit to customers that gives it competitive differentiation.

Corporate Governance – The system by which organizations are directed and controlled. Its structure specifies the distribution of rights and responsibilities among different participants in the organization and spells out the rules and procedures for making decisions on corporate affairs. The result is the structure through which corporate objectives are set and through which the means of obtaining those objectives and monitoring performance are achieved.

Cost Behavior – How a cost reacts or responds to changes in activity levels. Costs may be fixed, variable, or mixed.

Cost Center – A business segment whose manager has control over costs, but not over revenues or the use of invested funds.

Cost Driver – A factor that causes overhead costs, such as machine-hours, labor hours, or computer time.

Cost Management – The application of managerial accounting concepts, methods of data collection, data analysis, and data presentation so that relevant information can be provided for purposes of planning, monitoring, and controlling costs.

Cost Object – Anything for which cost data are desired, such as products, product lines, customers, jobs, or organizational subunits.

Cost of Capital – The average rate of return that a corporation must pay to its long-term creditors and shareholders for the use of their funds.

Cost of Goods Manufactured – Manufacturing costs associated with goods that are completed and become available for sale during the period.

Current Cash Debt Coverage Ratio – A measure of liquidity that can be calculated by dividing cash provided by operating activities by average current liabilities.

Current Ratio – A measure commonly used to evaluate a company's liquidity and short-term debt-paying ability that can be calculated by dividing total current assets by total current liabilities.

Customer Relationship Management – A combination of customer information systems, personalization systems, content management systems, and campaign management systems.

Debt to Asset Ratio – A measure of solvency that shows the percentage of total assets financed with borrowed funds; calculated by dividing total liabilities by total assets.

Decentralization – The process of delegating decision-making authority throughout an organization by empowering managers at various operating levels within the organization to make key decisions relating to their area of responsibility.

Depletion – The process of allocating the cost of a natural resource over its estimated useful life.

Depreciation – The process of allocating the cost of an item of property, plant, and equipment over its estimated useful life.

Differential Cost – Any difference in cost between two alternative courses of action under consideration. Also referred to as relevant cost.

Differential Revenue – Any difference in revenue between two alternative courses of action under consideration. Also referred to as relevant revenue.

Direct Allocation Method – A method of allocating service department costs to operating departments that allocates all service department costs directly to those operating departments without recognizing any services provided to other service departments.

Direct Cost – Any cost that can be easily and conveniently traced to a specified cost object.

Direct Labor – Any manufacturing labor costs that can be conveniently and easily traced to individual units of product.

Direct Labor Budget – A detailed plan that shows the labor requirements needed to meet projected production requirements over a specified period of time.

Direct Materials – Any manufacturing materials costs that can be conveniently and easily traced to individual units of product.

Direct Materials Budget – A detailed plan that shows the amount of raw materials that must be purchased during a specified period of time in order to meet production needs and provide for the desired level of ending raw materials inventory.

Directing – Mobilizing employees to carryout plans and perform routine operations.

Discretionary Fixed Cost – Any fixed cost that is considered to be relatively easy to adjust because it arises from annual decisions by management to spend in certain fixed cost areas such as advertising, employee development, or research and development.

Duration Driver – In activity-based costing, a measure of the amount of time required to perform an activity.

Earnings Per Share (EPS) – A measure of the net income earned on each share of common stock outstanding; calculated by dividing net income minus preferred stock dividends by the average number of common shares outstanding during the year.

Economic Value Added (EVA) – A concept similar to residual income used for performance evaluation purposes.

Enterprise Governance – The set of responsibilities and practices exercised by executive management and the board of directors with the goal of providing strategic direction, ensuring that objectives are achieved, ascertaining that risks are managed appropriately, and verifying that the organization's resources are used responsibly. It is wider than, and inclusive of, corporate governance.

Feedback – Accounting and non-accounting reports and other information that assist managers in monitoring performance and in focusing on problems and/or opportunities that might otherwise go unnoticed.

Financial Accounting – Accounting activities concerned with providing information to external users such as stockholders, creditors, and government agencies.

Finished Goods – Units of output that have been completed but not yet sold to customers.

First-Stage Allocation – The process through which manufacturing overhead costs are assigned to activity cost pools in an activity-based costing system.

Fixed Cost – A cost that remains constant in total, within a relevant range, even as activity changes. On a per unit basis, it varies inversely with changes in activity.

Flexible Budget – A budget that has been designed to cover a range of activity and that can be used to develop budgeted costs at any point within that range to compare to actual costs incurred.

Free Cash Flow – The amount of cash available from operations after adjusting for capital expenditures and cash dividends paid; calculated by subtracting capital expenditures and cash dividends paid from operating cash flow.

Horizontal Analysis – A technique for evaluating a series of financial statement data over a period of time to determine the increase or decrease that has taken place, expressed as either an amount or a percentage.

Ideal Standards – Standards in a standard costing system that allow for no machine breakdowns or other work interruptions and that require peak efficiency at all times.

Incremental Cost – Any change in cost between two alternative courses of action under consideration.

Incremental Revenue – Any change in revenue between two alternative courses of action under consideration.

Indirect Cost – Any cost that cannot be easily and conveniently traced to a specified cost object.

Indirect Labor – Labor costs of janitors, supervisors, materials handlers, and other factory workers that cannot be conveniently and easily traced to individual units of product.

Indirect Materials – Materials costs for small items such as glue and nails that are an integral part of a finished product but cannot be conveniently and easily traced to individual units of product.

Intellectual Capital – Comprised of human capital (knowledge, skills, experience), relational capital (external relationships including customers and suppliers), and structural capital (knowledge that remains within the entity and includes procedures and systems).

Internal Control – The entire system of controls, both financial and non-financial, established in order to provide reasonable assurance of effective and efficient operation, internal financial control, and compliance with laws and regulations.

Internal Rate of Return – The rate or return promised by a capital investment project over its useful life. It is the discount rate at which the present value of all cash inflows exactly equals the present value of all cash outflows so that the net present value is zero.

Inventory Turnover Ratio – A liquidity measure that shows the number of times on average that inventory is sold during the period; calculated by dividing cost of goods sold by the average inventory during the period.

Investment Center – A business segment whose manager has control over costs, revenues, and invested funds.

Joint Cost – Any cost incurred up to the split-off point in a process that produces joint products.

Joint Products – Two or more items that are produced using a common input.

Just-In-Time (JIT) – A production and inventory control system where raw materials are purchased and units of output are produced only on an as-needed basis to meet customer demand.

Keep or Drop Decision – Decision resulting from a relevant cost analysis concerning whether a product line or segment should be retained or dropped.

Knowledge Management – A collective phrase for a series of processes and practices used by organizations in order to increase their value by improving the effectiveness of the generation and application of intellectual capital.

Liquidity – The ability of a company to pay its short-term obligations as they are expected to become due within the next year or operating cycle.

Liquidity Ratios – Measures of the company's ability to pay its short-term obligations as they become due and to meet unexpected needs for cash as they arise.

Make or Buy Decision – Decision resulting from a relevant cost analysis concerning whether an item should be produced internally or purchased from an outside source.

Management by Exception – A system of management which involves setting standards for various operating activities and then comparing actual results to these standards, with any significant differences being brought to the attention of management as "exceptions."

Managerial Accounting – Accounting activities concerned with providing information to managers for planning and control purposes and for making operating decisions.

Manufacturing Overhead – Any manufacturing cost that cannot be classified as direct labor or direct materials.

Manufacturing Overhead Budget – A detailed plan that shows all production costs except direct materials and direct labor that are expected to be incurred over a specified time period.

Marketing or Selling Costs – Any cost associated with securing customer orders and delivering the finished product or service into the hands of the customer.

Master Budget – A summary of the organization's plans in which specific targets are set for sales, production, distribution, and financing activities; generally includes a cash budget, budgeted income statement, and budgeted balance sheet.

Merchandise Purchases Budget – A detailed plan that shows the amount of goods a merchandising company must purchase from suppliers during the period in order to cover projected sales and provide desired levels of ending inventory.

Mission and Vision Statements – Statements that aim to describe the purpose of an organization, define its success, outline its strategy, and share its values.

Mixed Cost – A cost that contains both fixed and variable elements.

Net Operating Income – Income before interest and income taxes have been deducted.

Net Present Value – The difference between the present value of all cash inflows and the present value of all cash outflows associated with a capital investment project.

Operating Assets – Cash, accounts receivable, inventory, plant and equipment, and any other assets held for productive use by an organization.

Operating Department – Any department or segment within an organization within which the central purposes of the organization are carried out.

Operating Lease – An agreement allowing one party (the lessee) to use the asset of another party (the lessor) in an arrangement accounted for as a rental.

Opportunity Cost – The potential benefit that is foregone when one alternative is selected over another.

Outsourcing – The use of external suppliers as a source of finished products, components, or services. Also known as contract manufacturing or subcontracting.

Payback Period – The length of time that it takes for a capital investment project to fully recover its initial cash outflows from the cash inflows that it generates.

Performance Report – A detailed report which compares budgeted data with actual results.

Period Cost – Any cost that is reported on the income statement in the period in which it is incurred or accrued; such costs consist of marketing and administrative expenses.

Planning – Selecting a course of action and specifying how it will be implemented.

Planning and Control Cycle – The flow of management activities through planning, directing and motivating, and controlling, and then back to planning again.

Post-Audit – The follow-up that occurs after a capital investment project has been approved and implemented to determine whether expected results are actually realized.

Practical Standards – Standards in a standard costing system that allow for normal machine downtime and other work interruptions, and which can be attained through the reasonable but highly efficient efforts by the average worker.

Predictive Accounting – The use of process information to project future financial and non-financial performance.

Present Value – The value today of an amount to be received at some future date after taking current interest rates into account.

Prime Cost – Cost of the inputs to the production process. It is the sum of direct materials costs plus direct labor costs.

Process Reengineering – Improving operations by completely redesigning business processes in order to eliminate unnecessary steps, minimize errors, and reduce costs.

Product Cost – Any cost associated with the purchase or manufacture of goods; not reported on the income statement until the period in which the finished product is sold; such costs consist of direct materials, direct labor, and manufacturing overhead.

Production Budget – A detailed plan that shows the number of units that must to be produced during a period in order to cover projected sales and provide desired levels of ending inventory.

Profit Center – A business segment whose manager has control over costs and revenues but not over invested funds.

Profit Margin Ratio – A measure of profitability that shows the percentage of each sales dollar that flows through to net income; calculated as net operating income divided by net sales.

Profitability Index – The ratio of the present value of a capital investment project's cash inflows to the present value of its cash outflows.

Profitability Ratios – Measures of the income or operating success of a company over a given period of time, usually one year.

Quality of Earnings – Refers to the level of full and transparent information that is provided to external users of a corporation's financial statements.

Ratio – An expression of the mathematical relationship between two or more financial statement items that may be expressed as a percentage, a rate, or a proportion.

Ratio Analysis – A technique for evaluating financial statements that expresses the relationship among two or more selected financial statement items.

Raw Materials – Materials that are used to manufacture a finished product.

Reciprocal Allocation Method – A method of allocating service department costs to operating departments that gives full recognition to interdepartmental services.

Required Rate of Return – The minimum rate of return that any capital investment project must yield in order for it to be considered acceptable.

Residual Income – The net operating income of an investment center that exceeds its minimum required return on operating assets.

Responsibility Accounting – An accountability system under which managers are held responsible for differences between budgeted and actual results only for those items of revenue and expense over which they can exert significant control.

Responsibility Center – Any business segment whose manager has control over cost, revenue, and/or invested funds.

Return on Equity – A measure of profitability that shows the efficiency with which operating assets were used to generate returns to stockholders; can be calculated by dividing net operating income by average common stockholders' equity.

Return on Investment – A measure of profitability that shows the efficiency with which operating assets were used to generate operating profits; can be calculated by dividing net operating income by average operating assets or by multiplying profit margin by asset turnover rate.

Sales Budget – A detailed schedule that shows the expected sales for coming periods, typically expressed both in dollars and in units.

Second-Stage Allocation – The process by which activity rates are used to apply costs to products and customers in activity-based costing.

Segment – Any part of an organization that can be evaluated independently of other parts and about which management seeks financial data.

Segment Margin – The amount remaining after a segment's traceable fixed costs have been subtracted from its contribution margin. It represents the amount available after a segment has covered all of its own traceable costs.

Sell or Process Further Decision – Decision resulting from a relevant cost analysis concerning whether a joint product should be sold at the split-off point or sold after further processing.

Selling and Administrative Expense Budget – A detailed plan that shows the expected selling and administrative expenses that will be incurred during a specified period of time.

Service Department – Any department that provides support or assistance to operating departments but does not directly engage in production or other operating activities.

Simple Rate of Return – The rate of a return on a capital investment project that is determined by dividing its annual accounting net operating income by the initial investment required. Also referred to as Accounting Rate of Return.

Solvency – The ability of a company to pay interest as it comes due and to repay the principal amount of a debt at its maturity.

Solvency Ratios – Measures of the ability of a company to pay its long-term obligations as they become due and to survive over time.

Special Order – Any one-time order that is not considered part of the organization's normal ongoing business.

Split-Off Point – The point in the manufacturing process where some or all of the joint products can be recognized and sold as individual products.

Static Budget – A budget created prior to the onset of the budgeting period that is valid only for the planned activity level.

Step Allocation Method – A method of allocating service department costs to operating departments that allocates service department costs to other service departments as well as to operating departments in a sequential fashion that typically starts with the service department that provides the greatest amount of service to other departments.

Strategic Enterprise Management – An approach to strategic management which focuses on creating and sustaining shareholder value through the integrated use of best practice modeling and analysis techniques, technologies, and processes in support of better decision making.

Strategic Planning – The formulation, evaluation, and selection of strategies for the purpose of preparing a long-term plan of action in order to attain objectives.

Sunk Cost – Any cost that has already been incurred or that cannot be changed by any decision made currently or in the future.

Theory of Constraints – A management approach that emphasizes the importance of managing bottlenecks caused by scarce resources.

Times Interest Earned Ratio – A solvency measure of the company's ability to meet interest payments as they come due that can be calculated by dividing income before interest expense and income taxes by interest expense.

Total Manufacturing Cost – Cost of all inputs to the production process during a period. It is the sum of direct materials used, direct labor incurred, and manufacturing overhead.

Total Quality Management – An integrated and comprehensive system of planning and controlling all business functions so that products and services are produced which meet or exceed customer expectations.

Traceable Fixed Cost – Any fixed cost that is incurred because of the existence of a particular business segment.

Transaction Driver – In activity-based costing, a simple count of the number of times an activity occurs.

Treasury Management – The corporate handling of all financial managers, the generation of internal and external funds for the business, the management of currencies and cash flows, and the complex strategies, policies, and procedures of corporate finance.

Value Chain – The major business functions that add value to an organization's products or services, such as research and development, product design, manufacturing, marketing, distribution, and customer service.

Value-Based Management – The process of searching for and implementing those activities that will contribute most to increases in shareholder value.

Variable Cost – A cost that varies in total, within a relevant range, in direct proportion to changes in activity. On a per unit basis, it remains constant as activity levels change.

Variable Cost Ratio – The ratio of total variable costs to total revenues, or the ratio of unit variable cost to unit selling price. It is used in cost-volume-profit analysis.

Variable Costing – A costing method that treats only the variable manufacturing costs (direct materials, direct labor, and variable overhead) as product costs while it treats fixed overhead as a period cost. It is also referred to as direct costing.

Vertical Analysis – A technique for evaluating financial statement data that expresses each item in a financial statement as a percent of a base amount.

Work in Process – Units of product that have been only partially completed and will require further work before they are ready for sale to customers.

Working Capital (Net) – A measure used to evaluate a company's liquidity and short-term debt-paying ability that can be calculated by subtracting total current liabilities from total current assets.

XBRL – A computer language for financial reporting known as Extensive Business Reporting Language. It allows companies to publish, extract, and exchange financial information through the Internet and other electronic means in a standardized manner.

Zero-Based Budget – A method of budgeting that requires managers each year to justify all costs as if the programs involved were being proposed for the first time.