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Handbook of process-based accounting : leveraging processes to predict results

James A. Brimson

THE HANDBOOK OF PROCESS-BASED ACCOUNTING

LEVERAGING PROCESSES TO PREDICT RESULTS

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AMERICAN INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS

AICPA

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Dedication

This book is dedicated to my family. I have been blessed with a wife and children, and now grandchildren whose support and love gave me the strength to write this book. I toast Sheryl, Jimmy, Katy, Steve, Heath, Heather, Carter, Lauren, and Ansley.

About the Author

James A. Brimson is president of Activity-Based Management Institute (ABMI), Arlington, Texas (IPM@starband.net), an international performance management consulting and education company. He is a recognized expert in activity-based management and assists numerous organizations in its successful implementation. He was previously partner-in-charge of then Coopers & Lybrand, worldwide activity-based cost management Center of Excellence, London, UK. His group developed cost management methodologies and worked with clients worldwide. Mr. Brimson was director of CAM-I (an international consortium conducting research and development in advanced manufacturing technology), where he originated the Cost Management Project, the original source of activity-based costing (ABC) as a management tool.

He served on the Cost Accounting Standards Advisory Board (CASAB), which developed new cost accounting standards that apply to all U.S. governmental agencies. He also served on the National Manufacturing Studies Board.

Brimson is a prolific author and co-author in the areas of activity accounting, ABC, cost accounting and cost management. His book *Cost Management for Today's Manufacturing Environment: The CAM-I Conceptual Model* (co-authored by Callie Berliner) won the Management Accounting Section of the American Accounting Association 1990 "Notable Contribution to Management Accounting Literature Award." His other books include *Activity Accounting: An Activity-Based Costing Approach*; *Activity-Based Management for Service Industries, Government Entities and Nonprofit Organizations* (co-authored by John Antos); and *Driving Value Through Activity-Based Budgeting* (co-authored by John Antos).

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Foreword

Our reporting system is acknowledged to be the best in the world, and has set the standards by which all others are judged. As good as our system is, however, it can, and must, be strengthened and made relevant to our new global world of rapid communication in the common language of business.

—Harvey L. Pitt
Chairman, U.S. Securities and Exchange Commission
October 22, 2001

To meet users' changing needs, business reporting must . . . focus on the factors that create longer term value, including non-financial measures indicating how key business processes are performing.

—Report of The AICPA Special Committee on Financial Reporting
"Jenkins Committee"
1994

In today's economy, it would be difficult to find anyone who thought that ideas have no measurable value. Where would we be if not for the ideas people had that led to microchip processors? The Internet? Cable TV? PDAs? Fuel cells? And don't forget what now seem like boring ideas—refrigerators, cars, washers and dryers. All of the items that we take for granted, or soon will, started with someone working on an idea.

So how is it that the current accounting and financial reporting model cannot find a way to properly reflect the value of ideas on a company's balance sheet? How come Wall Street can reward a company that creates ideas through stock price valuation that is many times higher than book value? But it goes beyond Wall Street, to private companies that have a harder time with valuation because they don't have market forces determining a share price on a daily basis.

It is clear that the present-day financial reporting system has not kept up with changes in the world's economy. The current reporting system was designed to track transactions and measure the tangible property a business or organization owned at a point in time. In those days, investors were willing to wait for quarterly numbers to assess a company's stock. But in today's economy, where knowledge assets and intangible assets are such a large part of a company's value, the current financial reporting system is increasingly more difficult to rely on for decision-making.

This is not to say that the reporting system should to be scrapped entirely—it still must focus on such core principles as "definition, consistency, verifiability, comparability, credibility, and integrity," as noted by Harvey L. Pitt, in his October 2001 speech before the AICPA Governing Council. However, the reporting system needs to catch up to twenty-first century realities.

How to change the financial reporting system is a subject of debate, and many alternatives are being discussed, but not yet in an organized way. Some people have called for the valuation and inclusion of intangibles on the balance sheet, while others want nonfinancial information (that is, performance measures) included in the information that companies report to investors.

With this Handbook, you have the examples and tools to implement and operate a process-based accounting system. Leveraging information about processes, along with information in the accounting and other systems, will allow you to begin understanding the immediate and longer-term future of your company. In the short-term, this system can help you run your business proactively rather than reactively. In the longer-term, it gives you a basis for measuring your company's value beyond what currently appears in the financial statements.

The AICPA is participating in the debate regarding a new financial reporting model. Such a model is an idea whose time has come and is best accomplished in a spirit of collaboration among all user communities: investors, analysts, financial managers, regulators, and others.

Alan W. Anderson, CPA
Senior Vice President
AICPA

Preface

"When I say, for example, 'The train arrives at a Zurich station at seven o'clock,' what that means is, 'The arrival of the little hand of my watch at the number seven and the arrival of the train are simultaneous events.' " This quote opened Albert Einstein's 1905 paper that introduced the special theory of relativity. The most interesting aspect of this story is that Albert Einstein was able to conceive the theory of relativity while his peers remained mired in their classical thinking. He changed the world because he approached an established idea from a totally different perspective. What we do and do not see arises because of the way in which we look.

Every profession, including accounting, has its own manner of viewing the world. Accounting has developed its set of tools and methods for answering financial questions over many years. The methods of accounting consist of those formally promulgated—generally accepted accounting principles (GAAP)—as well as widely used practices such as activity-based costing (ABC). Accounting rules come from both these formal and informal sources. As challenges or exceptions to the rules arise, the rules are incrementally changed or, as has happened in some instances, change is stymied by the complexities inherent in the standards in the first place. Three important factors are currently pushing the profession toward a new vision.

First, the chasm between the answers being provided by a patchwork accounting system and the business problems facing organizations has become wider. A primary problem is that organizations remain burdened with a significant amount of non-value-added activities. Downturns in business cycles continue to result in oft-times inappropriate short-term actions, such as downsizing, freezing training, and discontinuing travel, that stop the organizational bleeding but do not cure the enterprise's problems. Financial reporting, to the extent that it may inadequately or unrealistically present the results of operations of entities could misallocate capital funds on the world capital market.

Although these problems are daunting, they require immediate and forceful resolution. Unfortunately, the root of these problems lies at the feet of financial accounting and reporting systems that focus on past results. We must keep those practices that have proven useful while adopting new approaches that lead to forward-looking financial statements. Determining what practices fall into which of those two categories could be difficult.

Second, several powerful professional accounting organizations are beginning to take leadership roles in challenging today's conservative approaches to external reporting. In the United States, the Financial Accounting Standards Board (FASB) and the Securities Exchange Commission (SEC) have stepped forward to apply pressure to the profession to improve its effectiveness. For example, in 1994, the Jenkins Committee, sponsored by the AICPA, issued a report entitled "Improving Business Reporting—A Customer Focus: Meeting the Needs of Investors and Creditors." This document suggested the need for an entirely new accounting framework. In addition, the SEC has often chided the accounting profession and even usurped its authority for failing to address critical accounting issues.

Several of the international public accounting firms have picked up the drumbeat. One noteworthy effort, led by PricewaterhouseCoopers (PwC) is the development of "ValueReporting." The PwC global Web site describes this concept as follows:

> The ValueReporting message is straightforward enough—value is only realized if it is being effectively communicated to the capital markets. Put bluntly, investors cannot value what they cannot see—perhaps explaining why so many managers bemoan the gap that they feel exists between the internal perception of a company's potential and that of the stock market. Methods of corporate valuation and reporting are evolving rapidly, as traditional accounting models can no longer be relied upon to provide a full picture of corporate health.[1]

Third, the explosion of e-commerce and the burgeoning use of the Internet have increased the amount of information available to external parties. A challenge facing organizations is to determine what information should be made available to the public, while simultaneously developing nimble financial and performance reporting systems that allow organizations to rapidly evaluate opportunities—for example, accounting systems that support such concepts as process-based accounting.

The recent sudden increase in the use of "pro forma earnings" is symptomatic of this issue. Some companies have begun to supplement their reported financial earnings with "operating earnings" also known as "pro forma earnings." Organizations tout these results in their news releases and conference calls while downplaying their GAAP reported results. "Once companies' earnings are crunched by the analyst, they enter a food chain, where they are repeated, often without explanation in hundreds of news outlets, including

[1] PricewaterhouseCoopers, "What is ValueReporting?" www.pwcglobal.com/gx/eng/about/svcs/ValueReporting/whatis.html (January 1, 2001).

wire services, newspapers, investment newsletters, cable news channels, and financial Web sites."[2]

The pro forma earnings are unregulated. Since an organization will always seek to show its performance in the best possible light rather than the most comprehensive, one must question the veracity of these earnings releases. Yet, investors are free to look at whatever numbers they deem important and ignore others they consider less relevant. The confusion created by conflicting reported results can bias perceptions of reality in the minds of investors.

At the heart of the matter, financial reporting provides little insight into future performance. If an organization grew by 10 percent last year, what will management expect next year? We all know that they will insist on a continued healthy growth rate. After all, if we could grow last year, what could keep us from doing the same this year? The organization proudly announces to the investment community that they should expect another banner year. Yet examples abound of organizations that surpassed all the analyst expectations for the past reporting period but were on the brink of a downslide. The seeds of rot in an organization's processes were present even when performance was at its height. Unfortunately, the management team did not recognize the signs or elected to ignore them.

There are solutions to these major problems; some of them are even simple. But they require a dramatic shift in our perceptions, our thinking, and our values. Indeed, we are now at the beginning of such a fundamental change of accounting worldview—a radical shift in paradigms. We must accept the need for a profound change in our accounting framework if we are ever going to provide the relevant information that a business so desperately wants rather than a scorecard reflecting past events. But this realization has not yet taken hold with many people in the accounting profession.

To solve our systemic problems, we must be willing to view accounting from a new perspective—the process perspective. Process thinking holds the key that unlocks the promise to breakthrough performance. Multiple techniques are stressing process thinking. The six sigma and quality community talks about improving processes and removing process variation. Lean enterprise promotes reducing time and wasteful activities from the processes. The core competency people talk about focusing on core processes. Michael Hammer focuses on managing processes both within an organization and within its customer and supply chains. Michael Porter speaks about developing a sustaining competitive advantage by focusing on a set of processes that competitors cannot easily duplicate. Supply chain management advocates talk about processes extending between organizations and their suppliers. Enterprise resource planning (ERP) software vendors talk about understanding processes and improving them by using ERP software. The ABC community is in accord about the need to group activities into cross-functional processes to improve performance. Finally, and obviously, process management encourages an orga-

[2] *Wall Street Journal,* "What's the P/E Ratio? Well, Depends on What Is Meant by Earnings," Tuesday, August 21, 2001.

nization to introduce a new business vocabulary that stresses process ownership and process measures.

Process thinking forms the backbone of the techniques that world-class companies have implemented. Combining these tools within a process accounting framework enables an enterprise to develop a financial model that offers a promise of fulfilling the objective and predictive requirements needed for both internal and external reporting.

Developing a process-based accounting system requires a major paradigm shift. Current "accounting-think" can be viewed as a shared collection of concepts, values, perceptions, and practices that forms a particular vision of reality and is the basis for the way the accounting community organizes itself. Thomas Kuhn developed the notion of a scientific paradigm that he defined as "a constellation of achievements—concepts, values, techniques, etc.—shared by a scientific community and used by that community to define legitimate problems and solutions." Changes of paradigms, according to Kuhn, occur in discontinuous, revolutionary breaks called "paradigm shifts."

What is the essence of the new accounting paradigm? At its heart is a shift in accounting from a historical and passive focus to a forward-looking, proactive focus. While accounting standards demand that data be objective and verifiable, the paradigm shift is that if you view an organization from a process perspective, you can have a forward-looking process-based accounting system that is based on objective and verifiable data.

This paradigm shift of accounting to a process view creates a cascade of new management tools. A common accounting practice is to manage cost by cost element (for example, salary and wages, depreciation, travel, and training). Accounting reports the actual cost against a budget or plan from which a variance is calculated. Practically every organization prepares such reports. But why? Variance analysis merely shows actual capacity purchased versus budgeted capacity. For example, assume a human resources (HR) department consists of seven people. The monthly accounting variance analysis will simply tell you that you planned to hire seven people at a certain salary and that you actually hired seven people with salaries close to the plan.

However, purchased capacity is meaningless without an understanding of the work produced by your resources. Similarly, purchased capacity and work performed are also meaningless without measures of performance. What work did the HR people accomplish? Is workload down and we need only six people? Or is workload up and we need more than seven people? Or do we need an immediate process improvement? Too few, or too many, resources will adversely affect performance. For instance, the HR group might get sloppy in their hiring process because they are overworked and merely want to fill a position so they can get on with processing the next vacancy. Yet, a single inferior hire will result in a tremendous loss of value to the organization. Therefore, traditional monthly accounting variance analysis is incomplete without workload and performance information.

The growing importance of intangible assets in creating stakeholder value has created another paradigm shift. For many years, conventional "accounting-think'' has sought a rational approach to include intangible assets on the balance sheet. However, again the process worldview offers an alternative solution. Performance and process control measures enable a new and objective method to measure intangible value. The gist of the new thinking is that processes create value. Assets are consumed as part of a process. We must no longer look to assets as the source of intangible value. Therefore, we should measure the intangible value created by processes.

Processes enable still another paradigm shift in performance measurement. Today we search for an optimal set of performance measures that evaluate how well the organization has performed. The conflict between creating a limited yet comprehensive set of measures often freezes an organization into a state of inaction. Many organizations take years to select their measures and often are never satisfied with them. Again processes offer a paradigm shift in thinking—control the process and good results will follow. The process perspective will continue to shatter traditional paradigms and, thereby, enable organizations to address their most perplexing problems. The antithesis is to measure performance without controlling the process; such thinking is an exercise in futility. Instead of searching for the best set of performance measures, we should institute process controls at the work level with only a minimal number of strategic performance measures reported at the enterprise level.

This book recognizes that an accounting system can be a competitive liability or a competitive advantage. The change to process-based accounting will not be easy. It will involve trial and error, and pendulum swings. Not making the change is the easiest course of action. The ''do nothing'' course of action will result in a continued decline in relevance of accounting information. The management team and external stakeholders will be forced to obtain answers to their financial questions through more nontraditional information sources, such as the ''pro forma earnings.'' On the other hand, accounting can evolve into a competitive weapon wielded by accountants and management teams bold enough to make the paradigm shift.

Organizations that make the change to a process-based accounting system will prepare and generate information that will finally fulfill the long-standing accounting objective: ''to provide information that is useful to present and potential investors, creditors, and other users in making rational investment, credit, and similar decisions.''[3] In other words, accounting would not become the ''Latin language of business'' but would drive the value creation reformation.

James A. Brimson

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[3] Financial Accounting Standards Board (FASB) Statement of Financial Accounting Concepts No. 1, *Objectives of Financial Reporting by Business Enterprises* (Stamford, Conn.: FASB, 1978).

Introduction

This is the first book that presents a practical approach to implementing and operating a forward-looking accounting system. The approach is based on process management principles. Process-based accounting is an important deliverable to financial and operational managers as a management tool. It puts management in a position to anticipate financial results and respond to them, creating sustainable competitive advantage for their company. *The Handbook of Process-Based Accounting: Leveraging Processes to Predict Results* should be required reading for any manager interested in helping their company achieve its strategic mission. The Handbook:

- Shows how to plan for future financial and operational results.
- Shows how to provide managers with "early warning" signals of impending problems in enough time to manage the operations back on track.
- Focuses on processes, which are the fundamental way that things get done in an organization.
- Provides techniques to increase insight and anticipatory management capability not possible with the historical accounting model.
- Shows how to use process data to provide objective and verifiable forward-looking information.
- Introduces a fourth financial statement—the process performance statement—which drives decision-makers to anticipate future performance.
- Shows how to create a better understanding of value by marrying measurable outputs with financial and operational information.
- Helps to identify the process problems that limit value-creation potential.
- Ties together performance measurement, capacity measurement and activity management to create management information for pro-active decision-making.
- Shows how to use process control charts to eliminate the need for a multitude of performance measures.
- Augments traditional accounting information with process and operational data, enabling you to make informed projections and interpretations about the future.

- Tells how the product introduction cycle can be improved with process-based accounting.
- Provides numerous tools, including management reports, illustrations, and tables to implement process-based accounting today.

In clear, practical terms, *The Handbook of Process-Based Accounting* shows you how to recognize problems before they become variances on financial reports, giving you an opportunity to manage operations to meet financial and other targets. This is not a new software product, it is not the latest flash-in-the-pan, and it is not the latest schematic diagram from some high-profile management guru. This Handbook shows you, step-by-step, a new way of approaching existing information and using it to predict some future performance behavior of the company. As we say in process-based accounting, ''Let's close next month's books today.''

PowerPoint Presentation

Free PowerPoint slides are available for downloading from the CPA2Biz Online Store. These presentation slides can be used to present and explain process-based accounting to others in your organization or at your client. To find them, simply access the store at www.cpa2biz.com/store and execute a ''Search'' for the title of the book, *The Handbook of Process-Based Accounting: Leveraging Processes to Predict Results.* Click on the book title to display the full description of the book. Scroll down the screen to see the downloadable PowerPoint slides.

Part 1

Setting Up the Process-Based Accounting System: Implementation and Operation

Part 1 of the book explains the ideas that form the foundations of process-based accounting and presents a step-by-step implementation guide. Chapters 1 through 4 demonstrate that the process management concepts that encompass process-based accounting will provide the management team with forward-looking information that is essential to managing an organization. The three basic financial statements—income statement, balance sheet, and cash flow statement—reflect past events. These statements are vital to meeting fiduciary reporting responsibilities but are woefully inadequate in managing forward. Future performance is inexorably intertwined with an organization's processes. Existing processes will either deliver excellent future performance or will result in unpredictable and fluctuating results.

A practical step-by-step implementation methodology is also presented. The methodology employs a set of tools and techniques that are in use at many companies today. Process-based accounting builds on existing performance-improvement efforts in use at many companies while simultaneously creating synergistic benefits by integrating these tools. Alternatively, process-based accounting enables organizations that have not implemented the core techniques to put into action a skeletal portion of these techniques without having to initiate a full implementation.

1

The Nature and Need for a Forward-Looking Accounting System: Process-Based Accounting

At the beginning of each month, an accounting ritual is performed. Anxieties rise as executives wait while accountants scurry around working long hours to gather and process data to report the past month's financial results. Another month-end close has arrived. Yet for what purpose? At best, the financial information confirms expected results, and management breathes a sigh of relief. At worst, the inquisition begins. Unfavorable variances must be explained.

A bad situation is exacerbated in the case of publicly held companies. They have already issued earnings forecasts, and the penalties (as seen in stock prices) for failing to meet these goals are onerous. Executives huddle to develop strategies to minimize the damage. Operational decisions must be adapted to meet the publicly released projected earnings. This cycle of reactions goes on month after month, unbroken except for the planning and budgeting exercises that wipe the slate clean and release the next earnings projection (see the sidebar "A Word About Key Concepts").

Yet many dream of a new ritual where there is less dependence on historical information—where accounting systems focus attention on upcoming events and provide insight into their probable impact on future outcomes. With such information, executives can concentrate on achieving future financial targets rather than reacting to the next crisis. They want to close the books for next month rather than last month. Enter predictive accounting—the next step in the process-based accounting system.

This chapter will show you how to:

- Define process-based and predictive accounting concepts.
- Use process data to provide objective and verifiable forward-looking information.
- Use a process performance statement as the fourth financial statement.

A Word About Key Concepts

Throughout this Handbook the terms predictive accounting and process-based accounting will be used in tandem. The term ***process-based accounting*** stresses the essential role of processes in the accounting systems of the future. The term ***predictive accounting*** stresses the purpose of adding process data—to create forward-looking information. Forward-looking information is essential to the management process.

Predictive accounting projects future financial performance using a statistical understanding of an organization's processes. Predictive accounting seeks to understand the future. It is neither a crystal ball nor a wicked witch's mirror. It is based on the observation that much of an organization's work is repeatable. The work steps of these activities have been well thought out and provide an "invisible hand" that guides daily work.

Predictive accounting uses process maps to understand the sequence of activities. At any point in time, say the last day of the month, an organization knows the actual events that have occurred as of that date. The process map identifies the upcoming events, which are then translated into predictive financial statements using resource-consumption-activity standards and statistical probabilities.

Predictive accounting expands the three required financial statements (income statement, balance sheet, and cash flow statement) to include a process performance statement. The process performance statement measures the value-creation potential and storehouse of value created by an organization's products and processes.

THE FOURTH FINANCIAL STATEMENT: A PROCESS PERFORMANCE STATEMENT

This book is about accounting systems becoming more responsive to management needs. The principal needs are threefold:

1. Accounting must become more forward-looking. Accounting professionals have long discussed the need for forward-looking financial information. Clearly, the past has already happened, and no reporting system can change history. Yet, while accounting looks backward, management must look forward.
2. Accounting must measure the value-creation potential of an organization's processes. Processes deliver or destroy value; because customers buy value, the organization's processes must focus on creating it. To understand value creation, the management system must answer the following questions: What is the value-creation potential of an organization's processes? How well does the process achieve its strategic objective? How effectively do an organization's processes create positive cash flow? How much do an organization's processes vary (low variation improves cost-effectiveness, improves predictability, and minimizes excess capacity)?

What is the organization's storehouse of value available for future operations? These are very different questions than merely reporting how much an organization spent last period.

3. Accounting must become more relevant to nonaccountants. Operational managers at many organizations have embraced advanced quality concepts, lean manufacturing, and other improvement initiatives. Support groups have implemented improved performance measurement systems and advanced computer systems. Yet, the accounting systems, at even the best of companies, still do not support these initiatives.

The more the major challenges facing businesses are discussed, the more accounting emerges as having an important role to play. By focusing management's attention on the important factors that determine success, accounting must provide management with a concise set of relevant performance information that provides insight into what is likely to occur in the future.

Process-based and predictive accounting seek to answer the questions presented here and to foresee an organization's future performance. The insights predictive accounting provides increase the probability that management action can achieve its strategic mission. Ultimately the challenges must be seen as facets of one single crisis—a crisis of increasing the visibility of the key factors that drive a business's success. It arises from the accounting profession's sustaining a conservative mindset that falsely claims that predicting the future cannot be objective and verifiable. Predictive accounting, however, seeks to disprove that mindset. The role of historical reporting will shift to one that satisfies fiduciary responsibilities, confirms that the expected results were achieved, and calibrates the process-based and predictive accounting system.

Predictive accounting raises the need for a fourth financial statement—the process performance statement. The process performance statement drives decision-makers to anticipate future performance. Organizations that miss their projected performance, by either overshooting it or falling short, must understand why the underlying processes malfunctioned and take corrective action. Inept processes cause organizations to miss their performance projections. A simple philosophy underlies predictive accounting: An organization has the opportunity to manage its operations rather than reacting to outdated reports.

While many have bemoaned the need for forward-looking financial statements, no concrete proposal has been forthcoming of how to fill this need—that is, until now. This publication proposes that a process performance statement be included in financial statements along with the income statement, balance sheet, and cash flow statement. The process statement will quantify the organization's processes and their strategic outcomes (including their current and targeted performance). A sample process performance statement is displayed in Table 1.1.

There are several essential elements of the process statement presented in Table 1.1 that make it forward-looking. To begin with, the process statement is organized by process. The process view represents the organization's work.

Table 1.1 Process Performance Statement

	Amount ($000s)	Value Creation	Strategic Measure/Process Value: Value	Target	Velocity	Variation	Inventory
Sales	$40,000						
Less:							
Raw materials	9,000						
Less:							
Understand markets and customers	280	Revenue per customer	$ 4	$ 5	—	1.3	$ 5,700
Develop vision and strategy	110	Shareholder value	+2%	+5%	—	2.1	800
Design products and services							
Research and development	600	Average revenue per patent	$11,240	$15,000	—	1.1	250
Introduce new product/service	250	Revenue per new product	$10,040	$15,000	—	1.3	200
Refine existing products/services	400	Target cost achievement	88%	98%	—	1.4	32,000
Market and sell							
Market products	860	Revenue per lead	$0.1	$0.15	—	2.0	750
Sell products or services to relevant customer segments	1,250	Contacts sold	45%	60%	3.8 weeks	0.8	18,000
Process customer orders	320	Accurate and on time	92%	100%	5.5 days	2.4	
Produce and deliver for manufacturing/service organization							
Procure materials	1,500	Targeted time, quality and price	84%	100%	25 days	2.3	
Convert resources or inputs into products/service	18,300	Targeted time, quality and price	74%	100%	14.4 days	1.5	1,400
Deliver products	380	Targeted time, quality and price	88%	100%	5 days	2.6	
Invoice and service customers							
Bill the customer	220	On time payment	82%	98%	35 days	2.0	
Provide after-sales service	150	$ per existing customer	$1.5	$1.0	—	2.5	
Respond to customer inquiries	90	$ per existing customer	$0.9	$0.3	—	0.8	

Develop and manage human resources							
Manage deployment of personnel	240	Average length of employment	5.2 years	10 years	—	1.7	
Develop and train employees	150	Improvement rate	4%	10%	—	2.3	
Ensure employee well-being and satisfaction	120	Employee turnover	7.5%	2.0%	—	2.2	
Manage information resources							
Manage information storage and retrieval	480	Targeted service level	62%	100%	—	1.4	
Manage facilities and network operations	310	Targeted service level	87%	100%	—	1.9	
Facilitate information sharing and communication	290	Targeted service level	93%	100%	—	2.1	
Manage financial and physical resources							
Process finance and accounting transactions	490	$ per sales invoice	$1.30	$0.75	—	2.1	
Develop budget	260	Financial estimate accuracy	93%	100%	—	1.4	
Conduct internal audits	140	Significant audit exceptions	3	0	—	2.0	
Manage the tax function	150	Effective tax rate	27%	30%	—	2.1	
Execute environmental management program	100	Targeted environmental			—	1.4	(1,000)
Manage external relationships	90	Cost of capital			—	1.9	500
Manage improvement and change	130	Improvement rate			—	1.3	
Net profit	$3,340						

Some processes, such as research and development, new product introduction, and marketing, create long-term value. Other processes, such as procurement, financial management, and operations, create current period value.

Process Outcomes

The second part (the Strategic Measure, Value, and Target columns) of the process statement records the current and targeted process outcomes. Each process exists to deliver an outcome. An organization must explicitly identify the desired process outcome. This requires a thorough understanding of how each individual process outcome will achieve the overall organization-wide outcome mission. Outcomes must be established for all processes.

Process Velocity

The third section (the Process Velocity column) of the process statement communicates process velocity. Process velocity measures the speed with which the process converts resources into cash. Take for example, the procurement process. A perfect process velocity reduces work in process to zero, meaning that the required material is delivered directly to the requester—exactly when required, with perfect quality, and with the proper quantity. Any deviation from these requirements necessitates working capital to be tied up in raw material inventory. Working capital decreases free cash and lowers the value created.

Process Variation

The fourth section (Variation column) of the process statement summarizes how much each process varies. Process variation is the bane of both predictability and excellent performance. A standard deviation is computed for each process as a measure of variation. A high standard deviation—with a value over 2.0 or 3.0—indicates a stable and predictable process. A 6.0 standard deviation is referred to as six sigma; this is the objective of many organizations. A low standard deviation indicates an unstable and unpredictable process. (See Appendix 2, Six Sigma Conversion Table.)

Process Value

The fifth and final part (Value Inventory column) of the process statement is the value inventory. The value inventory represents the storehouse of value created from past and current operations. Every process creates or destroys value. The inventory of value is unrealized value that is available for future operations. The total value of all processes approximates the organization's overall value.

The fourth financial statement is presented for use within organizations to improve visibility of the factors that influence how efficiently processes create value. Ultimately, a debate will begin on the need to report the fourth process statement externally. Efficient capital markets (a significant external force) need forward-looking information.

Traditional financial reports present the results as things have been; predictive accounting explains why financial results are what they are, and what to expect in the future. For example, the balance sheet reports the final amount of raw material inventory at the end of the reporting period. This information is valuable to an analyst for limited purposes such as calculating ratios for comparisons with prior trends and with industry leaders. However, an investor who understands the procurement process used by the organization has a greater ability to understand *why* inventories are at their reported levels. For instance, a store-and-pick procurement process necessitates higher inventories than a just-in-time (JIT) procurement process. An investor who becomes aware that an organization is in the process of implementing JIT to replace its store-and-pick process has a greater ability to anticipate that the organization will have lower inventory levels in the future. The investor can extrapolate its related impact on organizational costs and earnings.

The potential changes to reporting requirements, tax rules, liability exposure, and financial market regulations will emerge only after an increasing number of organizations implement predictive accounting. The debate will revolve around the following issues:

- *Capital market considerations.* What is the value to the capital markets of reporting value creation? Will the increase in capital market efficiency offset the additional reporting cost? What are the financial reporting rules or requirements that make it more difficult or risky for corporations to collect and provide better information to the public about their intangible sources of value?
- *Standardized process reporting.* Should a standardized process model be developed for key industry segments? Who will be responsible for creating and maintaining the model? Can a better understanding of the contribution of a process to the value-creation chain improve the measurement of productivity?
- *Human capital.* Should reporting of expenditures on human capital (including training and experience) be quantified and included in external reporting requirements?
- *Standardized performance measurement reporting.* Should a standardized performance measurement model be developed for key industry segments? Without standardized performance measures, competitive organizations may each report the same performance measures, which are constructed very differently from each other. Who will be responsible for creating and maintaining the model?
- *Financial performance transparency.* An organization's processes change slowly over a long period of time. Processes can be used to confirm reported financial results or provide warning signals of impending problems.

- *Inventory of value created (market value).* Should external reporting be extended to include the market value created by an organization? What are the policy implications of the improper measurement of the value created? What policy roadblocks, if any, inhibit better measurement?
- *Environmental and safety issues.* What are the ways in which public policies impinge upon efforts by organizations to rethink their value creation strategies? How does the new focus on investments in process value creation, especially human capital and intellectual capital, affect public policies?
- *Tax policy.* Will taxing authorities attempt to tax value creation?

There is a strong view held by many that regulations merely increase red tape and drive compliance needlessly high. In the opinion of these people, presenting process data externally leads to additional bureaucracy. A further concern is that many organizations are unwilling to present what they consider to be confidential information.

On the other side of the debate, these same organizations expect efficient capital markets that enable capital to flow to the appropriate organizations. The price of efficient capital markets is relevant information. Capital markets need more forward-looking information and improved financial performance transparency than is being provided today.

This publication focuses on the use of process information to improve internal decision-making. These external reporting issues, while occasionally referred to in this publication, will not be addressed in depth.

IS PREDICTABILITY POSSIBLE?

Predictability is possible if an organization manages their processes. Repeatability equates to predictability. A human resources worker does not come to work in the morning wondering what procedures he or she should follow when hiring a new employee. Neither does a loan officer ask what criteria he or she feels like following when evaluating a new loan application. To repeat is to do a thing over and over, to iterate, to do it more than once. When work is done repeatedly and consistently, the worker is able to achieve reliable results and the organization can allocate the appropriate resources (capacity) to the work group. Providing consistent results is very important to the person who receives the output of the work. The process's customers expect and demand that the output meets their needs—the output is to be delivered when needed, and it must meet their specifications at the agreed price.

An inconsistent process or a significant change in conditions will negate a process's predictability. A change to a set of conditions is known as an exception to the rule, and exceptions are encountered every day. Processes subject to volatile workload changes or capacity constraints (that is, bottlenecks) are examples. Changed conditions induce variation into a process and decrease its predictability. An exception to the rule requires the person to make subjective decisions that are often inconsistent. The new conditions were not considered when the work procedures were developed and the taskmaster of experience has not yet tested the new solution.

The distinction between predictability and unpredictability is important because prediction is the essence of making a profit. Predictability enables organizations to shape their future. When the predicted results are within statistical limits of the actual results, management has confidence in the process projections. Glimpsing the future enables managers to anticipate problems and thus put themselves in a position to act.

Unpredictability will repeatedly undermine the best efforts of management to achieve targeted results. Financial performance varies dramatically for unstable processes. Management may find it difficult to determine when and how to initiate the appropriate actions when they are constantly putting out fires caused by an unpredictable process. Unpredictability leads to crisis management and chaos. It becomes an adventure every time an unstable process is executed. With unstable processes, managers must become adept at troubleshooting and must be excellent orators to accept the credit for good performance and shift the blame for bad performance. In fact, attempts to achieve profit plans using unpredictable process leads to more frustration than success because managers have too many symptoms of problems to chase. Preemptive action, rather than reactive action, keeps profits up.

Action is required where the predicted results are not within statistical limits of actual results. The process must be improved to reduce its variation. Some factor has changed the process's performance pattern, or the organization did not properly understand the original performance variables. In either case, the root of the problem must be uncovered and the process renewed. Management can stay far ahead of problems when they proactively resolve any conflicts between the predicted and observed process patterns.

SUMMARY

The tools of process-based and predictive accounting have been under development for the past several years. The ultimate goal of predictive accounting is to develop better ways to measure, monitor, and invest in value creating processes. Initially the focus is on improving internal management practices. What remains to be determined is proof of the practicality of process-based accounting, and a harmonization of external reporting with the predictive accounting system. As financial statements move from using historical cost to being forward-looking, value reporting and financial reporting can move from regurgitation of the past to prediction of the future.

2

The Process-Based and Predictive Accounting Framework

As stated at the outset of Chapter 1, "The Nature and Need for a Forward-Looking Accounting System," process-based and predictive accounting projects future financial performance using a statistical understanding of an organization's processes. Armed with process-based accounting information, management can focus on answering the following questions faced daily by operational people:

- What is your anticipated upcoming performance?
- How much value are your processes capable of creating?
- What are your biggest process problems that limit your value creation potential?
- What are your desired process outcomes? How close are your actual outcomes to targeted outcomes?
- How stable (predictable) are your processes?
- What is your process capacity and how well is it matched to future requirements?

WHY USE PROCESS-BASED ACCOUNTING?

Predictive accounting seeks to change the internal short-term financial emphasis from reporting what happened in the immediate past to what is anticipated in the immediate future—variance analysis is transformed into variance prevention. Economic success increasingly depends on the effectiveness and speed with which an organization adapts its internal processes to changes in the external environment (for example, changes in customers' needs, competitors' actions, and economic forces). An executive needs to know of problems before they become variances on financial reports that must be explained.

Process-based accounting provides decision-makers with "early-warning" signals of impending performance problems. Timely signals enable managers to take proactive corrective action aimed at altering potentially undesirable results. Proactive action keeps performance on track before it becomes an insurmountable task to attain the targeted performance results. This goal is feasible because the future is yet to occur, which means predictive costs are changeable (as is not the case with historical reporting). Predictive costs are pertinent because they consider the statistical probability that a process will deliver a certain cost and performance results. Conversely, bad news that is reported only after it occurs severely limits a manager's opportunity to shape future performance.

WHAT DOES IT INCORPORATE?

Predictive accounting integrates a variety of process tools into an enterprise management framework. The tools that make up predictive accounting are already in use at many well-run companies—six sigma, root cause analysis, ISO 9000, balanced scorecard, lean enterprise, activity-based costing, integrated computer systems, and process mapping. Using existing tools is very provocative because it does not depend on unproven concepts.

What predictive accounting adds is a foundation that integrates these elements into a process framework. Of chief impetus is the convergence of process knowledge and information technology that has enabled management to advance the process model. A process framework (see Figure 2.1) creates a powerful synergy by joining these potent but independent techniques. It also institutionalizes the use of process tools into a comprehensive management system.

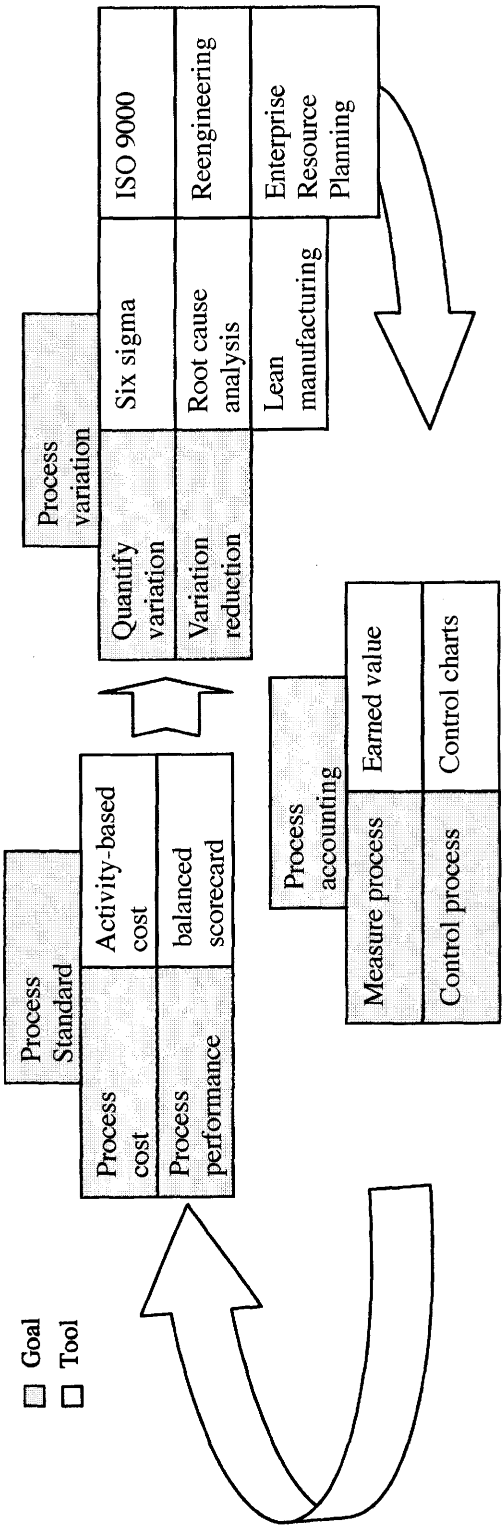
It should be kept in mind that predictive accounting does not require an organization to implement all the process-based accounting tools and techniques. Predictive accounting uses components of these tools, as explained in the next section.

HOW DOES IT WORK?

The concepts that form the foundation of predictive accounting are very simple—future cost and performance are the consequence of certain events that have already occurred. These events become the basis for the following:

- To measure the value created by the process (see Chapter 5, "Determining Value Creation").
- To project upcoming activities that will follow (see Chapter 6, "Process Management: The Key to Creating Value").
- To project cost using a process resource consumption rate (standard cost) (see Chapter 6).
- To constantly reduce process variation (see Chapter 7, "Process Variation and Cause-and-Effect Analysis").
- To adjust the cost and performance projections based on the compatibility of work to an organization's existing processes (see Chapter 8, "Creating Value With Product Management").

Figure 2.1 Process-Based Accounting Tools



- To measure process performance (see Chapter 9, "Using Reliable Performance Measures for Maximum Effectiveness").
- To update the process (activity) standard with each significant process improvement (see Chapter 10, "How to Use Earned Value Reporting as a Feedback System").
- To use control charts to measure whether a process is in control (see Chapter 10).

WHEN IS IT REPORTED?

Process-based accounting reports are provided on a periodic (monthly) basis. The reports must provide the management team with timely information. A monthly process-based report enables management to take corrective action before the projected performance problems becomes an unfavorable variance fact.

SIX ELEMENTS OF PROCESS-BASED AND PREDICTIVE ACCOUNTING

Process-based accounting is the foundation of predictive accounting. A process consists of a sequence of steps that consume resources to transform material, energy, or information from an initial state (input) to a final state (output). A process is how an organization offers its products or services—in fact, there can be no product or service without a set of processes. Processes represent the work of an organization.

Predictive accounting sees a business not as a collection of isolated events, but as a network of events that are fundamentally interconnected and interdependent. In every organization there are literally hundreds of major processes (macro processes) going on every day. Most are repetitive—an organization does the same thing over and over again. If an organization does repetitive work in an expected sequence, there is no reason that accounting should not look forward as well as back. Traditional accounting reports the financial results of how well the organization performed its processes in previous periods. Predictive accounting reports how well the processes are capable of performing in the future periods.

Processes are forward looking by virtue of their repeatability and the sequential nature of work. The sequential relationship of processes is the key to assessing work patterns. Given this understanding, predictive accounting considers the events that have already occurred and statistically projects upcoming workload. Cost and performance can be projected, within statistical limits, by associating resource consumption with these future events. Thus, an organization should monitor initiating events, detect whether (or when) the events were expected, assess whether the events will cause process variation, and then use statistical analysis to project the potential financial impact of the events.

Organizations strive to develop well-planned processes that consistently achieve their targeted results. A key to consistency is dependability. A consistent and dependable process will deliver predictable and high-performance outcomes. It also minimizes the "just in case" excessive capacity required by an out-of-control process.

Process-based accounting becomes forward looking by clearly understanding several characteristics of a process:

- *Flow.* The sequence of processes and activities within a process.
- *Resource consumption.* The average amount of resources consumed in producing one unit of output.
- *Cycle time.* The time taken by the process to transform an input into an output. Cycle time is directly related to process velocity, that is the ability of the process to create free cash.
- *Effectiveness.* How well a process meets its cost and performance targets.
- *Storehouse of value.* Value inventory created for future operations.
- *Process value creation.* Gauged by the excess of life cycle revenue over cost.

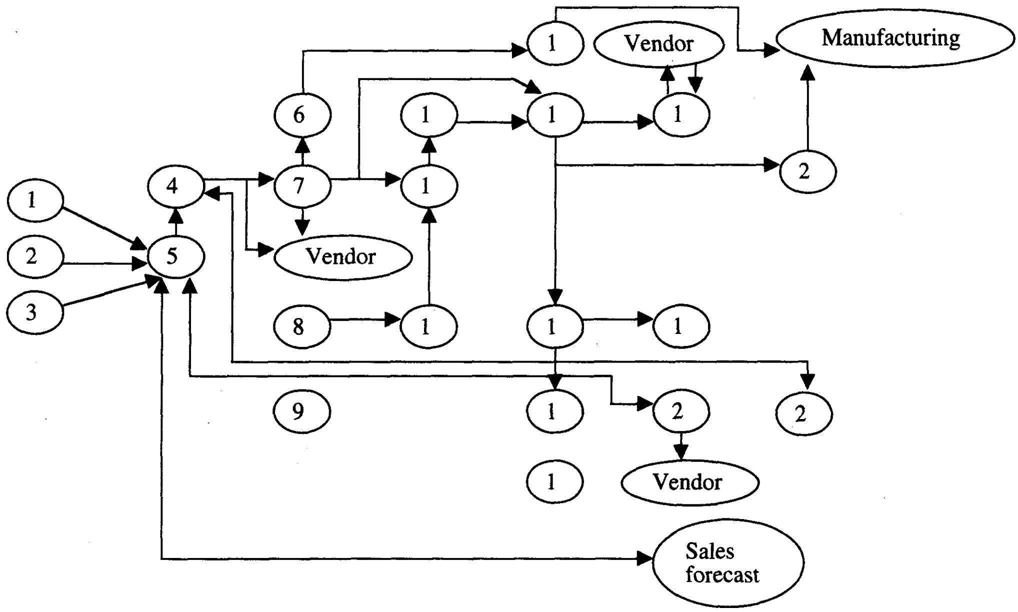
Process Flow

The activities of a process are linked by the physical or information flow: The outputs from one process become the inputs to one or more other processes. A process is triggered by an event. A process cannot be activated until its inputs are available, and they are available only when all processes that produced them are completed. This implies that all events have a sequence; certain events precede and other events follow. At any point in time, certain events have already occurred that will largely dictate the upcoming short-term events. In other words, the seeds of the future have to a large degree already been sown. Stated in technical terms, an organization's future financial performance is the consequence of a series of interrelated cause-and-effect business events and activities.

Process maps are a graphical representation of physical or information flows. A sample procurement business process map illustrates the dependence among events (see Figure 2.2).

The procurement process map portrays the sequence of events in the procurement process. The process is executed every time a purchase order is placed—an event that takes place dozens of times in a single day. If the procurement process were plotted on a time-phased graph each time for each purchase order placed, management would understand when all upcoming activities in the procurement process are anticipated to occur. During any month, each purchase order would be found in a different state of completion depending on when the process was started. Of even more interest, statistical predictions could be made to ascertain how much work was to be accomplished during the upcoming month. The necessity for the upcoming activities has already been set in motion by earlier events—the placing of a purchase order. Predictability does not depend first and foremost on forecasting—rather it depends on an understanding of the sequence of events (see Figure 2.3) and the statistical probability of the resulting financial impact.

Figure 2.2 Procurement Process



Procure Material			
1 Develop sales forecast	Sales	12 Expedite material	Receiving
2 Take customer phone order	Sales	13 Expedite material	Quality
3 Take customer mail order	Sales	14 Inspect material	Quality
4 Issue requisition	Planning	15 Reject material	Quality
5 Run Material Resource Planning	Planning	16 Returns goods to vendor	Quality
6 Resolve vendor problems	Purchasing	17 Certify vendor	Quality
7 Issue purchase orders	Purchasing	18 Pay vendor invoice	Accounting
8 Expedite orders	Purchasing	19 Contact vendor	Accounting
9 Certify vendor	Purchasing	20 Issue debit order	Accounting
10 Move material	Receiving	21 Store material	Warehouse
11 Receive material	Receiving	22 Cycle count inventory	Warehouse

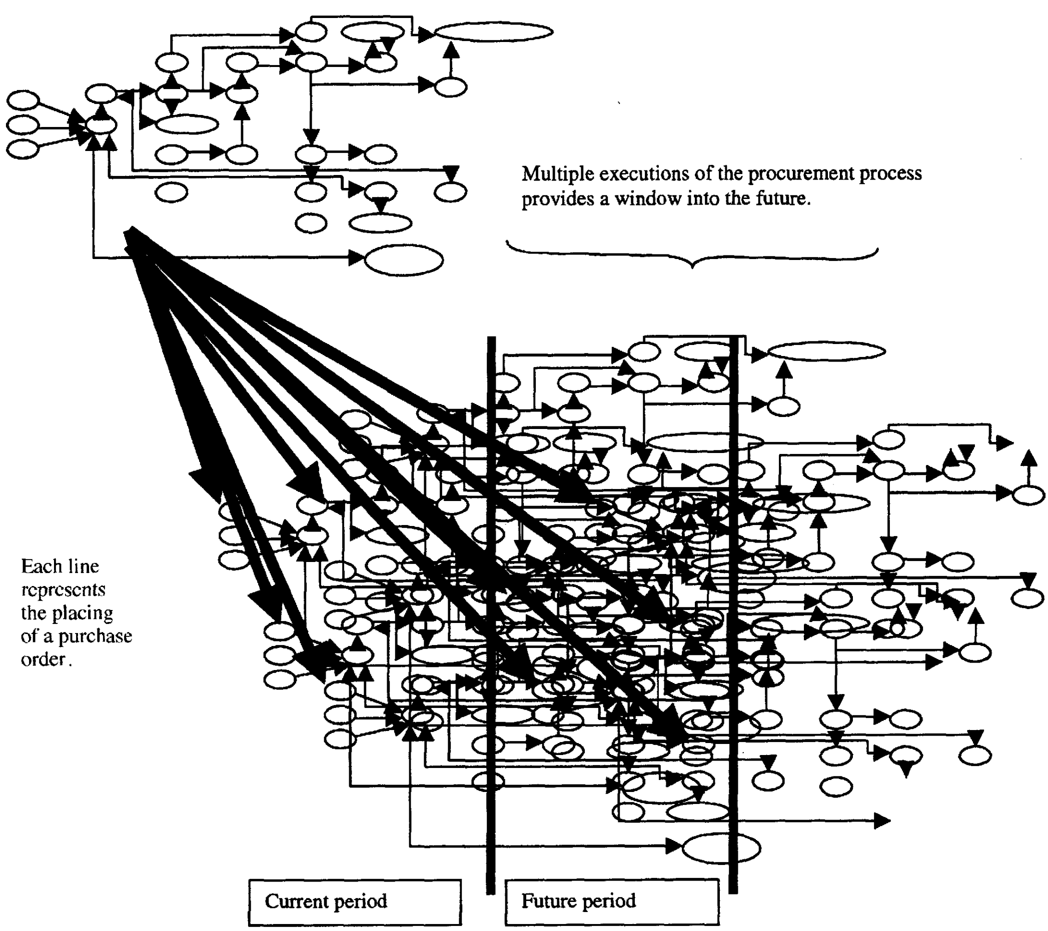
Process Resource Consumption

A second major factor that makes processes forward looking is each activity consumes resources in a rational and predictable manner. The process (activity) standards provide a powerful basis to project future performance. The model assigns resources to process (activity) based on the average amount of resources needed to complete one unit of output. For example, an activity process cost could be developed for the activity of collecting past-due invoices (see Table 2.1).

Process Cycle Time

A third major factor that makes processes forward looking is a short process cycle time, also called process velocity. The shorter the cycle time, the more

Figure 2.3 Sequence of Events



predictable the process. Process cycle time is the total length of time required to complete the entire process. Process velocity measures the speed with which the process converts resources into cash. It includes not only the time taken to perform the work but also the time spent moving, waiting, storing, reviewing, and reworking. Reducing cycle time creates free cash flow. Economic value thinking has taught that free cash flow equates to shareholder value. Money tied up in working capital decreases the amount of free cash flow. It frees resources, reduces cost, improves the quality of the output, and can increase sales. Consider the following processes:

Process	*Process Velocity Impact*
New product introduction	Earlier sales
Procurement	Lower finished goods inventory
Production	Lower work-in-process inventory
Product distribution	Lower finished goods inventory
Bill customer	Lower accounts receivable

Table 2.1 Activity: Collect Past Due Invoices

Performance measure	Day's sales outstanding	32 days	
Resources consumed:	Collection clerk	12 minutes	
	PC workstation	12 minutes	
	AR software	1 past due invoice	
	Facilities	100 square feet	
Outputs consumed:	No. of past due invoices	10,000 per year	
Cost of resources consumed:	AR clerk	\$12.50 per hour for 1/5 hour	\$2.50
	PC workstation	\$3,000 cost; 3 year life; \$1,000 / (120,000 min. per year) × 12	0.10
	AR software	1 invoice × \$0.05 / invoice	0.05
	Facilities	\$14.00 per square foot per year; \$1,400 / (120,000 min. per year) × 12	0.14
Cost per past due invoice processed			\$2.79

Note: The \$0.05 per invoice was derived from the shared service accounting system.
Future costs are predictable because we know the average amount of resources that are consumed each time an activity is executed.

Organizations that have streamlined their processes to improve process velocity will create more free cash flow and have a more predictable process than those that have slower process velocity. The inevitable consequence is that organizations with effective processes are better positioned to create free cash and thus have a greater value creation potential.

Process Effectiveness

A fourth major factor that influences whether a process is forward looking is process effectiveness. A highly effective process consistently and predictably delivers its output. Process effectiveness depends on two main factors: the ability to consistently meet process outcomes and process variation.

The first measure is whether a process can consistently meet its targeted outcomes. Each process exists to deliver an outcome. An outcome is the performance results—the consequence of a process. An outcome clarifies why a process exists. For example, the success of a training program should not be measured by the number of students trained but rather by an increase in process efficiency following training. Failure to achieve this outcome causes high-cost, self-induced crises and dissatisfied customers.

Organizations that consistently achieve their targeted process outcomes will create more future value than those that do not. Highly effective processes (that is, a minimal gap between the target and the actual outcome achieved) can be relied on to deliver future value—they have proven their mettle. Highly ineffective processes (that is, a large gap) cause business events to spiral out of control, creating self-induced crises that reduce value creation.

The second measure of process effectiveness is how much a process varies. All processes vary. How much a process varies can be computed using statistical techniques. Where the variation is wide, there can be a significant difference in performance results of the process. Wide variation invalidates a predictive system. More important, wide variation also negates any consistent performance. Buyers and investors will shy away from organizations that cannot effectively execute their processes.

The less a process varies, the greater its predictability. The better the predictability, the greater the value-creation potential of an organization. A low process standard deviation indicates an unstable and unpredictable process. Managers must understand the magnitude of their process variation and constantly eliminate the factors that cause it. Process-based accounting requires organizations to measure and track process variation. When the measurement is coupled with root cause analysis, the manager is armed with the information needed to reduce process variation.

Process variation is an important indicator of an organization's ability to create value. For example, an organization might have reported excellent sales performance during the past period. However, if the sales process has significant variation, a reasonable investor will have little confidence that the sales successes will continue in the future. In fact, statistically one would expect below-average sales performance in the near future.

Process Storehouse of Value

A fifth major factor that influences the forward-looking nature of a process is the ease in measuring the value created by a process. The storehouse of value created represents the "reserve" future operations can draw on. It is important to keep in mind the difference between measuring value and measuring cost. For example, an organization may have two improvement projects that cost the same amount of money. However, one project can have a much greater improvement impact than the second project. The cost of the two projects is the same, but the second has much greater value to the organization.

The value inventory represents the storehouse of value created (or lost) from past and current operations. Every process creates or destroys value as discussed in the next section. The inventory of value is the unrealized value that is available for future operations. The total value of all processes approximates the organization's overall value.

The significance of the storehouse of value should be obvious to any decision-maker. An organization that has created a storehouse of unrealized value is in a strong position to prosper in the future. An organization must carefully balance the short-term performance results with investments in future value. Accounting systems measure the cost expended on any process—not the value created. Value represents the importance of the output to the process user.

However, value can change very rapidly in a short period of time. For example, companies that offer an anthrax vaccination have seen the value of their product soar in the wake of September 11, 2001, events. These rapid changes in value illustrate the dependence of value on key external events.

Process Value Creation

A basic tenet of predictive accounting is that processes create value. It follows that an organization must measure their process performance if it is to measure value. A process-based accounting system monitors the consistency and performance of the organization's processes and consequently improves results. Good performance and predictability inevitably follow. Value is gauged by the excess of life cycle revenue over cost. Processes create value in several ways, including:

- By achieving their targeted outcomes. An organization's strategic mission should be deployed to every process as a targeted outcome.
- By rapidly creating positive cash flow. Economic value is created by generating free cash flow.
- By minimizing process variation. Large process variation causes high costs, problems in downstream processes, excess "just-in-case" capacity, and unpredictability.
- By "rightsizing" cost—largely affected by the physical work accomplished weighed against the actual costs to accomplish that work.
- By matching process capacity to customer requirements.

PERFORMANCE MEASURES IN PROCESS-BASED ACCOUNTING

Process information is incomplete without performance measures. Although processes predict future performance, performance measures analyze how well processes are performed. Not all organizations can or will implement a process equally well. Process-based accounting requires a comprehensive spectrum of measures, both financial and nonfinancial (for example, cost, time, quality, and productivity), to provide a meaningful context for understanding past performance while anticipating the effectiveness of investments in capital and technology. A company seeking to measure business performance by using only cost data will make a serious error, because that company will continue to measure spending levels without measuring the underlying factors that influence future performance.

What makes predictive accounting distinctively different from a traditional performance measurement system is its difference in philosophy. A traditional system seeks to measure past performance. It waits for an event to occur and for the process to be executed. It then measures how well the process performed. This is a passive system. A further problem arises in the large amount of data needed by passive systems. A performance measurement system must measure all the critical factors that influence performance.

In contrast, predictive accounting seeks to shape future performance. It employs process controls to monitor the process and ensure the performance targets are met. This approach minimizes the number of factors to measure by an order of magnitude. It is totally unnecessary to measure performance when we know beforehand whether performance is going to be achieved. A process that is in control will deliver predictable performance—therefore why measure it?

A second powerful aspect of predictive accounting is the way it measures strategic performance. The measurement system measures the strategic outcomes of the enterprise. Again, very few measures are necessary to accomplish this goal. The outcome results will validate the selected set of strategic performance measures or indicate the need for new ones. Where an enterprise outcome result is unpredictable, the set of performance measures must be improved. Conversely, where enterprise outcome results are predicted by the performance measurement system, management can have confidence they have their hands on the pulse of the business.

TRADITIONAL ACCOUNTING IN MANAGEMENT DECISION MAKING

Traditional accounting presents last period's performance results. This data is objective and verifiable. It answers questions such as: Does the bottom line show a profit or loss? How much did the organization spend on advertising? This data is fairly easy to understand, and it can be proven to be true, which is more valuable to management than somebody's opinion. As a consequence, accounting plays a central role in a management system:

- It assesses the financial results of past operations (income statement).
- It measures the wealth created from past operations (balance sheet/cash flow statement).
- It provides a basis for projecting future financial performance (budgeting).

The accounting profession has set distinct boundaries between two groups of activities, or systems: financial accounting systems—the first estate of accounting—related to reporting past financial results, and management accounting systems—the second estate of accounting—needed for internal management decision making. Such distinctions are intended to differentiate between the "hard" numbers that are based on generally acceptable accounting principles (GAAP) and the "soft" numbers used to make business decisions. Business performance measurement systems—the third estate of accounting—produces measures that are frequently used to supplement management accounting information but have not yet become an integral part of financial accounting. A popular performance measurement system is the balanced scorecard. Thus three separate systems are often in simultaneous use at organizations leading to contradictory and incomplete messages conveyed to the management team.

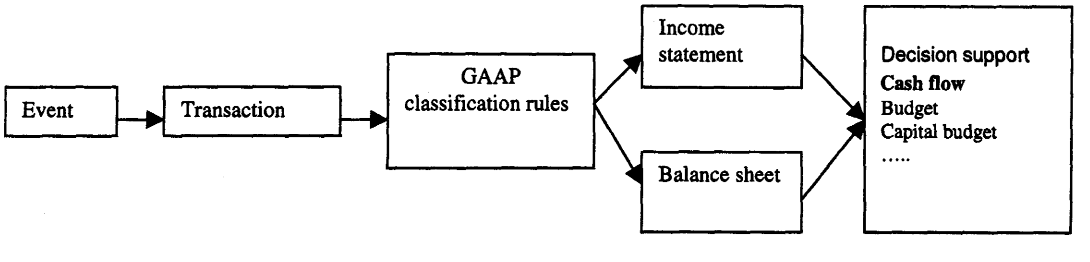
The first estate, financial accounting systems, records an organization's transactions, assigns them to cost accounts, and prepares periodic financial statements from these records. Financial reporting assesses, both accurately and objectively, the historical financial results that fulfill an organization's fiduciary responsibilities. Stakeholders in an organization need confidence that the reported numbers are consistent and free of fraud and bias. GAAP has been developed to meet this requirement. For all the arguments about the merits of traditional accounting, the fact remains that it is a very powerful tool for fulfilling the fiduciary responsibilities of an organization.

The various financial reports are used to impart information about the financial results during a past period of time to managers, owners, creditors, stock analysts, governmental agencies, and the general public. The resulting income statements, balance sheet, and cash flow statement are reports intended to be the definitive financial results for a past reporting period (see Figure 2.4 for a conventional financial accounting process). Auditors attest to the financial statements that the reported information complies with GAAP principles.

An important attribute of financial accounting is that the reported data is historical. Accountants record the financial results of the actual events that occurred during a period of time. Financial reports are historical because the event that generated the transaction has already occurred. The advantage of historical information is that it is objective, consistent, and verifiable. It also provides absolute results that are recorded at their dollar-and-cents amount and are balanced through the use of double-entry accounting. This provides the precision that accountants so avidly seek. Even though accounting practices provide some latitude in choosing the accounting methods used for reporting financial results, financial report users have a high level of faith that the financial statements "present fairly" the performance of the organization during the reported period.

The second estate, management accounting systems, rearranges data into formats that are most relevant to both internal management and an organization's stakeholders. The stakeholders need a useful management tool for deciding what to do about the future. Today's approach, without a process-based accounting system, is to develop decision support calculations that use historical data as a forward-looking tool. Trying to make historical data useful as a predictive tool has proved to be the weakest link in accounting practice. Simply extrapolating last period's results to the future is of limited value. The world changes rapidly. There are new competitors, substitute products and services, replacement products and services, and new ways of performing work. All these factors make simple extrapolation of the prior period to forecast the future yield potentially erroneous results.

Figure 2.4 Conventional Financial Accounting Process



The need for forward-looking information has never been greater than today. Managing with historical information has often been equated to driving a car by only looking in the rear view mirror. You can objectively report an organization's past-period financial results. You can even create a map of what you expect the upcoming financial "road" to look like (a budget). However, any upcoming potholes or obstructions can devastate the best-laid plans. Leading organizations want to know about the future. They want to understand what to expect. If accounting remains primarily focused on providing fiduciary information, accounting will have decreasing relevance at companies.

Three Primary Limitations of Traditional Accounting

Three primary limitations of traditional accounting make it difficult to use as a forward-looking management tool. The limitations of traditional accounting include the following:

- It is inadequate to measure the value created by an organization.
- It does not measure the performance outcomes, other than profits, of an organization.
- It does not provide a context (measure of goodness) to an actual result; it must be compared to another number.

Value Measurement

Traditional accounting practices do not adequately measure the wealth created from operations. Traditional accounting was established on the basis that wealth is created by tangible assets. The recent shift from tangible to intangible assets in many technology and service organizations has shattered this assumption. How is an organization's brand value measured? How much value is customer loyalty worth? These issues are deemed to be subjective and difficult to quantify and are thus shunned by all but the most progressive accountants.

Some argue that the stock market creates its own assessment of the intangible worth of an organization. However, stock analysts do so using too much subjective information. Examples of over-priced stocks abound. Failure to adequately measure the intangible assets of a knowledge-based organization reduces the relevance of the financial information and causes significant disruptions within the capital markets.

Most executives are hesitant to release predictive information to outside parties for fear that they might highly punish the organization for failing to meet its projected performance. A much easier course of action is to revise the historical results by using "pro forma earnings." (See the sidebar "What Are Earnings? The Conflict Between GAAP and Wall Street.") Thus using accounting as a forward-looking decision tool has primarily been relegated to internal management accounting. For decision-making purposes, predictive information is more important and more relevant information than historical reporting.

What Are Earnings? The Conflict Between GAAP and Wall Street

Companies and the accounting regulators have been increasingly at odds over information that is reported to Wall Street. Many company executives believe the conservative nature of GAAP makes it an increasingly misleading tool for reporting financial results to investors. Some companies have begun to supplement the reported financial earnings with "operating earnings," also known as "pro forma earnings." These results are presented in an organization's news releases and conference calls, while its GAAP reported results are downplayed.

Pro forma earnings are typically higher than net income because they exclude special and one-time events at the whim of management. The rationale is to provide investors with a clear set of performance results of their ongoing business that are not muddied with unusual events. The conservative nature of GAAP requires these items be included in current earnings.

The argument against having separate pro forma earnings is that they are completely unregulated and an organization will always seek to show its performance in the best possible light rather than the most comprehensive. Many items organizations seek to exclude are the consequence of poor processes—inventory write-offs, the expense of employee layoffs and asset revaluation to name a few. If the underlying processes have not been fixed, these accounting adjustments are destined to reoccur. If the processes have been improved, these adjustments do not reflect future operating results and should be excluded. Whether to classify an item as one-time is intertwined with process knowledge.

The Internet and the corresponding explosion of available information have heightened the arrival of pro forma earnings. Investors are free to look at whatever numbers they deem important and ignore others they consider less relevant. The confusion created by conflicting reported results can bias investors.

Performance Outcome Measurement

Traditional accounting does not measure the performance outcomes of an organization. Traditional accounting directly measures the revenue generated by an organization and its resource cost. Measures of how well an organization performed are reduced to a single figure—operating profit or loss, the difference between revenue and cost. Measures of efficiency are missing from the accounting equation. How much work was accomplished? How efficient were the processes in delivering the products and services? How much value was created for or drained from the enterprise?

Answers to these critical questions depend on expanding the accounting systems to include operational (nonfinancial) data. Internal management, as well as external stakeholders, want to understand whether an organization's processes are capable of delivering the targeted strategic outcomes. If not, rather than making a fourth-quarter revision of profit targets, the organization must systematically improve a process's capabilities to meet these targets. This requires an organization to establish process controls (see Chapter 7, "Process Variation and Cause-and-Effect Analysis") for each activity and to develop a set of performance measures (see Chapter 9, "Using Reliable Performance Measures for Maximum Effectiveness") to determine success in achieving strategy.

Result Measurement

It is difficult to provide a context for judging an organization's performance, that is, meaningful results. Throughout the years, accounting has sought to fulfill organizations' forward-looking requirement by supplementing historical data with contextual data. Management and investors simply cannot make sense of any actual (absolute) result without a contextual starting point. Accounting needs supplementary numbers against which to compare actual results in order to provide a meaningful interpretation. Some of the most common comparisons include the following:

- Actual results with budgeted results
- Actual results with the same month last year
- Actual year-to-date results with the previous year-to-date results

The comparisons have been traditionally presented in monthly reports consisting of several pages of tables of numbers that are extracted from accounting records. A typical monthly report might look like the one shown in Table 2.2.

Budget Variance Analysis. A budget is a financial plan for a future period. Budgets, plans, and targets are all specifications of where the organization wants to be in the future. During any period of time, accounting measures the actual results. The fact that the actual results are stated as a single value means that accounting is using an absolute value for financial performance measurement. For example, the accounts receivable department spent $16,265.90 for salary and wages. To give context—a form of a benchmark—to the actual result, that number must be compared to another absolute number, such as the budgeted or planned expenditure. Say the department budgeted to spend $15,000 on salary and wages. A variance between the actual and budgeted expenditures is $1,265.90.

The objective of this comparison is to form a judgment whether the actual value is either desirable or undesirable. The budget provides a "stake in the ground" against which to judge actual results. The underlying concept is that significant variances (in particular, overspending variances) are bad until proven otherwise. Significant variances are analyzed to determine the problem that caused the variance. In this case, why is the department spending more

Table 2.2 Conventional Performance Analysis

Budget variance

Percentage analysis

Monthly report for September 30
Department: Accounts Receivable

Production	Monthly Actual Value	Monthly Budget Value	% Diff	% Diff From Sept Last Year	Year-to-date Values Total	Year-to-date Values Budget	Year-to-date Values Diff	This YTD as % Diff of Last YTD
Salary and wages	16	15	4	+13	163	150	9	(8)
Depreciation	5	5	0	+ 2	45	0	100	+100
Supplies	2	1.5	33	+ 8	4.46	4.16	7	+9
Training	0	1	(100)	- 50	11.02	11.27	(2.2)	+9
Travel	4	2	100	- 50	280.82	278.82	1	+2
Outside service	9	10	(10)	+20	21.6	19.7	10	+6

Prior period

on salary and wages than planned? Corrective action, where deemed appropriate by management, should be initiated to resolve the problem and prevent future variances from plan.

Advocates of historical reporting suggest that variance analysis is a powerful tool that improves future financial performance. Variance analysis enables organizations to learn from history (a significant variance indicates a probable problem). Once identified, the organization should correct the problem to prevent it from recurring in the future.

There are, however, several flaws in this logic. First, this approach assumes that the problems that occurred in the past period are the most urgent and significant problems to be fixed. Just because a problem recently occurred does not make it the most pressing problem.

Second, it is hard to motivate managers to invest in improving long-term performance given the limited resources at their disposal. Every organization must use its problem-solving time very carefully because when staff members are problem-solving, they are not performing their regular work. Limited resources have become a fact of business life that has arisen from downsizing and pressure to improve short-term performance. In a lean environment, management attention will always be focused on completing current work rather than resolving past problems.

Third, the most common variance analysis practice is to compare actual costs to budget by type of resource—salary and wages, travel, supplies, and so forth. This form of variance analysis may provide misleading signals because it tells only a piece of the performance story. A variance simply informs users that they had more or less of a resource than planned. To complete the analysis one must know:

- The amount of work the group needed to complete. Management must assess how much work was actually completed relative to the amount of work to be completed. Did the group complete all the actual required work, or was some backlogged?
- The group's work capacity. Said another way, when a resource is paid for (a departmental cost), the organization is purchasing a capacity to do work. The original workload forecast was a prime determinant of the budget. What traditional financial variance analysis portrays is the actual capacity purchased compared with the planned capacity. The most important fact goes unrecorded: How effectively did the group use its available capacity? Insufficient capacity will result in poor performance; work will become backlogged or it will be done less thoroughly. Too much capacity results in high cost and lower profit margins.
- How well the group executed its work. Variance analysis fails to quantify process performance. How well was the activity performed relative to targeted performance? Poor performance will alienate the process's customers.

Budget plays an important role in the single most important number reported within a business: profits. An organizational crisis is inevitable when management finally accepts that they will not reach their budgeted profit margin. Drastic times call for drastic measures. Draconian cost controls are often implemented to stem the bleeding and to demonstrate management's commitment to stakeholders.

Although profit margins are an important performance measure, conventional accounting systems provide very little information about how a budgeted profit margin might be achieved. This is because profit margins result from complex relationships between an organization's processes and outside customers. A poorly executed process will result in an unhappy customer and a high likelihood of a lower revenue stream.

Yet conventional accounting provides minimal insight into the links between the department's poor budget performance and the decreased profit margin. For instance, a review of a department's actual cost compared to budget might reveal a minimal variance. Departmental performance, according to traditional variance analysis, is adequate. However, the group's workload may be lower than planned. The variance analysis did not detect this condition for the simple reason that workload is intermingled with numbers reported by the traditional accounting system. The traditional accounting system does not facilitate making the link between the cause of the poor performance to the dip in the profit margin.

To be effective, a budget needs to be more than a plugged number that enabled the financial plan to give management the results they need to present to the stakeholders. Such figures should never be arbitrary. A budget can be meaningful only when the budgeted results are within the capabilities of the organization's process to deliver the targeted results. The preparation of a plan or budget should not be a yearly or periodic event; it should be updated whenever a key event disrupts an organization's process's ability to deliver targeted performance results. Finally, a plan or budget must be understood to represent a possible range of outcomes. Techniques such as six sigma seek to restrict the range of probable outcomes by minimizing process variation.

Prior Period Comparison. Context can also be established by comparing the current result (historical result) with results from other past periods. Comparison with results from the same month last year provides a benchmark of growth and adjusts for seasonal factors. Comparison of year-to-date financial results with year-to-date budget minimizes the noise caused by the up-and-down movement of monthly results. The year-to-date values will, as the year progresses, show less random variation than is present in the individual monthly values. It is assumed that results are improving if this year or month's value has changed for the better. If this month's value has changed for the worst, management attention must be directed to correct the problem.

Even though it is straightforward to compare one number with another past number, such comparative techniques have severe drawbacks as a management tool. These comparisons are limited because they compare only two data points. The conclusions can be misleading because both of the comparative numbers are subject to variation that is inevitably present in any process. It will always be difficult to determine just how much of the difference between the actual and comparative values is due to random variation, and how much, if any, of the difference is due to real change.

Percentage Analysis. The prevailing logic that supports percentage comparisons is that the greater the percentage differences, the more immediate the need to take corrective action. Smaller percentages indicate that action is a lower priority. There are three problems with the use of percent differences as a basis for interpreting results.

First, the size of the percent difference will partially depend upon the magnitude of the base number—a 10 percent change from $10 to $11 is a minor change, yet a 10 percent change from $1,000,000 to $1,100,000 is a very significant change. Percentages show the relative size of a change rather than the actual amount of change. Therefore, comparing one percentage change with another is not a reliable way to detect patterns in the data because it does not take into account the difference in the base numbers.

Second, the practice of comparing the size of the percent differences assumes that all processes should show the same amount of relative variation month to month. Again, statistics betray the relevance of using percentage differences. All processes have their own inherent amount of month-to-month variation. A process may have a performance value that will approach the upper limit one period and the lower limit the next period. Both values are within the range of anticipated results. However, the percentage differences in the two numbers could be large. The process could be in control but the large percent difference erroneously encourages an immediate remedy to a problem that does not exist. To try to explain variation for an in-control process is an exercise in futility because any value within the upper and lower limits is an "expected" value. To investigate an expected value is a wasted effort. Conversely, a process may be very stable and have minimal variation between the upper and lower control limits. In this case a small percentage change might indicate the need for corrective action since the value is outside its control limit. This signal would be missed when using percentage differences. Therefore, comparing percent differences will guarantee that some processes receive more attention than is justified while others receive less consideration than is warranted.

Third, when comparing the percent differences between the current value and a past period's value, a large percent difference may be due to an unusual value in the past period rather than an abnormal value in the present. This type of comparison assumes both the current periods' results and the period against which they are compared are normal. Such assumptions are potentially invalid. Either or both periods could contain extraordinary results.

SHORTCOMING OF VARIANCE ANALYSIS

Variance analysis merely compares your planned and actual resource usage. It does not reveal how you got there, and it does not tell you how deep of a mess you are in or how to get out of the mess in which you might find yourself. Rather, variance analysis always results in either a favorable or an unfavorable outcome. An outcome is favorable if actual spending is below planned spending. This is referred to as a binary analysis. A binary value can have only two possible outcomes: favorable or unfavorable. The current results will be either above or below a comparable number.

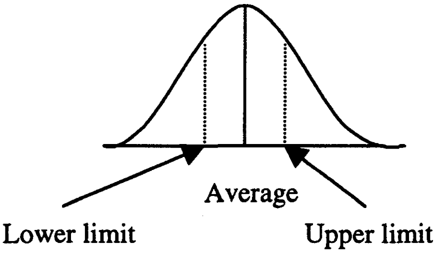
Of course in a "well run" company with processes in control, the average could be expected to be generally near the midpoint of monthly performance results. One should expect to be above average about half the time, and to be below average half the time. As a consequence, the binary approach will make management feel good about half the time, and it will make them feel bad about half the time. Those with favorable results get a pat on the back, and those with unfavorable figures get kicked a little lower down. Those with favorable figures are "doing okay," while those with unfavorable figures are "in trouble."

The major flaw with the binary approach is that an organization's processes deliver a range of performance. Statistical techniques can be used to determine the range of anticipated results. The results will vary between the upper and lower limits (see Figure 2.5). To worry about performance that lies between these limits is a waste of time; the manager merely worries about random noise. A manager should be concerned only when performance is below the lower limit or above the upper limit.

Another consequence of the binary approach is the suddenness with which management can go from a state of delight to a state of distress. There is little passion to improve performance as long as management is getting favorable results. However, there is immediate pressure to improve performance when faced with unfavorable results. Binary analyses will inevitably result in periods of benign neglect alternating with periods of intense frustration. This on-again, off-again approach is equivalent to a wind sprint rather than a marathon approach to management. An even more critical danger is that the binary approach creates a temptation to make the data look favorable. Distorting data is always easier than working to improve the system.

All these problems make the comparative and percent difference analysis an ineffectual tool for finding potential patterns within data. Nevertheless, comparative analysis is a common practice. Chasing random variation results

Figure 2.5 Statistical Bell-Shaped Probability Distribution



in a misuse of valuable time. A missed signal is a wasted opportunity. The process attempted to reveal that there was a problem. If uncorrected, it is likely to persist and may even grow more significant over time. While it remains undetected, it will continue to have a detrimental effect upon operations. This will result in increased costs, decreased reliability, employee frustration, and potential loss of business. The problem will have to get much larger before it will be detected using the traditional comparative techniques. By that time the damage is done.

OTHER DEFICIENCIES OF TRADITIONAL ACCOUNTING

Under present accounting rules, companies can often choose among alternative accounting procedures to account for a particular transaction. Accounting income, therefore, is not an absolute number but will fall within a range of possible numbers, depending on the accounting procedures the company employs. In addition, meeting periodic financial results often causes inappropriate resource allocations. Financial reporting requirements have very stringent requirements concerning how assets and asset-sustaining costs are capitalized or expensed. Although these rules assist in ensuring comparability, they often do a poor job in matching asset costs to life cycle costs. Companies may reject financial expenditures or postpone them until future periods because the expenditures were "not in the budget" or because of the negative, unexpected impact they might create on expected earnings. Decisions made on the basis of how a particular performance period is affected may not be decisions that are in the best long-run interest of the organization. Following is a discussion of various deficiencies in traditional accounting.

No Opportunity for Corrective Action

Too many times, variances are explained rather than fixed. Unfortunately, by the time historical information is available, it is too late for users to take any actions that could have prevented poor performance. At best, information can give warnings only of problems to come. Excellent performance requires that any problem be quickly detected and corrective action initiated. The dilemma is that corrective action requires time. Completing current work on a timely basis has a higher priority than correcting problems. Thus with limited time, most companies tend to explain past variances after they arise rather than preventing their reoccurrence.

Time Lags

Accounting information is not timely. A long-standing accounting dilemma is that of the lag between the time transactions occur and the time they are reported in the form of accounting statements. A variety of factors cause this delay. Procedurally, accounting records must be updated before monthly closings. This requires large amounts of transaction data to be entered, examined, verified, and processed—all of which takes considerable time. Although the majority of information needed to prepare financial statements is maintained in the accounting department, some data is needed from other sources. Thus, the accounting department must find, analyze, and record data residing in other departments' information systems. In such circumstances, the backlogs and bottlenecks to obtaining period-end statements are often external to the accounting department.

Stock Market Fluctuations

Stock prices are heavily influenced by projected earnings. Investors generally buy stock in a company so they can receive dividends or sell the stock when the price increases to some desired level. Stock prices react to numerous factors; one of the most important is market expectation of future earnings. The organization creates a stock market expectation when it announces its earnings forecasts. Subsequent announcements of projected earnings shortfalls will create stock price downturns. In either event, stock prices are affected, possibly significantly, in advance of actual reported earnings. The closing accounting information is merely the time-delayed confirmation of previously anticipated facts.

Time and Resources to Close the Books

Significant time and resources are consumed in general ledger closes. Most companies expend considerable time and money closing their general ledger systems monthly because management is uncertain about financial results. If better information could be predicted about the outcomes of "initiating events," the need for month-end closings would be significantly reduced and resources could be more effectively redeployed to value-adding activities.

Managing Earnings Rather Than Operations

Management incentives to "meet the numbers" often cause abnormal activities. Management at times manages their earnings rather than their operations. This practice places an extraordinary emphasis on meeting monthly and annual earnings budget. As a consequence, companies often incur non-value-adding activities in their efforts to ensure the numbers are met. For example, many manufacturing companies commonly ship as much product as possible at month-end to increase sales revenues. However, these shipments are often made without regard to their original schedules, causing wasted expediting and rescheduling activities.

HOW PROCESS-BASED ACCOUNTING SUPPLEMENTS TRADITIONAL ACCOUNTING

Predictive accounting does not take the place of a conventional accounting system. Predictive accounting, instead, seeks to augment traditional accounting information with process and operational data (see Chapter 6, "Process Management—The Key to Creating Value") and performance measures (see Chapter 9, "Using Reliable Performance Measures for Maximum Effectiveness"). A coupled system will enable both internal and, eventually, external users of financial information to make informed projections and interpretations about the future.

Predictive accounting is a management system that is logical, comprehensive, integrated, and easily understood. To predict is to foretell. It provides information in a format that minimizes the possibility that managers will overlook opportunities for increasing profits. However, predictive accounting is not intended to replace management intuition or initiative. Excellence requires managers to look beyond current thinking and to take decisive actions. Management must have the determination to change current policies, procedures, and systems in a manner that will make the company more efficient. Instead, predictive accounting seeks to transform data into information to prevent poor performance rather than reacting to poor performance.

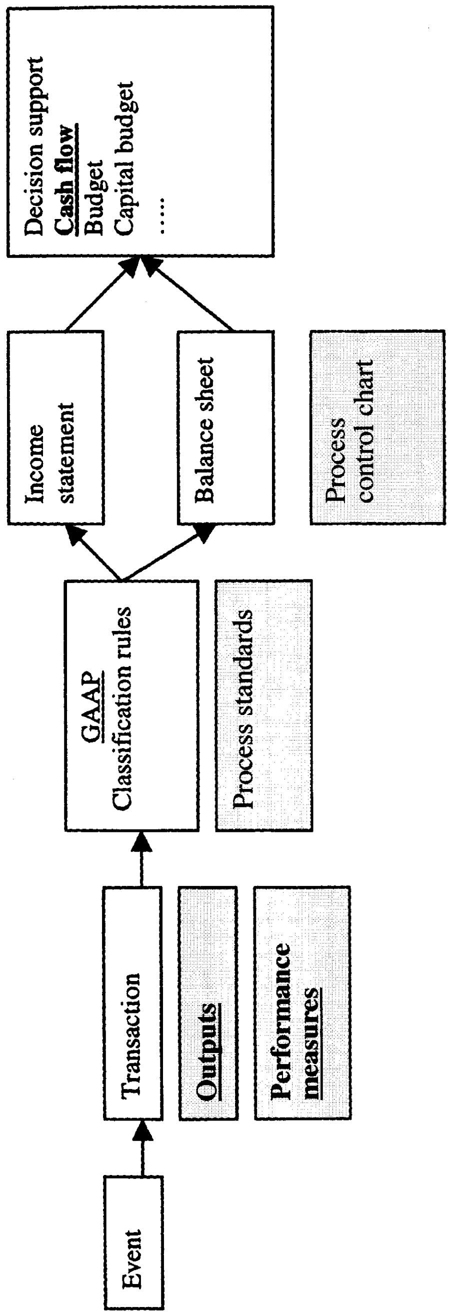
It is important when developing a process-based accounting system to keep in mind the importance of maintaining the integrity of the conventional financial accounting system. There is no need for a new and separate accounting system. Process-based accounting must add to rather than tear down the existing accounting system. Process-based accounting creates a better understanding of value by marrying measurable outputs and performance measures with traditional financial information. Incorporating operational (nonfinancial) and performance data into a financial database allows multiple views of the same base data. This database approach enables data to have different roll-ups depending on the needs of the financial report users. Much of the operational data needed by a process-based accounting system is readily available and closely monitored by a variety of operational systems.

The predictive accounting framework integrates a process database into the traditional accounting system (see Figure 2.6).

Several characteristics of process-based accounting distinguish it from traditional accounting. Chief among these differences is that it:

- Shifts an organization's focus away from reactive responses to problems to proactively eliminating the source of problems. This involves greater attention to identifying and eliminating chronic problems rather than being dominated by the crises that control today's management practices.
- Searches for objective information to augment the subjective information on which management bases many of their decisions.
- Focuses management attention on the process that delivers results rather than the results themselves.

Figure 2.6 Process-Based Accounting Process



Under predictive accounting, the accounting profession is poised to take one of its most significant leaps forward by increasing the relevancy of reported financial information. Accounting information will focus on managing upcoming events rather than reporting past history.

TEN BOTTOM-LINE MANAGEMENT GUIDELINES FOR PROCESS-BASED ACCOUNTING

Several nuances of predictive accounting make it a particularly powerful management tool. Chief among these are the following 10 characteristics.

Before One Can Improve Performance, One Must Improve the Process

Accounting systems never solve problems—they merely report financial results. In fact, never once has performance improved by simply reporting accounting facts! Superior financial performance depends on capable and stable processes.

Performance improvements come from improving the process. The implications to accounting are abundant:

1. The accounting system must provide process data and measure the progress of process performance improvement.
2. The traditional practice for controlling cost by cost type ignores the process performance and is less useful as a management control tool.
3. Process improvement must be done at all levels of processes and with all employees involved.

Process-Based Accounting Proactively Focuses Management Attention on Processes

Poor performance almost never is the result of a single cataclysmic event. Poor performance most often results from many small events that management either does not focus on or chooses to ignore. These small events eventually converge into an overwhelming force that cause management to take reactionary measures to resolve.

It is management's responsibility to establish proactive targets that focus management attention on an organization's core priorities. To a large extent, this is what happens when a visionary manager launches a new management technology. For example, when management embarks on and gives priority to a new performance measurement system, they are focusing their organizations and asking them to proactively manage performance.

Focusing management attention on the factors they can control is essential to superior performance. Consider that a large number of companies have implemented or are currently implementing new management techniques, such as six sigma, balanced scorecard, activity-based costing (ABC), lean manufacturing, and other improvement initiatives. In all honesty, the results of most implementations range from poor to good but seldom reach outstanding. The question is: Why are these organizations doing many of the right things but not achieving quantum improvements? Part of the reason is insufficient management attention.

Operational managers' top priority is to successfully complete their daily work. They are often aware of the organization's strategic goals. But moving from senior management to operational management, this clarity begins to get muddy. Although operational managers may understand their superiors' goals, they will always put strategy implementation as a lower priority than completing their daily work. At the process-worker levels, it often reaches a static stage where employees know only their specific job and care little about the strategic objectives.

Management attention should be treated as a scarce resource. Executive priorities will unquestionably advance or retard the fortunes of an enterprise. Priorities must be reinforced. For priorities to be meaningful, all employees in the organization must commit to them. Processes help bridge the gap between daily work and strategic priorities. Focusing management attention on the important work to be done benefits the whole organization.

Outstanding performance requires:

- Sustained effort
- Constancy of purpose
- An environment where continual improvement is the operating philosophy

Predictive accounting provides the necessary focus.

Predictive Ability Is Directly Related to Process Variation

Future financial results are predictable only when there is minimal process variation. The six sigma and total quality management movements have demonstrated the correlation between high variation and unpredictable performance results. It has also been proven that stable processes provide consistent output quality. Predictive accounting must incorporate six sigma techniques to minimize process variability and maintain, to the best extent possible, process stability.

Variation reduction begins with the analysis of activities and processes in an effort to understand their reliability—the rate at which processes will fail. Next, the management team must understand the factors that cause a process to vary. Root cause analysis fulfills this need. It calculates the likelihood of process failure and documents the root causes. The goal is to make your processes more reliable to reduce waste, lower costs, and meet your organization's goals.

Next you must implement a system to detect process failure—a process control chart. A process monitoring system will increase the timeliness of detecting problems. It also provides employees with a basis to identify corrective actions needed to reduce failures or mitigate their adverse effects. If your process demonstrates a high degree of process failures, this means you can expect your system to fail more often than is acceptable.

The second stage is to implement corrective actions that will reduce the severity or future occurrences of the problem. The objective is to ensure that your process's predicted failure rates are within acceptable limits. By eliminating root cause problems, the number of predicted process failures decreases, and you can expect more reliable performance.

Control Charts Are a Superior Tool in Interpreting Financial Results

The control chart approach to data analysis is more powerful than variance analysis. It is also fundamentally different. Instead of attempting to attach a meaning to each specific variance between actual and budget, the control chart approach concentrates on the behavior of the underlying process. It is, therefore, more comprehensive and yields more insight and greater understanding than variance analysis.

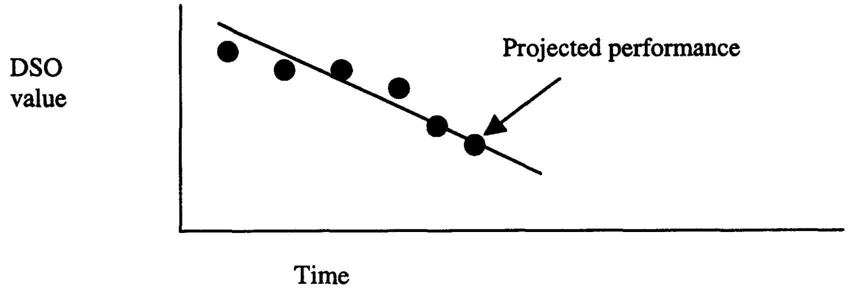
The Process Model Must Use Statistics to Anticipate, Rather Than Forecast, Future Events

Forecasting is the art and science of predicting future occurrences and activities. Clearly, then, the objective of forecasting is harmonious with predictive accounting. The issue is that the term *forecasting* is often used to apply to pattern-based forecasting, which relies on the assumption that the future is an extension of the past. Understanding how much value a process creates seeks to understand the future in terms of its underlying processes.

An accounts receivable (A/R) department can be used to illustrate the differences between pattern-based and process-valuation forecasting. Day's sales outstanding (DSO) is a typical performance measure for A/R. Pattern-based forecasting would plot the historical results of past DSO results and extrapolate future projections from the underlying patterns in the historical data (see Figure 2.7).

The underlying assumption of pattern-based forecasting is that the historical results provide a reasonable indicator of future performance. However, such assumptions are valid only when there are no major changes in the key factors that influence a process. The projections would be inappropriate if situations were known or expected that would cause an alternative behavior. For instance, a major change in interest rates or credit-lending factors might preclude an extension of the pattern-based forecast.

Figure 2.7 Forecasted Projected Performance

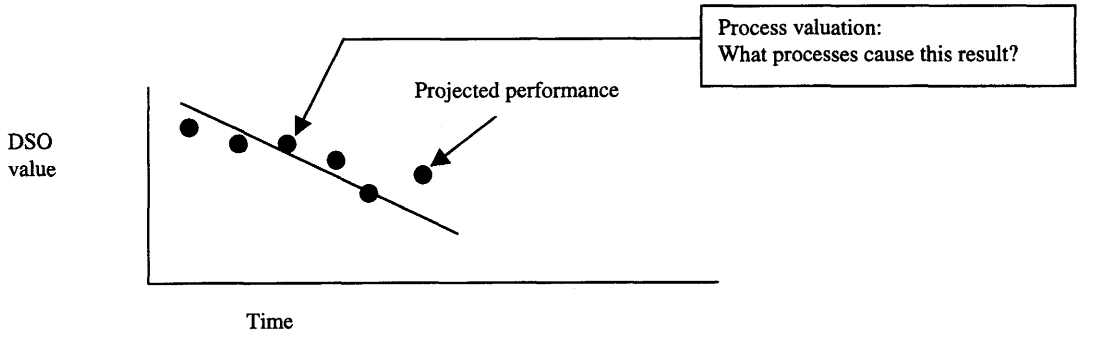


Predictive accounting uses a process (activity) standard that is based on existing process procedures. These procedures describe how the organization collects past-due invoices. The pattern-based forecast would be accurate if the process remains stable. However, a key event can disrupt the process equilibrium and thus invalidate the projected performance (see Figure 2.8).

Assume that the A/R department saw a significant increase in sales. Statistically, an increase in the number of past-due invoices could be expected. If the increased number of past-due invoices requires more time to collect than currently available resources can handle, the existing process would become unstable. The collections group would have to decide how to react to the new activity demand. For instance, the group could decide to rank the collection effort according to priority and pursue only the largest past-due invoices. Alternatively, they may work on all past-due invoices but spend less time on each collection effort by skipping some procedures. In either case, less thorough follow-up and, thus, higher DSO can be anticipated.

Simple extrapolation of historical trends to create a forecast that is most often unreliable because of all the rapid changes occurring in an industry. Instead, understanding the processes and the factors that influence them arms an organization with the information needed to proactively alter the future. An organization must understand the key events that disrupt the processes and then constantly adjust the process to minimize the impact of those events.

Figure 2.8 Predictive Accounting Projected Performance



Product/Service Features Are a Source of Process Variation

Variations in product or service's features change a process's base time making the process either easier, or more difficult, to execute and perform. Every process is designed to handle certain product characteristics. Process time is decreased or increased when a product's characteristics vary from the "norm." For example, the factors that influence a drilling process include the type of metal, its thickness, and its shape. These features have a dramatic impact on process time and consequently process cost. The key factors that alter the accounts receivable collection processing time would include the level of difficulty in contacting the debtor, the quantity and amount of past-due receivables from the debtor, and the legal status (such as Chapter 7 or 11 bankruptcy) of the debtor.

Process variation includes normal random (or systemic) and problem-induced variation. Both sources cause process variation. Quality management techniques, such as six sigma, stress the importance of identifying and eliminating process variation. Systemic variation is created "as a random variance generated by the entire system's working together; it cannot be attributed to a single, isolated source."[1] Alternatively, problem-induced variation is nonrandom and results from a particular source. Systemic variations are largely noncontrollable (or controllable only at great expense), whereas special cause variations are large and controllable. For instance, a systematic process variation could be created by an infrequent computer "glitch" in the accounting software that did not flag an overdue accounts receivable until it was past-due by 45 days. It might be extremely difficult to recreate the set of conditions that led to the error. A problem-induced variation could be created by the inclusion of incorrect debtor information in the accounting records. Correcting either of these sources of variation would create an additional cost to the A/R department. However, the cost of correcting the first would be applicable to all accounts, while the cost of correcting the second would be applicable only to the particular debtor.

Capacity Affects Process Cost

Capacity refers to an organization's ability to "do something." The level of capacity acquired reflects a managerial forecast of workload and service levels. An activity's costs are in excess of what they need to be where too much capacity exists for a given activity. Thus, excess capacity drives up process cost to the organization. "Capacity is, after all, the denominator in the cost equation."[2] Capacity cost must be allocated in the most rational and reasonable manner to the activity supported by those resources. An organization that ignores excess

[1] Randall S. Schuler and Drew L. Harris, *Managing Quality* (Reading, Mass.: Addison-Wesley, 1992), p. 25.

[2] C.J. McNair and Richard Vangermeersch, *Total Capacity Management* (Boca Raton, Fla.: St. Lucie Press, 1998), p. 26.

capacity cost is ignoring the fact that the resources tied up inappropriately could be used elsewhere in the organization to reduce costs or increase revenues.

Getting the "correct" capacity is critical to achieving a target cost. Too little capacity creates bottlenecks and drives cost up as process workers scramble around, reacting to crises created by the bottlenecks. Too much capacity also drives up cost—you are paying for unnecessary resources. Organizations that are able to drive feature variation, process variation, and excess capacity costs toward zero will be left with an actual cost that is equal to base process cost. In this scenario, costs becomes predictable and, thus, reflective of the future rather than of the past.

Process-Based Accounting Obligates Managers to Strive to Totally Eliminate Process Variation

A precision paradigm declares that an organization will strive to do every task once and do it right the first time. The process tools that support predictive accounting are based on zero process variation. For example, six sigma attempts to achieve zero defects in the process. Lean manufacturing and enterprise resource planning (ERP) approaches try to achieve zero time between process needs and resource availability. Likewise, computer-integrated manufacturing strives for zero touch labor while total productive maintenance and the reliability engineering have as their goal zero failures.

If the organization limits this concept to operational activities, it will be very difficult to establish it as a paradigm. It is in the best interest of any organization to have precision in administrative activities as well as in manufacturing and service producing processes. Procedures that are not thoroughly thought out can cause disasters and loss of quality, and drain money from value adding activities.

Process-Based Accounting Adds a Process Foundation

We depend on our managers and workers to identify poor or weak performance and to make improvements that will lead to superior operating results. Historically the improvement process has been more intuitive than scientific. Colleges, training courses, books, and business experience teach managers a collection of tools and techniques. Some of these techniques are embedded in a company's formal management system—budgeting, capital investment justification, and employee evaluations are but a few examples. However, more often than not, the company delegates responsibility to managers to discover which management techniques are most effective for their specific area of responsibility. This leads to patches of excellence but an under-performing organization as a whole.

The most common reason for under-performance is the inability of some managers and workers to recognize potential problems until they escalate into a major dilemma or an unfulfilled opportunity. Organizations that provide employees with a sound, well-organized approach to identify problems and opportunities are more likely to achieve their strategic mission than those that depend on employee intuition. The management system should be based on a systematic, fact-based process that collects and analyzes a variety of information. Finally, the management system should be fully deployed to all areas and work units. Predictive accounting is such a management system.

Process-Based Accounting Is Based on Objective and Verifiable Information

Process-based accounting meets the important criteria of any accounting system—it is relevant and reliable. To be relevant, the accounting should have predictive value and feedback value, and be timely. Clearly process-based accounting exceeds historical accounting based on these criteria. To be reliable, the system must be verifiable, valid, and objective. Process-based accounting is at least as reliable as historical accounting systems because it uses the same general ledger and operational data.

Process-based accounting must meet the immutable criteria of objectivity and verifiability. Predictive accounting relies on hard facts that relate events. It relies on the hard facts that support statistical analysis. Consider that predictive accounting uses some of the most interesting of these "hard" facts, including:

- The sequence of the order and timing of activities. Organizations create process maps to understand and document the order and timing of activities in the business processes.
- The repeatability of activities. Repeatability equates to predictability.
- The degree to which a process is in control. Predictability is highest when the process remains within the acceptable variation limits and there is neither an obvious trend nor any long sequence of points above or below the average process performance.
- The significant few problems on which management must focus. The root causes of process variation follow Pareto's 80/20 rule—20 percent of a process's problems will cause 80 percent of a process's variation. Thus, there are a small handful of root cause problems that account for the majority of process variation.

The four "hard facts" stated here form the touchstone of the process revolution. These hard facts now form the heart of the process-based and predictive accounting revolution. Consider their implications. If there is a set sequence to processes and its component activities are repeatable, the results of a process are predictable within statistical limits. The statistical probabilities can be improved by a constant attention to identifying the factors that cause process variation. Root cause analysis identifies the significant few problems that need to be fixed. As the problems are resolved over time, management reaps twofold benefits: Performance improves and management will become more confident in using process data to predict future performance results.

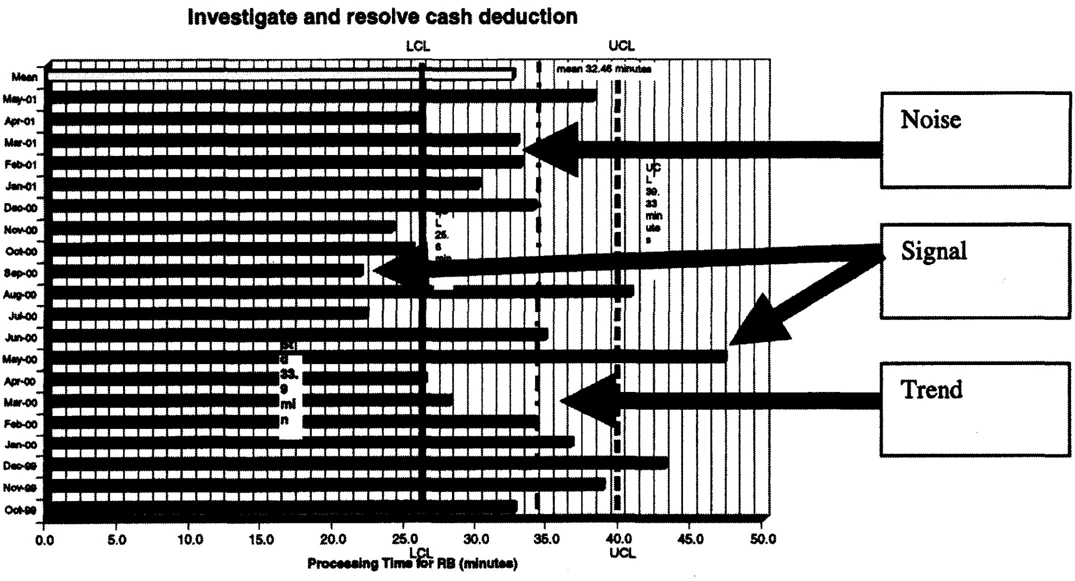
HOW TO IDENTIFY PROCESS PATTERNS USING CONTROL CHARTS

A control chart graph is an integral part of a predictive accounting system. Accounting presents last period's performance results. The need to understand costs is clear. Understanding costs helps managers make decisions that affect current and future profitability. Actions to improve process performance should be bold, forceful, and limited to where they are needed. Change of any sort causes a disruption in performance. A disruption is a small price to pay for a long-term productivity improvement. A disruption is a large price to pay when it is unnecessary.

A control chart is a simple and effective way to identify process patterns. It plots financial data in a time series graph. The time series consists of a sequence of individual performance values. The control chart characterizes the behavior of the time series of financial data. Occasionally, a time series is consistently within control limits: Such time series are predictable and stable over time. More commonly, however, time series are inconsistent: They are unpredictable and changing over time (See Chapter 7, "Process Variation and Cause-and-Effect Analysis").

The lines on the control chart (see Figure 2.9) provide reference points in deciding which type of behavior is displayed by any given time series. The

Figure 2.9 Control Chart



When results fall outside the control limits, the process is indicating a problem. This problem could reoccur, and it could be worse next time.

central line represents the average process performance and acts as a visual reference for detecting shifts or trends. The control limits (computed from the data) lines are placed equidistant on either side of the central line. The control limits indicate the expected range of performance results. Values within the control limits are expected. Values outside the control limits are signals of potential process problems.

Control charts provide a basis for taking action because they take variation into account. Variation is the random component that undermines simple and limited comparisons between two numbers. The "noise" introduced by variation is what confuses and clouds all comparisons between single values. Noise is where an organization initiates corrective action even though the process results are "expected" from the process—within the upper and lower control limits. Control charts separate signals of problems from noise—random, expected variations in data that is ever present; otherwise, the actions taken will be totally inconsistent with the data. Until noise can be identified in a process, one cannot fully understand what is indicated by a single result. The control chart does not tell us what has changed, but it does tell us that a change has occurred, and when it occurred.

The control chart is unsurpassed for filtering out process noise so the user can minimize the number of times that one interprets a trace of noise as if it were a signal. Instead of attempting to attach a meaning to each specific variance between actual and budget, the control chart approach concentrates on the behavior of the underlying process. A control chart evaluates whether the current period results fit the process's performance pattern. Although every data set contains noise, some data sets may contain signals. Any pronounced trends or dramatic changes should send flashing red lights to the management team.

By causing the potential signals to stand out, the control chart also minimizes the number of times that one misses a signal. The use of traditional approaches guarantees an excess of both kinds of mistakes people make when interpreting data. More often than necessary, managers interpret noise as a signal and thereby waste time and resources in looking for an explanation that does not exist. On the other hand, many signals, and the opportunity for improvement that these signals represent, are missed by traditional accounting systems.

The first mistake is to interpret random variation as a meaningful departure from the past, that is, highlighting noise as if it were a signal. This mistake will lead to actions that are at best, inappropriate, and at worst, completely contrary to the proper course of action. Chasing shadows wastes limited resources while failing to attack true waste.

The second mistake is in not recognizing that a change has occurred in a process and therefore failing to detect a signal when it is present. This mistake is most often found in the simplistic approach of comparing numbers. The underlying process changes, but the values are still within the comparable range of values, so no one notices.

The interpretation of the control chart is as follows. The month-to-month variation is plotted on the control chart and analyzed. There are two ways that a signal can be detected:

1. A single monthly value falls outside a control limit.
2. At least three out of four consecutive values are closer to one of the limits than they are to the central line. This is known as a trend.

Signals will be detected as soon as they become clear and pronounced. An organization should look for an explanation when an individual monthly value falls outside the upper or lower limit or a trend is detected. Such a change is not statistically probable and it is likely to be the direct result of a significant problem. If the situation is not resolved, a major problem is likely to reoccur in the future and blind-side performance once again. The process has already done all that it can to alert the organization to the presence of a problem. How many more signals can an organization afford to miss before the problem leads to a catastrophe? Action must be initiated as soon as possible to restore the operability of the failed process to the same condition as before the failure.

When the control chart does not show any bona fide change—monthly values remain between the control limits—then the process is said to be in control and is operating as consistently as possible. There is less of a priority to improve a process when managers are satisfied with its performance. However, this may not always be the case. A second factor to consider is the range of variation.

Predictability can be improved by holding the performance values "steady." A process doesn't know, or care, about the planned performance targets. Keep in mind that the performance targets represent what the organization wants performance to be. The process will deliver a range of performance that depends on its capabilities. No browbeating, wishing, and hoping and no management system will bring performance results into line with targeted performance. At least it cannot be done until some fundamental changes are made to the underlying process. The natural process limits are the voice of the process. Limits define the range of performance the process is capable of delivering as long as it continues to operate as currently constructed. The only possible resolution to poor performance is to fix the process.

A common management mistake is to dictate arbitrary performance targets without a careful study of process capabilities. Only frustration and unfulfilled expectations will result where a process is not capable of operating within the targeted limits in the foreseeable future. Thus, such a management decree will simply encourage the workers to twist the system or to distort the data. Such decrees, by themselves, do nothing to change or improve performance.

Likewise, creating an alternative performance management report cannot cure dissatisfaction with the natural process limits. If one is not pleased with the amount of variation shown by the natural process limits, one must change the underlying process, rather than set arbitrary goals, berate the workers, or look for alternative ways of computing the limits.

The control chart provides the user confidence to extrapolate into the near future. When a process displays a reasonable degree of statistical control, the outcomes are predictable and it is possible to effectively plan and budget. If a process displays unpredictable behavior, the underlying process is said to be "out of control." Thus, the essence of predictability is statistical process control (SPC). A process that does not display a reasonable degree of statistical control is unpredictable. Moreover, whenever it is reasonable to make this extrapolation, the control chart also defines the range of values that is likely to be realized in the near future.

Those who do not use control charts to analyze data will always be at a disadvantage compared to those who do. Unless, and until, managers know when to take action, they will remain unable to properly analyze and interpret accounting data. Traditional accounting presents an abundance of extraneous data. People are visually oriented, and data tables are visually boring.

CAVEAT: DETECTING KEY EVENTS

Predictive accounting uses control charts to anticipate the routine problems that plague daily business. However, catastrophic problems will periodically occur. These problems are also detected by a financial value that exceeds a process control limit. The crucial difference is that these problems occur suddenly and usually take an organization by surprise. As a result, it is very expensive to mobilize the support needed to resolve the crisis while in the meantime performance is seriously affected.

There are four reasons for these failures to happen, even when a predictive accounting program has been implemented:

1. Key events are often driven by an unplanned external factor, such as rising electricity prices, sharply increasing interest rates, or a downturn in the economy. These types of key events typically build up over time and are thus predictable. The key is to identify when they reach a critical mass that should retrigger the planning process.
2. It is not possible to develop a system that can predict every possible event, such as a terrorist attack. Events that are outside a reasonable probability of occurrence cannot be prevented. Predictive accounting focuses on anticipating the key events. So, random failures are beyond the capacity of cost-effective preventive action in the complex business environment.
3. Key event monitoring uses a probability of failure. If a preventive accounting system ensures a reliability of 95 percent, users are accepting the risk of 5 percent failure.
4. The predictive accounting system fails. Sometimes data is not kept current or acted upon. As the number of problems that should be detected by the predictive accounting system increases, the effectiveness of the preventive program becomes strained for resources.

To ensure an effective predictive accounting system, key events must be monitored and anticipated where feasible. When a key event does occur, there must be a rapid *general repair,* that is, an action that restores the systems to their previous level of reliability.

PREDICTING LONG-TERM PROCESS PERFORMANCE

Workload is relatively predictable in the immediate future; however, what about the longer-term? Workload projections clearly become more subjective the further out in time they are projected. What value does predictive accounting bring to long-term financial planning?

Again, the answer lies in an organization's processes. Processes provide invaluable insight into the future. Organization performance is the counterpart to process performance. The way an organization conducts research, introduces new products or services, and markets, sells, and provides its products and services is incorporated into its process structure. People come and go and new technology is introduced, yet processes remain largely unaffected over time. Processes are analogous to steering a ship: you must anticipate a change in course far in advance of the need for the correction. It takes a major event or time to radically change how a process is performed.

Financial planning takes advantage of process inertia. Future financial performance depends on the organization's unique bundle of processes to meet changing customer demands, competitive challenges, and the economic environment. Management must determine what products and services customers are demanding. Good financial performance can be anticipated where these product and service demands closely fit with internal process capabilities. A poor fit signals mediocre financial performance.

Excellent financial performance requires a vigilant process improvement practice. Process capacity must be constantly matched to process demand. Too little capacity results in bottlenecks and all the consequential non-value-added activities needed to react to the bottleneck. Too much capacity results in excess resources and high process cost. Process variation must be understood and constantly eliminated. High process variation results in poor predictability. The root causes must be identified and constantly eliminated. Processes must be constantly evaluated to identify environmental, safety, and legal risks.

The bottom line is that the processes in place today largely govern an organization's long-term performance. If the current set of processes is highly capable of creating considerable value, management can use its processes as a competitive weapon to shape the future. Success goes to those organizations that create the future results they desire rather than reacting to unfolding events.

USING PROCESS-BASED ACCOUNTING TO IMPROVE DECISION MAKING

The goal of any accounting system is to organize and filter data to make it useful for making decisions. How data is organized depends on how you view the data. Process-based accounting shifts the view from controlling cost by type of cost element to controlling the process. It also seeks to supplement subjective data with objective data. Subjective data is derived from a manager's experience, plus how he or she thinks the data should look. A decision based on subjective data is in reality a decision based on feelings. If experience is the basis of interpreting the data, the interpretation is only as good as the manager's experience. If the current situation is outside the manager's experience, then his or her basis for interpreting may well be incorrect.

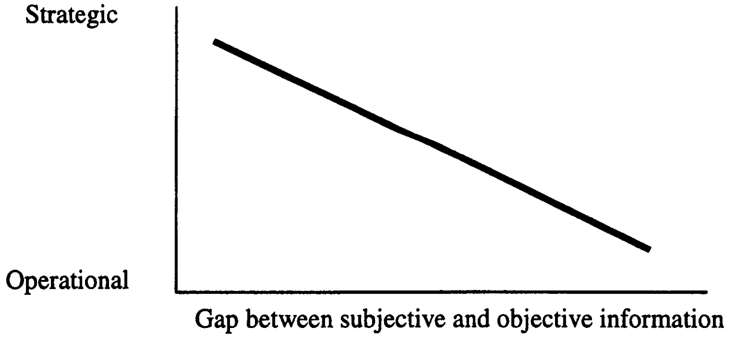
Employees too often make decisions based on their subjective interpretation of events they face. Unfortunately, much subjective information is riddled with flawed assumptions or flawed presuppositions. The most probable outcome of using subjective data is a flawed interpretation. However, in the absence of a formal approach to gathering objective information (such as that provided by an accounting system), most managers must use the seat-of-the-pants approach.

Objective information is based on facts. Accountants provide objective information. Accurate objective measures of performance should be used in lieu of subjective measures where critical decisions are made. The goal of process-based accounting is to improve decision making by making available more relevant and objective information.

A major problem is that many people do not realize the need for objective information. They feel comfortable making decisions using subjective information. The implications to accounting are significant. If people do not perceive the need for objective information, they will not support the need for improved information systems. In practice, the gap between subjective and objective information depends on the level of decision making within an organization. The more operational the decision (lower in the decision chain), the smaller the amount of subjective information used to make decisions. Conversely, the more strategic the decision (higher in the decision chain), the greater the gap will be (see Figure 2.10).

The reason for the narrow gap at the operational worker level is that operational decisions, such as scheduling work, requires very precise informa-

Figure 2.10 Subjective/Objective Information Trade-Off



tion. Strategic decisions instead depend on the experience and knowledge of many variables that a senior manager factors into their decisions.

The subjective/objective model is useful for understanding why many improvement initiatives fail. A senior manager may perceive the need for additional objective information provided by, let us say, an improved performance measurement system. The management team announces their intentions to implement the program. Some of their peers and subordinates may not appreciate the same need for the information—they are content with their subjective information. These people go through the motions of implementing the initiative but, in reality, are waiting for it to go away or for the executive to move on to other priorities. They do not have the will power to embrace the initiative and make it successful because they do not perceive the same need for the objective information. They are satisfied with their subjective information. In the worst case, they may even fear what the objective information may reveal. They implement the initiative because they are told they will implement it. Initiatives are rarely successful where people are told they ***will*** implement as a substitute for having the ***will*** to implement.

To successfully implement and operate a predictive accounting system, all three elements—people, organizational culture, and willingness to change—have to be considered simultaneously. A common mistake at many companies is that management overemphasizes the technical issues and gives poor attention to human concerns when implementing a new management technique.

Predictive accounting imposes a new mentality for all people in an organization. Company managers, operations, and support personnel necessarily must let go of old ways of thinking and be more flexible. Interdepartmental cooperation is one requirement for the success. In the past years, functional departments have isolated themselves in organizations. Now, employees must learn to work as a team.

Predictive accounting helps create an environment that promotes solving problems. It does so by exposing problems in light of the processes that created the problem. Many managers display a greater enthusiasm for analyzing problems and give the appearance of caring rather than having the will to implement the change. Visibility of problems juxtaposed with an understanding of their root causes makes it difficult to ignore problems. Getting to the root cause is the easy part. Getting something done to eliminate them is much more difficult.

It is often easier to continue doing work as it has always been done rather than to agree on root causes, develop recommendations, and to change the process. Some of the primary reasons include the following:

- The majority of the root causes involve working with other groups to resolve the problem. The other groups are often defensive and have other priorities.
- Groups do not have enough time to devote to solving problems. The priority is always to complete the current work. Downsizing and improving productivity has reduced available resources and time to work on productivity improvement projects.

- Improvement solutions often involve difficult actions. The hard part about dealing with latent root causes is that many problems deal with the soft issues of human behavior. Whenever you delve deeply into the root cause, you can expect organizational politics to become a factor. Turf protection, bonus incentive systems, and future promotional opportunities retard management action. What would you do if one of the root causes is a flawed procedure implemented by your boss? Do you confront the problem or ignore it?
- Processes must be improved. People must be redeployed. Systems must be updated. A lot of hard work is required to address these problems.
- Accountability must be established. Actions are difficult unless accountability and responsibility are assigned.
- Results must be validated by the formal accounting system. Many past improvement efforts have not produced what they promised.
- Stand-alone efforts that are not part of the formal management system tend to result in one-time initiatives.
- Bad information comes from flawed accounting and operational systems. These systems are the sources of information on which people base their decisions. If the sources are flawed, so will be the decisions that spring from them.

Two common mistakes are made when improving processes. First, many companies equate an investment in information technology as the solution to their problems. Senior executives often see the new technologies as a panacea. So, significant amounts of money are invested in buying these tools. However, information technology systems are nothing more than a tool—albeit an important tool. The sellers of the information system often over-promise the capabilities of their systems. This too often results in expenditure of a lot of money with less-than-hoped-for improvement in performance. When an organization finally realizes that it is not achieving the promised outcome, it quietly stops the project. However, in the meantime, the problems continue and the organization has lost a considerable amount of money and time.

A second common mistake is to look to the people, rather than the process, as the source of the problem. This type of thinking is evident whenever management's first reaction to a problem is better training. Training is important but it needs to be part of a revised process. Management must understand that it does not matter who did something; what matters is why process delivered certain results. If management does not address the root cause of the process variation, a failure is likely to recur. Therefore, if management verifies beyond a doubt that a root cause exists, it is a fact that must be addressed. Management futility results from expecting a different and better result without changing the process.

SUMMARY

Financial under-performance results from the inability of managers to recognize potential problems or opportunities until they become a major problem or lost opportunity. Traditional accounting systems measure past performance. Predictive accounting uses process management tools that focus on managing activities to achieve strategic targets as a way to create value and meet profit objectives. A process can only lead to excellent results when it is managed as a series of flexible, repeatable tasks that are continuously improved and the variability removed.

3

Steps for Implementing the Process-Based Accounting System

This chapter presents a practical methodology to implement a process-based accounting system. The methodology draws on a collection of process techniques that leading organizations (small, medium, and large) have successfully used in the past to improve performance. The methodology consists of six steps to set up a process-based accounting system and seven steps to run it on a continuing basis. This chapter discusses each of these steps in detail.

Before presenting the methodology, it is important to set the context of predictive accounting within the larger management system. Predictive accounting is a module that is added to an existing accounting system. It does not replace current accounting systems—it expands them. It becomes the source of management decision-making information. It relegates the role of traditional financial reporting to one of meeting fiduciary responsibilities. In a practical sense, the month-end accounting reports, as prepared at most organizations, are replaced with a forward-looking set of financial statements. The process statements focus management attention on upcoming events and their projected impact on enterprise performance.

The information to support process-based accounting resides in a multitude of operational systems, such as order entry, personnel, and other transaction-processing systems including, at larger companies, an enterprise resource planning (ERP) system. It must be kept in mind that even though an organization will gain tremendous value from the information in a process-based accounting system, the system is not a panacea. Organizations must continue to do the following:

- Work groups must continue to do their work conscientiously.
- Work groups must use the information from process-based accounting to spur employees to constantly remove process variation that leads to enhanced process capabilities with higher levels of performance.
- Management must articulate powerful strategies that will delight customers.

- Employees must remove their mental blinders and open their minds to new ways of thinking.

The rewards of predictive accounting are tremendous, but an organization must be committed to improving the relevance of accounting rather than just talking about it. Improving relevance requires the people closest to the work to open their minds to embrace the use of process information to make their work easier and more fulfilling. Success or failure is in their heads, not on paper produced from the accounting system! Failure by senior management to create a process imperative will limit the return an organization achieves. In this vein, it is important that the process-based accounting system be relatively easy to set up and operate. If it is deemed too cumbersome, it will ultimately be abandoned.

The methodology to set up a process-based accounting system contains six steps that embody several widely recognized management tools:

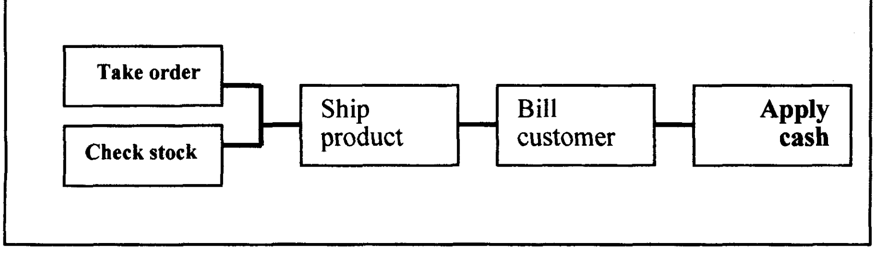
- Conduct an analysis to define the processes and activities.
- Develop an activity resource-consumption standard for each activity.
- Assess process variation and conduct a root cause analysis.
- Identify process performance measures.
- Identify external value drivers.
- Assess the planned workload using a key event-planning table.

After the initial setup of the process-based accounting system, an organization is able to produce the initial process performance statement described in Chapter 1, "The Nature and Need for a Forward-Looking Accounting System: Process-Based Accounting." It should be kept in mind that the opening data will need to be clarified before it should be used for decision making by the executive team. This chapter describes how to refine the data.

STEP 1: CONDUCT AN ACTIVITY ANALYSIS

The first step is to define an organization's processes and activities, as illustrated in Figure 3.1. Activity analysis provides a structure for examining an organiza-

Figure 3.1 Activity Analysis Example



tion at varying degrees of detail. For purposes of this chapter, the terms *processes, business processes, activities,* and *tasks* are used interchangeably—all are processes. (Any distinction lies only in the level of detail. See Chapter 6, "Process Management—The Key to Creating Value," for a description of process and a discussion of differences between terms.)

This chapter focuses primarily on activities because activities are the level at which costs are collected. Activities define the work of an enterprise. An activity is a structured set of tasks that consume resources to produce an output. Each activity is presented in the form of a short statement of what is done (not how or why). Every activity should be associated to a business process.

All processes represent a part of the enterprise that management is interested in monitoring. The process must have a responsible individual assigned to manage it. This often involves setting up a matrix organization, in which the functional manager takes responsibility of his or her group's activities and a process manager takes responsibility of the overall process performance. The employees who perform activities are referred to as a work group (see the sidebar "Work Group").

Two Activity Analysis Approaches

There are two approaches to activity analysis: a bottom-up, zero-based analysis and a top-down, activity dictionary approach. The bottom-up method has the advantage of greater employee involvement and thus ownership of the activity analysis. The top-down approach is quick and thorough. Organizations that have recently defined activities as part of an activity-based costing exercise, process analysis, or ISO 9000 certification should use the existing activity analysis as a starting point. This ensures consistency with these improvement efforts. However, the previous activity definitions might have to be modified to ensure they are defined using the process model that underpins predictive accounting. Two common adjustments needed to a typical activity analysis include:

1. Organizations that have defined their activities at a too-high level must break them down to a more discrete level.
2. Ensure every activity has an output measure. Many organizations assign cost drivers to activities. A cost driver can be any factor, including output measures. Process-based accounting requires the use of output measures.

> **Work Group**
>
> A work group consists of either an organizational unit in the formal organizational structure or a process work team. A process work team is a group of people from multifunctional disciplines who have shared responsibility to produce a specific end product or provide a specific service. Each unit or work team functions in a relatively autonomous or self-directed manner.

The top-down activity dictionary approach is recommended for organizations that have not developed a robust activity definition or where the activity analysis is out of date.

Both variants of activity analysis begin with assembling an analysis team. The analysis team normally consists of a few key individuals from each functional group who have a broad knowledge of the organization's work. The analysis team will select an analysis approach.

Bottom-up zero-based analysis. The analysis team begins with a brainstorming session that defines the primary outputs of the group. It is important that the group limit its outputs to only significant outputs. A significant output is one that consumes at least one-eighth of a full-time equivalent (FTE) person, that is, each activity must consume a minimum of at least 250 total employee work hours per year. It is important to keep in mind that the output is the result of executing an activity, not a measure of how well the activity was performed. For example, an activity to sell a car results in a sales contract. The organization's goal—to achieve a profit—is not achieved if the car is sold at a loss. The execution of an activity therefore creates certain tangible documents or an intangible action, idea, or concept.

Next, the team ascribes an activity definition to each output. An activity definition explains what the organization does, its output. It is suggested that the activity be described, at a minimum, by a verb and a noun. Pronouns should be added for clarity.

Top-down activity dictionary analysis. A top-down activity dictionary approach uses a standard dictionary of activities as a baseline for defining an organization's initial set of activities. The activity dictionary provides a list of "normal" activities performed by a functional group or within a business process. The power of an activity dictionary is that it provides a consistent starting point for defining activities. By listing generic work of a "typical" company within an industry, the activities will be defined easily and consistently. A standard set of activities also provides a comparative baseline that facilitates benchmarking.

The analysis team selects activities from the standard dictionary based on its relevance and significance to the group being analyzed. Appendix 1 contains a process classification framework that was developed by the American Productivity and Quality Center.

The activities selected from the dictionary must be tailored to each organization. Managers can determine whether a generic activity is appropriate for their organization based on its frequency of execution, magnitude of cost, and the amount of time spent performing the activity. The analysis team must add company-specific activities that are not part of the generic dictionary.

STEP 2: DEVELOP AN ACTIVITY STANDARD COST

The second step is to develop an activity resource-consumption standard cost for each activity. The standard is based on the average amount of resources consumed in processing one unit of output. Every activity has finite time duration and requires a finite expenditure of resources. Resources fall into six primary categories: employees (salary and wage), equipment (depreciation), facilities, information systems, material, and other. An activity cost should include all traceable—that is, where a cause and effect relationship can be established—resources and shared services. (See Chapter 4, "Steps for Operating the Process-Based Accounting System," for a more detailed discussion.) Table 3.1 illustrates a resource activity standard.

The process of setting an activity standard cost begins by identifying the group's expenses. The general ledger (GL) is the customary starting point for collecting cost. The GL account identifies where a cost was charged. The two important components of a GL account are the location and the account number. The location identifies the consumer; the account number identifies the type of cost. Examples of account number grouping include salary and wages, bonus, commissions, shift premium, and overtime, among others.

How to Trace Cost

A cost is traceable to an activity where a cause-and-effect relationship can be established. All significant costs should be traced rather than allocated to improve the accuracy of the process cost standard. Consider a painting activity. The primary cost for a human to paint a component part would consist of the time expended multiplied by the laborer's rate. Conversely, the primary cost for a robot to paint a component would consist of the time expended multiplied by the robot's depreciation rate. In either case, the painted component was physically unaffected by whether the painting was done by a human or a robot. An indisputable cause-and-effect relationship is established between the cost of the human or robot, the amount of paint, and the component product. A reasonable and verifiable cost-tracing relationship has been established. The

Table 3.1 Activity Resource Standard

Activity: Collect past due invoices			
Performance measure:	Day's sales outstanding	32 days	
Resources consumed:	Collection clerk	12 minutes	
	PC workstation	12 minutes	
	AR software	12 minutes per invoice	
	Facilities	100 square feet	
Outputs consumed:	# of past due invoices	10,000 per year	
Cost of resources consumed:	AR clerk	\$12.50 per hour for 1/5 hour	\$2.50
	PC workstation	\$3,000 cost; 3 year life;	
		\$1,000 / (120,000 min per year) × 12	0.10
	AR software	1 invoice × \$0.05 / invoice	0.05
	Facilities	\$14.00 per square foot per year;	
		\$1,400 / (120,000 min per year) × 12	0.14
	Cost per past due invoice processed		\$2.79

Note: The \$0.05 per invoice for the AR software was derived from the shared service accounting system.

other costs traceable to painting include supplies, facilities, and support equipment.

In a process-based accounting system, all costs should be traced where practical and economically feasible. A rule of thumb is that 80 percent to 90 percent of a work group's costs should be traced to the activities of the group. Tracing less than 80 percent to 90 percent does not provide the relevance necessary to manage costs—tracing more could be uneconomical. The remaining 10 percent to 20 percent of cost are considered nontraceable. Nontraceable cost can be allocated to activities if a fully absorbed cost is important to the final decision.

A critical factor in decision making is relevance. Relevant information influences decisions. To be relevant information must be:

- *Comprehensive.* Information includes the most pertinent information that, if known, would influence the final decision.
- *In a meaningful format.* Information is disjointed and diverse, while knowledge is systematic and cumulative.
- *Accurate.* Information must be factual and precise.

Tracing cost and determining relevance are synonymous. Decisions involve alternatives—relevance determines which costs and activities are considered and which are excluded. Traceable costs are controllable because a cause-and-effect relationship has been established. For example, economic decisions made purely on labor costs might overlook its critical impact on equipment, information system, or facilities costs.

Tracing cost helps bring management pressures to bear on overhead or shared costs (for example, sales, general and administrative; engineering; manufacturing; and corporate overhead) that are otherwise difficult to evaluate and control. The traditional practice is to allocate those costs to specific products or cost centers. Because many of these costs are traceable, they are controllable. To allocate a cost that is otherwise traceable is to accept the cost as unavoidable—a practice that can lead to profit shortfalls.

How to Adjust Cost

Adjustments must be made to the general ledger cost. Adjustments are necessary because the accounting department assigns cost to each work group based on accounting policies and management practices. These practices and policies arise for a multitude of reasons other than accounting accuracy. Mitigating reasons include:

- Significance of cost
- Ease of maintaining information by the accounting department
- Management priorities
- Assigning cost to responsible functional manager
- Company culture

As a consequence, certain costs are assigned to a single location when they are actually consumed by a myriad of other groups. For example, many organizations assign depreciation to a corporate account rather than to the work groups where the equipment is located. Inappropriate cost assignment distorts the process standard cost. A fundamental principle of process standard costing is to assign all traceable costs to the suitable activity where significant and feasible.

How to Assign Salary and Wage to Activities

A group's people related expense—salary and wage—represents the total cost of employee's base pay. People-related resources are normally traced to activities based on where the employees spend their time. There are two options for valuing salary and wage cost that is assigned to activities. The first method is to use the actual salary and wage cost. The second method is to use a standard labor rate for each unique job classification. Under the second method, the difference between total actual and total standard cost is allocated to each activity.

The benefit of the first method is that it is comprehensive and ensures that 100 percent of cost is traced. The disadvantage of the approach is that it might permit an employee to uncover a peer's actual salary. Most organizations consider actual employee salaries to be confidential. Where a single employee performs an activity, it is relatively easy to reconstruct his or her salary. Another consideration is that individual employees can leave an organization or change jobs. These changes cause a group's salary and wage cost component of the process rate to fluctuate. The fluctuation introduces *noise* into the activity standard cost.

The advantage of using a job classification rate is that the salary and wage component of the standard is stable and ensures salary confidentiality. The activity standard cost is more stable (less noise) when the salary and wage cost is based on the position or job classification's customary rate rather than the individual employee's actual wages. The disadvantage is that it creates a variance between the total standard cost and the group's actual cost. The variance must be allocated to activities in order to ensure 100 percent cost coverage.

Salary confidentiality is maintained by using the "average" (mid-point) pay rate for each job classification. Many organizations maintain a table of standard pay rates by job classification. Often the pay rate tables show the maximum and minimum pay rates. The mid-point rate, halfway between the maximum and minimum rates, is chosen to calculate the activity standard. Alternatively, a rate per hour for each job classification can be computed by dividing the average salary by the number of productive hour's available (mean rate).

The activity cost is determined by multiplying the standard job classification rate per hour by the total activity hours derived from step 1 in the activity analysis. Fringe benefits should be added to the salary and wage cost. A common practice is to add fringe benefits as a percentage of the base salary and wage cost.

Salary and wage cost should be comprehensive. Other adjustments might include the following:

- *Direct labor.* For conventional manufacturing production, the direct labor is often recorded directly to products. Process management requires that the labor be recorded to the processes (activities) and traced from the processes (activities) to the products. This procedure requires direct labor to be assigned to activities rather than directly to products.
- *Benefits.* Benefits include employer payroll taxes, workers' compensation benefits, company-paid health insurance, retirement benefits, and others. Payroll fringe benefits are normally allocated on the basis of payroll dollars or hours.

How to Assign Equipment Depreciation to Activities

Machines and equipment are an inseparable part of a process. Equipment improves an employee's productivity by supplementing his or her physical power with equipment power. Machinery and equipment cost is normally equated with depreciation. Depreciation takes the historical cost of an asset and systematically allocates it in proportion to the asset deterioration and the contribution it is expected to make in the generation of revenue each period. Thus, when an organization acquires a piece of capital equipment, it sets up a depreciation schedule under which it can write off a certain portion of the cost of the asset each year over its economic useful life.

Equipment resources are traced to activities based on how the equipment is used in the transformation process. The extent to which capital assets are used in place of labor is referred to as operating leverage. Three levels of operating leverage are commonly used to trace equipment cost:

1. *Operator paced.* The machine is used by the employee. The machine hours correspond to the operator hours. The number of machine hours is equal to the total hours that all employees have assigned to the activity that employs the machine.
2. *Machine paced.* The machine operates independently of the employee. The employee's role is to tend the machine. The actual number of hours equals the hours the machine was used.
3. *Job class allocated.* The operator uses the machine as an occasional tool in performing all or most activities. An allocation of equipment cost to activities is in proportion to the hours worked by each job classification.

The untraced hours represent unused capacity. One critical element of proper tracing of equipment cost is to separate the used from the unused equipment capacity. Equipment use is computed by determining the ratio of total hours used (from the activity analysis) to the total available hours (number of machines multiplied by total work hours in a year).

A proper process analysis should be careful not to bias the determination of a process cost by using arbitrary depreciation values. The problem is compounded for fully depreciated equipment. Equipment resources include hardware, installation, maintenance parts, maintenance labor, utilities, and facility space occupied. Most important, equipment cost should not be thought of as a sunk cost and thus ignored.

Equipment cost should be comprehensive and include the following:

- *Maintenance.* The cost of maintenance depends on a number of factors, such as the age and durability of the equipment. The annual maintenance cost per group of machines is a cost of operating the machine. It is relatively easy to trace the cost associated with planned maintenance to the machine cost. It is more difficult to trace the cost of breakdown without a maintenance management system.
- *Tool and fixture maintenance, storage and interest.* The cost of jigs and fixtures and their associated storage and interest are a part of a machine's operating cost.
- *Process preparation.* As each batch of components is scheduled for production, the associated fixtures must be prepared, that is, taken from storage, cleaned, and so on. Similarly, preparatory work is necessary for the work pieces for each batch.
- *Tool preparation and presetting.* This includes the cost of tool grinding and/or presetting, and similar tasks.

How to Assign Facilities to Activities

Facility cost is the cost associated with the section of the building a group occupies. An activity's physical requirements can have a significant influence on the process layout and the cost of providing the facilities space. It is therefore essential that the activity analysis look at all activities to be performed in a facility with an eye to understanding the physical space required for each activity. Thus, facility cost should be assigned to an activity, equipment, or employee based on facility usage and where there are significantly different facility requirements. For example, the space occupied by work in progress inventory is often of greater magnitude than the space taken up by machines. A dramatic cost difference occurs where expensive modifications are made to the plant for a specific machine.

There are four steps in setting facility rates. These steps include the following:

1. Identify all facilities related costs. The facilities rate is based on capital and operating costs. Capital cost includes the initial cost of the building plus significant capital modifications.
2. Break down the building layout into areas that have significantly different cost behavior patterns. Determine the total area occupied for each subdivided area. The criteria for separating the areas include the following:
   — Areas that require a significantly greater proportion of capital cost.
   — Areas that require significantly different maintenance.
   — Areas that require significantly different utility usage.
   — Areas where a significant facilities modification was made to install a new manufacturing process. Examples include clean rooms, cooling storage areas, and reinforced areas that contain heavy equipment.
   — Significant areas that are assigned to storage.
3. Trace the facility cost to each separate area.
4. Compute a facility rate for each separate area by dividing the area's traceable cost by the area it occupies.

As a minimum, the facility rate should be broken down into:

- Office
- Computer room
- Manufacturing
- Warehouse

Finally the analysis should determine plant capacity requirements. Space usage should be broken down into used and unused. Unused facility should be further broken down into excess and surge capacity. Surge capacity is that area necessary to support seasonal and abnormal production requirements or necessary to meet future demand. Excess capacity is any unnecessary capacity (beyond its targeted level).

Excess capacity	= Total capacity
Less:	Used capacity
	Capacity used in planned maintenance
	Surge capacity

Unused capacity	= Excess capacity
Less	Surge capacity

Facility cost should be comprehensive and include the following:

- *Power and heating costs.* These are dependent on a number of factors, including the number of machines and their unique energy requirements.
- *Insurance and similar expenditure.* This cost is directly proportional to the capital cost of the equipment used.

How to Assign Information Systems to Activities

Information systems include the acquisition and installation cost of information systems. Information system cost is an important shared service cost. (See Chapter 4, "Steps for Operating the Process-Based Accounting System," for a discussion of shared service cost.) Information system resources are traced to activities based on usage.

How to Assign Material to Activities

The material costs include all significant supplies and sundries consumed in a process. Materials are traced to activities based on normal usage.

Material cost includes consumable costs, such as consumable office supplies, gas, oil, and similar items.

How to Assign Other Resources to Activities

Other resources include all other costs not previously classified that are used to perform an activity. Other resources are traced to activities based on usage. Other resource costs should be comprehensive and include the following:

- *Transportation between operations.* Functional layouts lead to considerable losses in time as a result of the transportation of parts from one machine section to another. Transportation further requires such equipment as fork-lift trucks.
- *Scrap and rework.* This includes the cost of all activities and raw material that have gone into the part up to the time that it is scrapped.
- *Cost of work in progress.* High work in progress is a direct result of the long and uncertain throughput times.
- *Capital costs.* The capital cost of the machines used depends on the interest rate and the number and cost of the machines.

After all GL costs have been adjusted to ensure their inclusion in the appropriate work group's cost basis, the next step is to trace each resource (cost) to the appropriate activity. A resource activity worksheet or activity analysis computer program is used for this purpose. A resource activity worksheet lists the resources on the horizontal axis and the activities on vertical axis (see Figure 3.2).

The objective of activity analysis is to trace resources to activities in order to create an activity standard cost. A central tenant of activity analysis is that costs are consumed by activities. The more direct the relationship between a resource and the activity, the greater the relevance of the activity standard cost. A resource (cost) is considered traceable where a strong cause-and-effect relationship can be established with an activity. For instance, people are paid on the basis of time. Therefore, time is an excellent basis for tracing people's

Figure 3.2 Resource Tracing Table

	Resources Clerk (%)	*Information Technology (%)*	*Supplies (%)*
Activities:			
Apply cash	30	75	10
Research Deed	40		
Issue credit	10	15	5
Cash reports	5	10	15
Administration	10		70
Training	5		

cost to activities. Similarly, the amount of human resources consumed in an activity is normally stated in terms of time. Typical causal bases include the following:

Resource	*Tracing basis*
People	Time
Technology	Machine/technology hours of use
Facilities	Area occupied—square footage/meters
Utilities	Kilowatt hours of use

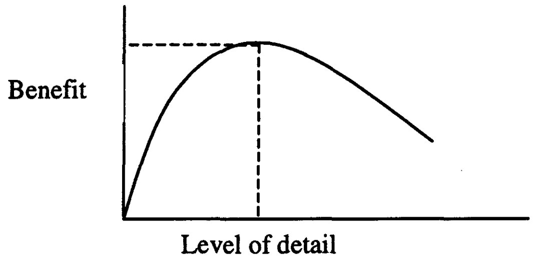
The final step in setting an activity standard cost is to validate that the activity is defined at the correct level of detail. An analysis that is too detailed wastes time tracing the minutia. It also results in a system with excessive data, possibly masking the important with the trivia. Conversely, an activity analysis that is too high-level is not detailed enough to be meaningful.

The key criteria in determining the correct level of detail include the following:

- Readily available and verifiable output
- Must represent a significant cost (greater than one-eighth FTE)
- Importance in a business process

This relationship and the evaluation criteria are illustrated in Figure 3.3. The graph shows that as activities are added, the decision-maker is better able to manage the organization (benefits increase). The greater level of detail permits the work group to focus on its important and unique work. However, at some point the additional activities begin to clutter the decisions and become a distraction. At this point, the benefit of additional activities begins to decrease.

Figure 3.3 Activity Level of Detail



STEP 3: ASSESS PROCESS VARIATION AND CONDUCT A ROOT CAUSE ANALYSIS

An assessment of process variation should be made for each primary activity defined in the activity analysis. First, the assessment should compute the actual amount of process variation. Second, the work group should determine the root cause problems that explain why a process varies. Minimizing cost variation is an important goal of process-based accounting. There is a direct correlation between cost variation and process variation.

How to Compute the Actual Amount of Process Variation

The first step is to determine the amount of process variation. Process variation identifies the gap between the current process performance and its potential performance. The gap supplies an indication of the potential opportunity for the process to create value. For instance, assume a sales order-taking process currently is capable of entering 150,000 orders per year. However, if root cause problems are eliminated, the potential capacity could increase to 250,000 orders per year. This gap of 100,000 orders per year represents a tremendous opportunity to improve productivity.

There are three methods to calculate process variation: ideal comparison method, statistical deviation method, and industrial engineering study.

Ideal Comparison Method

The ideal comparison method was developed to provide a rough approximation of process variance. The method begins with the standard activity time developed in steps 1 and 2. The time per activity is extracted from the activity database. The analysis team then determines how long it takes to perform the activity when there are no problems, i.e., the activity is completed without a hitch. This value is labeled the ideal activity time. The ideal activity time is determined by observation or it originates from the experience of the work group. It is unnecessary to perform a more rigorous analysis to set the ideal time because the purpose of this method is to compute a quick and approximate estimate of process variation. This method is summarized as follows:

Process Variation = Standard activity time – Ideal activity time

Statistical Deviation Method

The statistical deviation method uses a rigorous mathematical computation of variation developed by statisticians. The method first calculates the sample variance according to the following formula.

$$S^2 = \sqrt{[(x_i - x_a)^2/(n-1)]}$$

Next, calculate the standard deviation of the process data. The standard deviation, s, is the positive square root of the sample variance, s^2. Thus, $s = \sqrt{(s^2)}$.

Industrial Engineering Study

Industrial engineering (IE) includes a long-established set of techniques for studying processes, analyzing the results, and making improvements. The industrial engineers can conduct a time and motion study to set the ideal activity time. A time and motion study would set a more rigorous ideal activity time.

For instance, assume that cash deductions are taken for one in 10 customer invoices (see Table 3.2). This causes the person applying the cash to research the cause of the deduction, approve the deduction, or re-bill the customer. All these actions will increase the cost of the cash application activity.

Relevance is the key factor in selecting a technique to calculate process variation; precision is a secondary issue. An organization needs pertinent information to set priorities that guide the improvement process. Most organizations find a significant amount of "low-hanging fruit" in the early stages of implementing process-based accounting. An organization should focus on first fixing these processes.

Table 3.2 Apply Cash Activity Example

Process	*Root Cause*	*Frequency*	*Impact*	*Total Loss*
Apply cash	Cash paid does not equal invoice amount due to a deduction taken by the customer.	One deduction every 10 invoices	Ten minutes research time per deduction	$12,000/year

The constant attention to identifying and eliminating process variation will have a profound impact on the bottom line. It should be kept in mind that an organization cannot work on every problem simultaneously; therefore, it is important to determine which problems are the most significant. It has been demonstrated that 20 percent or less of the problems represent 80 percent of wasteful costs. This means an organization does not have to work on every problem uncovered in the process variation analysis—just the most important ones.

Significant process variation reductions are realized during the initial phases of process improvement. It is therefore recommended that organizations employ the ideal comparison method when first setting up a process-based accounting system. This method yields fast, accurate, and meaningful information to drive process improvement. To spend time on more rigorous techniques would yield limited and transient benefits.

As the process-based accounting system matures, the more rigorous statistical analysis computations can be embedded in the process-based accounting software. This approach "hides" the complicated mathematical computations inside the computer program. The only knowledge required of the user is to be able to interpret the meaning and significance of the calculated process variation.

Software availability for process-based accounting typically evolves in two phases. During the first phase, software vendors develop stand-alone packages that interface with an organization's in-place software systems. These stand-alone packages are inexpensive and enable an organization to learn and adjust its analysis during the implementation phase. In the second phase, the major accounting and EPR software vendors will add process-based accounting to their packages. This phase typically occurs four to five years after the stand-alone packages are introduced.

At present, only one package on process-based accounting principles has been developed. That package, Value Stream Manager (VSM), was developed by the Value Creation Group (www.valuecreationgroup.com). A major software vendor ABC Technologies (www.abctech.com) is modifying its Oros package to incorporate predictive accounting concepts.

How to Identify the Root Cause Problems That Explain Why a Process Varies

Root cause analysis is a disciplined problem-solving methodology used to reveal the source of process failures. The people who perform a process know best which problems keep them from doing their best work. Root cause analysis brings visibility to these problems. The tool exposes the problems and evaluates the frequency and severity of the root cause problems they face every day.

The steps of the root cause analysis are as follows:

1. Identify the root cause problems of process variation. The root cause problems explain the gap between the current activity performance and the targeted performance.
2. Quantify the monetary and performance impact of the problem. To calculate the monetary loss of each significant problem, multiply the problem frequency by its monetary impact.
3. Assemble work group members to resolve the problems. Determine the few (20 percent or less of the total) problems that result in 80 percent of lost value.
4. Use control charts to monitor the cost and performance results over time. Verify that the savings are valid.

1. Identify the Root Cause Problems

Understanding root cause events permits an organization to quantify the gap between actual and ideal performance. The occurrence of a process malfunction is the tangible result of a problem. For instance, an employee did something wrong or forgot to do something when performing a process. The tangible failures that result from the human error are really symptomatic of a deeper problem: The process allowed the human to fail. Root cause analysis studies the processes to determine what factor caused the person to do what he or she did. The work group must force themselves to look at all the possible causes rather than stopping at the most obvious possibility. Often the root cause is not the most obvious one.

There are numerous techniques for identifying and quantifying process problems. These techniques range from subjective to very rigorous quantitative methods. A key consideration in selecting an analysis technique is the trade-off between getting quick and relevant results and gaining increased precision through time-consuming techniques. A second critical concern is whether the technique is more likely to inspire the employees to act on the results. The more the employees are held accountable for identifying and resolving problems, the higher the probability that they will fix their problems. Conversely, the less the employee is involved and the more the analysis is done by staff employees, the less the employees will embrace the improvement initiative.

Root cause analysis begins with a definition of the failure event. The failure must be defined in a way that ensures that the work group's effort is directed to solving the problem rather than treating a symptom. A symptom arises from an event that takes place as a result of another event. The symptom is not the original cause of the failure—it is the effect. The word *symptomatic* is often used to denote the difference between the primary and secondary causes of problems. For example, a headache is a symptom of a problem. It is easy to take an aspirin to treat the symptom without understanding the root cause. Permanent reduction of headaches requires an understanding of their root causes. For instance, the headache might result from having to learn a new accounting technique such as process-based accounting. But the headache of changing the accounting worldview is inconsequential compared with those caused by having to constantly deal with problems.

A precise problem definition is important because it is used to rally the organization to proactively eliminate problems rather than react when they occur. It should focus management attention on the priority issues and communicate these issues in an easy-to-understand format to all employees. All employees should know what is important and what needs to be resolved to achieve the organization's strategic objectives. By ranking the problems in terms of the monetary and performance loss, employees can focus on the problems that are most important to a business.

Rules of thumb to consider when developing a problem definition include:

- It must be concise and easily understandable. Otherwise it will leave too much room for interpretation.
- It must address only one problem. This is important to maintain focus on resolving a limited number of problems.
- Finally, accountability should be assigned to the work group or someone in authority so everyone in the organization is aware that it is a priority issue.

At this point, the work group has clearly defined the problem and can now begin to analyze its root causes. Work group members must focus on the problems that occur most frequently and follow the cause-and-effect logic backward to the source of the problem.

Some of the most common techniques to detect the source of problems include the following:

- Work group brainstorming
- Five "whys"
- Fishbone diagrams
- Industrial engineering special studies

Work Group Brainstorming. Work group members brainstorm their perception of sources of the problems that plague the process. A brainstorming technique is unstructured. Any member can present any idea without prejudice from the group. There should be no discussion of the merits of the idea during the brainstorming session.

Five "Whys." These require the work group members to keep asking the question, How can the preceding event occur? The work group probes deeper into the chain of cause and effect (asking why) until they are satisfied that they have identified the root cause. The technique forces the work group members to come up with a set of possibilities that explains why the problem occurred. The five whys start with a very broad problem statement but get progressively more specific as the layers of cause and effect are peeled away.

Fishbone Diagrams. A fishbone diagram is a structured technique that graphically portrays the relationship between a problem and its possible causes (see Figure 3.4). The fishbone diagram begins with a problem statement. The work group draws a box around the statement and draws a horizontal arrow pointing to it. Four or five major categories of problems are added above and below the horizontal line. Some of the most common categories include:

- People
- Machines and equipment
- Methods and operating procedures
- Material

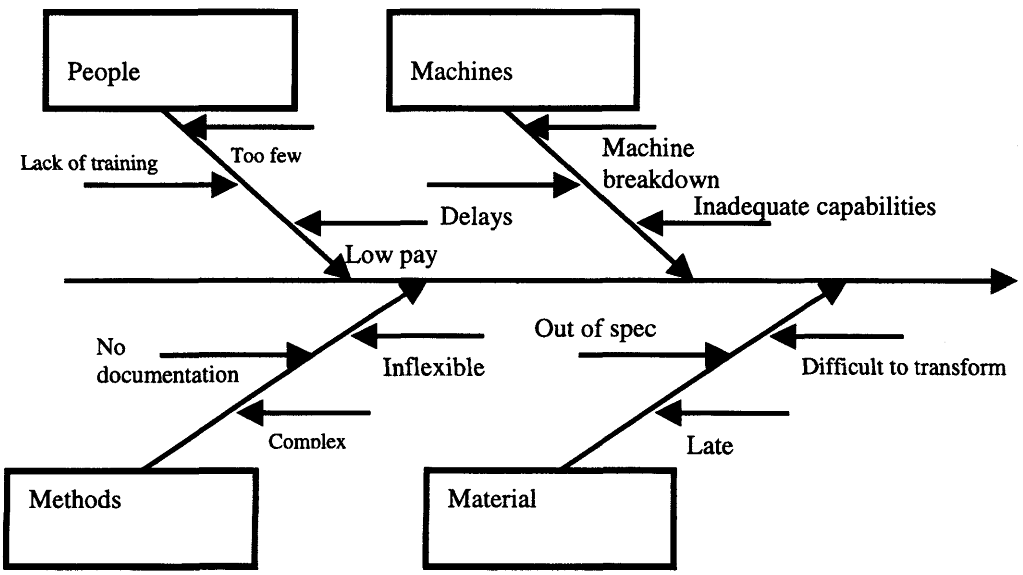
Through group discussions, the work group members identify specific causes and arrange them by the selected categories. The categories can be modified as needed.

Industrial Engineering Special Studies. Industrial engineering employs such techniques as process flow analysis, motion studies, time studies, and facility layout analysis to improve process performance. These tried and proven techniques provide an exhaustive analysis of problems and their root causes.

The results of root cause analysis can be classified into three categories of factors that cause process variation:

1. Any problem that causes the process to execute incorrectly.
2. Any problems caused by a high degree of difficulty in performing a process.
3. Any problems caused by special customer requirements.

Figure 3.4 Fishbone Diagram



Problems That Cause the Process to Execute Incorrectly. Failure to execute a process correctly anywhere in an organization will cause a process to fail. The failure might not occur until much further in the processing chain. Failure is defined as taking more time and consuming more resources than needed by the ideal process. Problems are manifested in several ways. Primary among these includes any factor that:

- Creates an output that does not meet customer specifications.
- Causes a delay in providing an output to a customer.
- Causes the process to take longer to execute than the ideal time.
- Unexpectedly interrupts the continuity of the process.
- Results in the unavailability of an asset.
- Results in an unplanned excess capacity of an asset or resource.
- Results in a loss of asset availability.

Noncompliance with activity and process procedures or inadequate procedures is one source of process variation. A machine breakdown is but one example. The machine breakdown will result in extended work queues that cause schedule disruptions and rescheduling activities. In addition, the maintenance department must quickly repair the machine using a less efficient maintenance process than would have been necessary had the preventive maintenance program been effective. Still further activities are generated in the finance department, which must resolve the resulting cost variances.

Problems that cause the process to execute incorrectly are unacceptable. These types of problems are controllable by the organization. The consequence of the problem is high cost and poor performance. It is management's responsibility to act and remove as many of the root causes of these problems as possible before they occur. Proactive action will render the process more efficient and error free. They can do so by improving the process.

The Degree of Difficulty of Performing the Work. Process variation occurs because every process is capable of dealing efficiently with work that is within certain specifications. However, the process is often asked to perform work outside the process capabilities—its specification limits. Keep in mind that a process is a unique configuration of material, machine, method of work, and people. The limits that are rationally achievable from a process are based on the process technology and procedures employed. A process will slow down or abort anytime the work requirements go beyond the bounds of the process's normal capabilities. A process will be efficient when work demands use existing process capabilities. Conversely, work that pushes the limits of an organization's processes can cause significant disruption and high cost.

Work requirements that exceed a process's capabilities cause additional work steps, longer processing time, and/or quality problems. Thus it is important to understand how each work requirement affects a process. To take a sewing example, thin material bunches in a sewing machine, causing the operator to feed the material into the sewing machine at a slower speed. Also, the number of sewing errors increases because the machine guides cannot hold the required tolerances. The loss of process efficiency is not the fault of the worker doing shoddy work; rather the sewing process is not capable of handling thin material. The worker must battle the process.

The implications are important to root cause analysis. Process variation caused by an incapable process can be addressed in only one of three ways:

1. Design the product/service in a manner that is more compatible with the existing process capabilities.
2. Market and sell only products that the organization is capable of efficiently producing with its current processes.
3. Expand process capabilities.

Special Customer Requirements. A third major source of variation is the customer. Certain customers require exclusive product features or services. Special requirements might consist of explicit delivery schedules or unique packaging. These unique requirements often disrupt the normal production and distribution processes and thus cause an organization's processes to vary.

The implications are important to root cause analysis. Process variation caused by special customer requirements can be addressed in one of two ways:

1. Market and sell products only to selected customer groups that the organization is capable of efficiently producing and delivering with its current processes.
2. Expand the process capabilities.

As was the case with product features, it is useless to look to the process as the root cause of customer-caused process variation.

2. Quantify the Monetary and Performance Impact of the Problem

Once the root causes of problems have been identified, the work group should ascertain the frequency and impact of each failure event. The frequency is based on the number of occurrences per year. The impact includes lost time, wasted material and related costs, the problem resolution time, and any downstream impact on other work groups. The monetary and performance impact is calculated by multiplying the frequency of the problem by its financial impact. The calculation is as follows:

$$\text{Total loss per year} = \text{Frequency} \times \text{Financial loss per occurrence}$$

To illustrate the calculation, assume the root cause analysis reveals that 5 percent of all timecards contain an error or are missing. Further assume that it takes a payroll clerk an average of seven minutes to resolve each error. The total loss per year would be calculated as follows:

Frequency	= 10,000 payroll checks per year × 5%
	= 500 errors per year
Financial loss per occurrence	= 7 minutes × \$18 per hour (fully burdened clerk rate) × 1/60 hours per minute
	= \$2.10 per occurrence
The total loss per year	= 500 × \$2.10
	= \$1,050

It is important to quantify problems in monetary terms in order to communicate the severity of the problems to the management team in the most appropriate form that will get their attention. Alternatively, the loss caused by problems could be expressed as lost time, that is, the organization wasted over 58 hours per year (7 minutes/60 minutes per hour × 500 occurrences) resolving payroll errors. Couldn't that time have been more productively spent on improving the process or on other activities that create value?

3. Resolve the Problems

The final step of root cause analysis is to develop solutions to the problem. All the analysis efforts will have been a waste of time unless the organization acts on the findings. It is important that the work group understand management's performance expectations. Is there a management imperative of performance targets that is expected from each work group? Or, is the management team merely paying lip service to achieving performance objectives? In this case, the work group must merely go through the motions because management attention will soon shift to another issue.

The work group must be very selective in selecting problems to correct if it is seeking quantum leaps in productivity. Most commonly, very few problems represent the majority of losses that an organization experiences every year. This presents a great opportunity and a great dilemma. The opportunity is obvious: Simply delineate those few problems that represent the largest amount of loss and dedicate the problem-solving resources to those few problems. The dilemma arises when the boss wants you to either work on his or her reactive work or, even worse, the "political topic of the day."

STEP 4: IDENTIFY PROCESS PERFORMANCE MEASURES

Performance measurement is a systematic and analytical assessment of how well a group performs its work. It measures the value created by an organization's processes. Value is a measure of how well a process meets performance targets at each stage of the process. Performance measurement systems collect data at various levels within the process and present this data in a manner that encourages process improvement.

There are two levels of performance measures within an organization. At the activity level, process controls must be established. There are two key principles in selecting a process control measure. First, find a single performance measure that determines whether a process is in control. Second, the data must be easy to capture. Some of the choices are included in Figure 3.5.

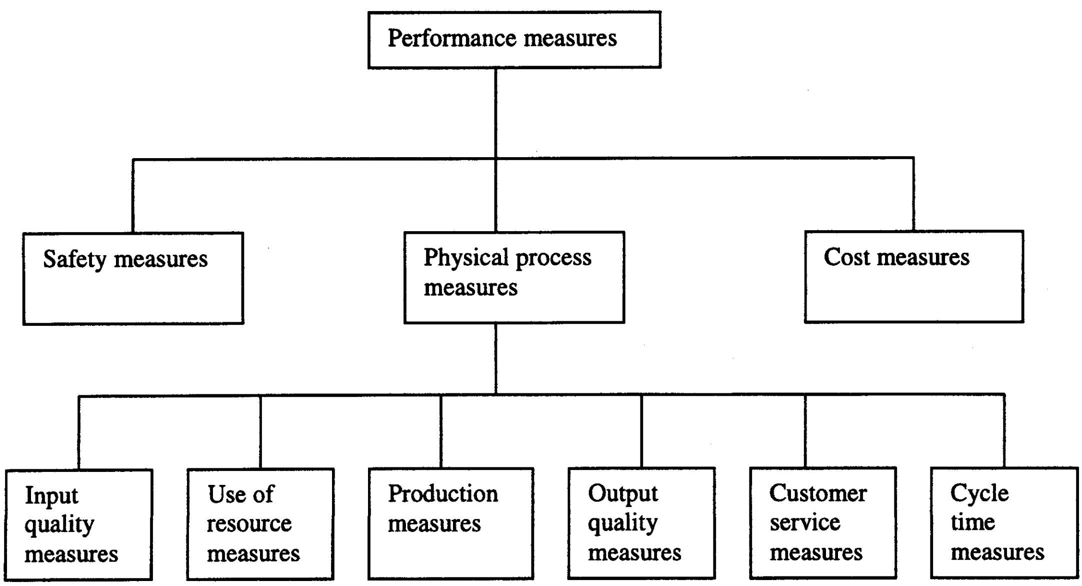
An example of a process control measure might be time per output. The process control system will monitor the actual time per output over a period of time and plot them on a time series graph. The average process time and upper and lower control limits would be added to the graph. As long as both the process and the work backlog remains in control, the management team has confidence that other aspects of performance targets are being met.

The second level of performance measurement determines whether the organization has achieved its strategic objectives. Each process may be in control and achieving its targeted performance, but the overall organization goals might not be met due to a mediocre strategic plan. A strategic performance measurement system is relatively simple to develop. Take the organization's mission statement and break it down into measurable goals. To illustrate this procedure, consider the following mission statement:

> The organization's mission is to dominate the xxxx industry, to provide our stakeholders with an above average return on investment, to make the organization a safe and challenging place to work and to exercise environmental conservation.

The strategic performance measures might include the following:

Figure 3.5 Performance Measurement Hierarchy



Mission Objective	*Performance Measure*
Dominate the xxxx industry	Market share by industry segment
	Brand value
Provide our stakeholders an above-average return on investment	Shareholder value
	Missed stock analyst earning projections
Make the organization a safe place to work	Injury days lost
Make the organization a challenging place to work	Employee turnover
	Amount of performance bonus compensation
Exercise environmental conservation	Amount of smoke emitted to the air
	Water cleanliness

The key to setting strategic performance measures is to develop a measure for each objective discussed in the mission statement. If an objective is important enough to discuss in the mission statement, it is important enough to measure. Conversely, if management believes they need a strategic measure, the outcome is important enough to include in the mission statement.

When assigning performance measures, it is easier at times to measure the negative results of performance rather than to directly measure performance. For instance, it is extremely difficult to directly measure how satisfied customers are, whereas it is very straightforward to measure when they are dissatisfied. An unhappy customer will buy from an organization's competitors. An unhappy customer may also continue to buy an organization's products because he or she feels there are no other viable alternatives. However, time is not on the side of the organization where customers reluctantly purchase from them. Time has a way of creating competition when a void in the market exists.

Performance measures are a critical element of a process-based accounting system. Performance measures assess how well an organization is achieving its strategic objectives. An organization might have done an excellent job of creating efficient and effective processes that are executing an ill-conceived strategy. Clearly, in this case the organization will not create value. Predictive accounting can effectively measure value creation only by integrating performance measures into the process-based accounting system.

STEP 5: IDENTIFY EXTERNAL VALUE DRIVERS

Every organization operates in a larger macro economy. Business plans are based on assumptions about the impact of economic forces on an organization.

Plans based on these assumptions are valid as long as the actual economic factor remains within a limited range of values. Changes beyond this limited range must trigger a new plan.

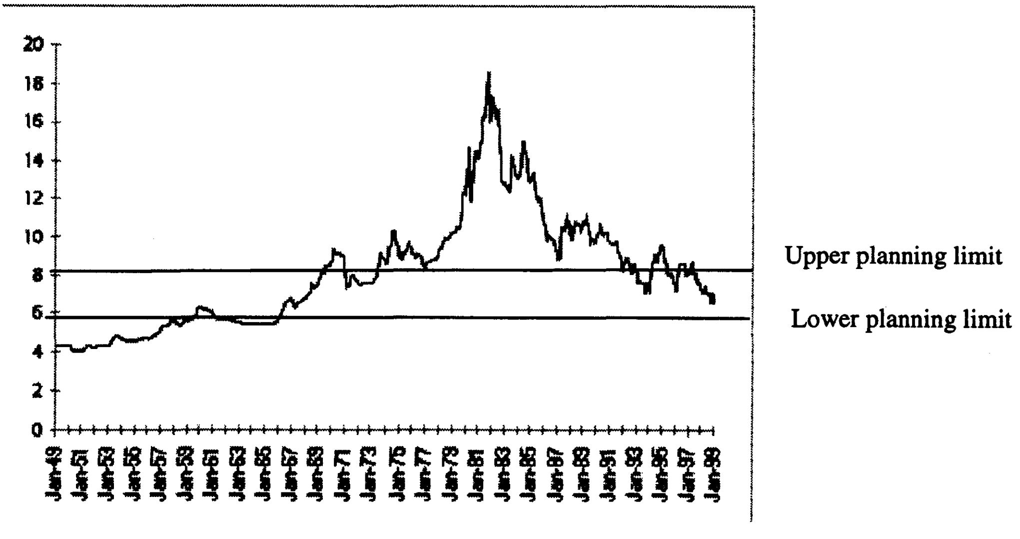
A planning control chart enables a company to continually monitor the key resource price and availability. Management should be alerted as the resources approach the planning control limits. The planning control chart enables the management team to develop plans based on their specific assumptions.

Interest rates can be used to illustrate a planning control chart. Assume a 7 percent interst rate was used during the planning session. It is determined that if the interest rates vary by more than 2 percent from the planned rate, the organization updates its plans. The organization would use the planning control chart to monitor interest rates using the same principles as a control chart (see Figure 3.6).

A key aspect of the planning control chart is that significant changes on either side of the control limits would trigger a new plan. In this example, an interest rate that exceeds the upper limit (9 percent) wouldjeopardize cash flow projections. The interest cost for current and future debt would be significantly larger than planned. Capital investments might have to be delayed or might require a higher hurdle rate. The impact of customers might dampen sales forecasts. All of these and other factors would need to be considered in the new plan.

A similar replan would be necesary if interest rates dropped below the lower limit. The opposite conditions would occur. There might be excess cash flow that would need to be allocated—the interest expense is lower than planned. Perhaps the hurdle rate might be lowered and capital investment that did not meet old hurdle rates might now be justified. Possible customers who had been holding off on purchases might cause a spike in sales.

Figure 3.6 Planning Control Chart



There is no need to trigger a new plan when the interest rates are within acceptable planning limits. The power of the planning control chart is that it forces an organization to explicitly identify and monitor the key events that would cause a major disruption to its business. As long as the planning assumptions remain within control limits, the management team need not concern itself with the impact of the economic factor. Management need only become involved when the factor shows a clear trend or exceeds its contol limit.

The key economic factors to monitor should include local, national, and international aspects.

Local Economy

The unemployment rate influences the number of available skilled people, wage rates, and employee turnover. High unemployment offers a pool of experienced people at a competitive rate and often results in low internal turnover. Low unemployment often results in difficulty in finding skilled people, salary and wage competition, and high turnover.

The wage rate growth is highly correlated with the unemployment rate. People cost remains one of the highest cost resources and most volatile in terms of process execution.

The cost of living affects the ability to attract a competent workforce. Many talented workers avoid moving to locations with a high cost of living.

The type of worker available to an organization affects productivity, quality, and customer satisfaction.

National Economy

An organization must look at the rate of GNP growth, to understand whether the economy is expanding or contracting. Strategic objectives are often scaled up in an expanding economy and scaled down in a contracting economy.

The inflation rate affects the cost of all resources—people, equipment, material, and other resources. The differential between the target price and inflation rate is an important factor in driving the need for continuous improvement. If for example, an organization was expecting a 4 percent inflation rate but was unable to raise its prices, it must target a minimum of a 4 percent productivity improvement to merely maintain its current level of profitability. Similarly, if the organization was able to increase prices by 5 percent, it would expect a 1 percent improvement in profitability without any performance improvement.

Interest rates have a direct impact on cash flow, capital investments, and in some industries, demand. The level of interest rates directly affects the cost of current and future debt. Interest rates affect the amount of capital investment an organization can afford. The higher the interest rate, the higher the hurdle rate an investment opportunity must meet. The impact on customers might mean an organization must dampen its sales forecasts.

A similar replan would be necessary if interest rates dropped much lower than expected. Excess cash flow might need to be allocated. Perhaps the hurdle rate might be lowered and capital investment that did not meet old hurdle rates might now be justified. Possible customers who had been holding off on purchases might cause a spike in sales.

The political and regulatory environments have dramatic impact on international competitiveness. Government policies, such as the minimum wage, environmental regulations, equal employment opportunity regulations, tax policies, and many others have an enormous impact on international competitiveness. Without getting into the political and emotional sensitivities of these issues, a company must understand the impact of the policies on performance.

Political and regulatory issues tend to be discrete events rather than a time series of values; for instance, legislation is introduced to raise the minimum wage. Industry groups and other forms of collaboration are the most effective tools to influence their outcome.

International Economy

Exchange rates can have a dramatic effect on the planned performance of international subsidiaries and suppliers. An international subsidiary might have stellar or terrible performance not because it is performing better or worse than planned but simply because of major changes in the exchange rate. The impact of exchange rate fluctuations on international suppliers can be minimized through the use of forward contracts that lock in prices at a "standard," agreed-upon exchange rate. These contracts are only temporary solutions that could surface in a dramatic manner at the end of the contract period, depending on the exchange rates in effect at the end of the contract period.

Key resources must be identified. A key resource is one that is a significant percentage of the product cost, for example, petrochemicals in the glass industry.

STEP 6: ASSESS THE PLANNED WORKLOAD USING A KEY EVENT PLANNING TABLE

The final step in setting up a process-based accounting system is to estimate the upcoming workload. The workload estimates form the basis of a process-based accounting system. In the short-run, workload is relatively predictable because the initiating event has occurred or is already in motion. The activities that follow can be statistically determined based on the process's sequence of processing steps.

The process driver is a key element in determining long-term workload requirements. What drives the number of purchase orders at an organization? The answer to this question requires an organization to carefully consider the key factors that influence its business—these factors are labeled key events. Luckily, Pareto's law suggests that the important factors to consider will be few in number.

The steps in constructing a key event table are discussed in the following sections.

Determine an output measure for each business process.

Example business process:	Take customer order
Business process output measure:	# of sales orders
Output measure quantity (year):	40,000

Calculate the ratio of the number of outputs for each activity divided by the number of outputs for the business process output measure.

Example activity within a business process:	Apply cash receipt
Activity output measure:	# of cash receipts
Activity measure quantity (year):	40,000
Ratio of cash receipts to sales order:	100% (40,000/40,000)

Determine the workload driver for the business process.

Workload driver:	Average order size; total sales by customer segment

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Create a key event hierarchy table (see Table 3.3).

The key event table compels an organization to construct a model of workload drivers. The organization must carefully consider the relationships among events and the forces that shape those events. The resulting analysis ends with only a handful of factors that drive all subsequent workload in an

Table 3.3 Key Event Hierarchy Table

		Key Events			
Level	*Output*		*Relationship*		*Timing*
1	Sales				
2	Sales orders		Average order size		Concurrent
3	Cash applications		1 per sales order		Lag-30 days
		Planned Workload			
Level	*Output*	*Period 1*	*Period 2*	*Period 3*	*Period 4*
1	Sales	$100K	$150K	$125K	$100K
2	Sales orders	1000	1500	1250	1000
3	Cash applications	980	1000	1500	1250

organization. This handful of factors is the "critical few" on which senior management should focus. These critical few must be targeted, measured, and constantly tweaked to keep them on track.

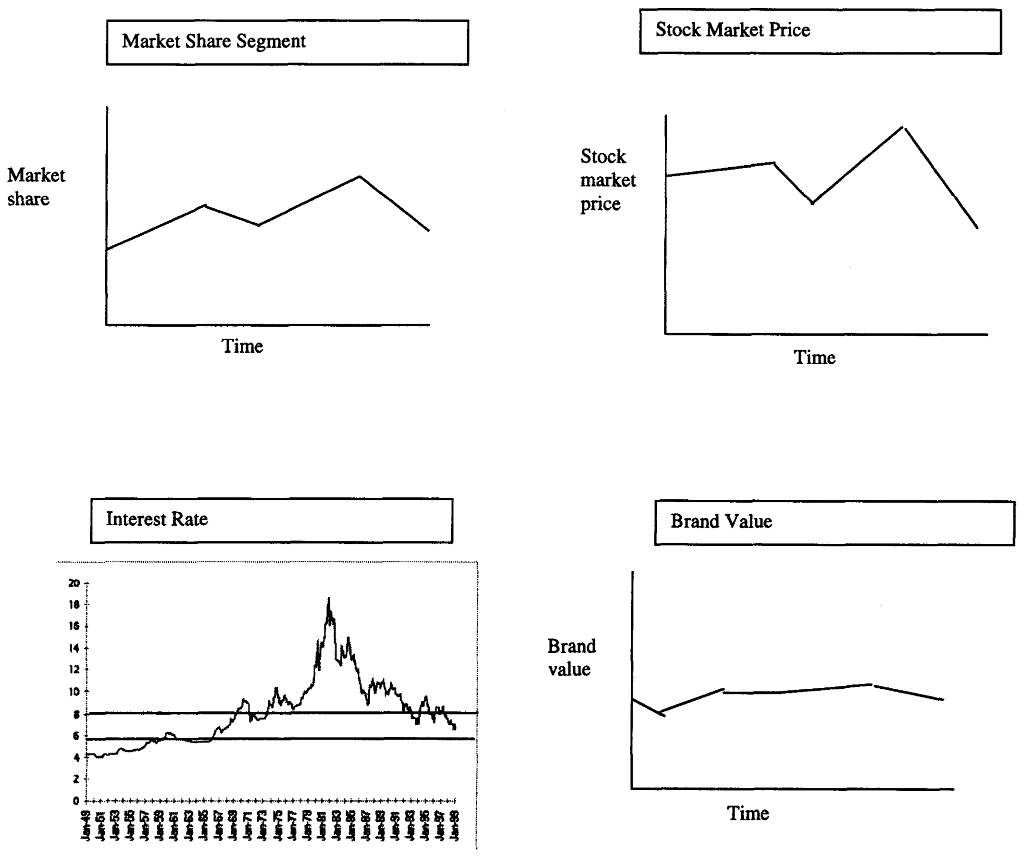
PROCESS-BASED ACCOUNTING REPORTS

At the completion of its initial process-based accounting set-up, the organization will be able to produce the process performance statement (see Chapter 1, "The Nature and Need for a Forward-Looking Accounting System: Process-Based Accounting") and the strategic performance statement (see Figure 3.7).

SUMMARY

This chapter has presented a practical step-by-step approach to creating the database necessary to support a process-based accounting system. Each step draws on techniques that are currently in use at many organizations. The next chapter presents a simple approach for keeping the information current.

Figure 3.7 Strategic Performance Statement



4

Steps for Operating the Process-Based Accounting System

Once the process-based accounting system has been set up, the management team will conduct periodic analysis of process performance. The purpose is to ensure the strategic objectives are being met and that there is a proper allocation of resources to complete the required workload without unnecessary excess capacity. It also forms the basis for determining the cash flows required by the financing plan to support the needed resources.

The methodology to operate a process-based accounting system is organized into seven steps:

1. Track actual workload.
2. Track the actual cost incurred by the group.
3. Compute the earned value cost.
4. Compute earned value variance.
5. Assign the earned value variance to individual activities.
6. Track earned value variance on a control chart.
7. Interpret earned value results.

An important milestone in a process-based accounting system is when management begins to depend on the predictive accounting information. It can be said that the process-based accounting system has reached a mature level when senior management no longer is interested in historical accounting results other than for fiduciary purposes. It is important for the monthly accounting close process to instill this level of management confidence in the process-based accounting information.

STEP 1: TRACK ACTUAL WORKLOAD

The first step in the monthly close is to track the actual workload accomplished during the month (see Table 4.1 for an example of actual output that is captured by a process-based accounting system). The actual work accomplished

Table 4.1 Actual Workload

Level	*Output*	*Period 1*	*Period 2*	*Period 3*	*Period 4*
1	Sales	$ 95K	$ 140K	$ 105K	$ 90K
2	Sales orders	960	1,420	1,200	980
3	Cash applications	170	965	1,430	1,235

forms the basis of earned value reporting—a concept that has been used extensively in project management in organizations of all sizes and is the foundation for the predictive accounting approach. Earned value reporting is described in Chapter 10, "How to Use Earned Value Reporting as a Feedback System." It is important that the practitioner should avoid subjectivity when measuring actual outputs. The optimal solution is for the actual outputs to be downloaded from operational systems. The automatic download improves data integrity while reducing redundant data entry into the process-based accounting system.

The timing of work can potentially distort an earned value analysis. The problem is most severe for work started in one analysis period and completed in another where the following conditions exist:

- The cost of the work is very large.
- The work has a long duration to complete.

A group's workload must be evaluated to determine whether either of these conditions exists. Where these exceptions are detected, the organization must assess its materiality to the earned value analysis.

Incomplete work exists where completed work overlaps an analysis period. The impact of incomplete work is that some of the actual cost will occur in one analysis period while the earned value will occur in another analysis period. The first step is to determine the significance of the issue. Many outputs are large in number and are completed in a relatively short period of time. These outputs are not materially effected by the output timing issue.

Significant outputs that take a considerable amount of time to complete need to be restructured. These outputs must be broken down into the individual tasks that are of a shorter duration. The decomposing of a process into tasks allows the user to determine when each task is completed. This procedure enables the organization to determine a percentage completion for the larger process.

For example, if an activity is to create an engineering design drawing, progress might be reported as follows:

- Five percent when the preliminary specifications are prepared
- Thirty-five percent when the first draft of the drawing draft is completed
- Forty-five percent when the first draft is reviewed

- Sixty percent when the revised draft is completed
- Eighty percent when the marketing approval is received
- Ninety-five percent when the final draft is completed
- One hundred percent when the drawing is issued to manufacturing

The key in defining earned value using the percent complete approach is that each task must be discrete and easy to determine when the task is completed. A completed task is best recognized by physical evidence, such as a computer transaction, a document, or a physical transformation of the product or service. The disadvantage of this approach is that it involves more data collection.

STEP 2: TRACK THE ACTUAL COST INCURRED BY THE GROUP

Capture the actual cost incurred by the work group during the analysis period (see Table 4.2 for an example of actual cost that is input into a process-based accounting system). The actual cost comes from the general ledger system. It is the same data that is reported to management on a monthly or quarterly basis.

It is most appropriate to use dollars as the unit of measure for earned value. Dollars can be used to control process cost because each labor hour, machine hour, and facilities space has a price. However, when using dollars, additional factors enter into the performance evaluation. This includes salary rate differences, escalation, and purchase price variances. Consider the effect of a process plan that calls for a certain job grade to do work. What is the impact if a person in a different job class with a different salary rate performs the work? The dollar measures include the effect of the differences in salaries. For financial control, this is relevant information. However, for performance control, this information muddies up the waters. Standard resource rates are used to minimize the impact of such events.

The Achilles heel of earned value is the difficulty of tracking actual cost to the individual processes. Tracking actual cost is relatively easy where resources are totally dedicated to a single process. The actual cost can come

Table 4.2 Actual Cost

Cost Account Description	*Amount*
Salary and wages	$2,000.00
Depreciation	83.33
Software cost	85.00
Facilities cost	112.50
Total	$2,280.83

directly from the payroll system and accounts payable invoices. The problem occurs when trying to trace shared service costs—often referred to as allocating indirect cost. This topic is discussed in Chapter 3, "Steps for Implementing the Process-Based Accounting System."

It is more difficult to trace a resource to activities when the resource is employed in multiple activities. It is very difficult to accurately determine the time people spend on each individual activity. A natural response on the part of most managers is to install a time reporting system. The use of time reporting systems is to be discouraged, as discussed in Chapter 3.

An alternative approach is to look at the total bundle of processes assigned to a resource group. This approach accumulates the total workload accomplished during an analysis period for each resource group. Process standards are used to determine how much time should have been spent to accomplish the work. The "should" amount of time is referred to as earned value time. The actual total available time for the resource is known. The earned value time is then subtracted from actual available time to compute an earned value variation. The earned value variation is plotted on a control chart to assess the stability of the bundle of processes.

$$\text{Earned value variation} = \text{Actual time} - \text{Earned value time}$$

STEP 3: COMPUTE THE EARNED VALUE COST

Earned value is computed for each activity. Earned value is the monetary value at a standard resource consumption rate needed to complete a unit of output. Earned value has been widely used in the construction industry. Consider building a house. One major task that can transcend monthly reporting periods is building a roof. Under earned value, the area to be roofed would be broken into the number of squares. At the end of the reporting period, the actual number of squares completed would be reported. The percentage of squares completed to the total squares is multiplied by the total cost of the roof. The resulting value is the earned value for the roof.

For all primary activities, the earned value is computed by multiplying the actual work accomplished by the process standard. A primary activity has a discernible output that is provided to a customer. A process standard consists of all of an activity's directly traceable resources needed to complete a unit of work. The standard resource consumption per output provides a baseline against which actual resource consumption can be compared.

For all secondary activities, earned value is computed as a standard allowance of cost. A secondary activity is an administrative or process improvement activity. Examples include training, completing a timesheet, or managing a work group. Secondary activities usually comprise many small tasks. If a work group spends 3 percent of its time attending to administrative activities and another 3 percent being trained, each month the group would "earn" 6 percent of its time and the associated cost needed to perform these secondary activities. It is at management's discretion to increase or decrease the time allotted to administrative activities.

Each resource, in turn, is associated with a general ledger chart of accounts. These connections enable the actual workload to directly compute earned value cost by general ledger account (see Table 4.3).

If a sales team planned to make 20 customer visits and yet only made 10, there should be other activities that the sales team completed. Less travel cost could also be expected, unless the salespeople work on other activities that require travel.

STEP 4: COMPUTE EARNED VALUE VARIANCE

The next step is to compare earned value with actual cost. The comparison is performed at the cost account level—the same level of detail reported in the general ledger. One would expect minimal variances where the processes are in control and capacity is well matched to actual workload (see Table 4.4 for an example of the earned value variance calculation within a process-based accounting system).

A variance is computed for each cost element. One would expect minimal variances where the processes are in control and capacity is well matched to actual workload. For example, if a sales team planned to make 20 customer visits and yet only made 10, its time should be accounted for by other work activities of the sales team. However, less travel cost should be expected because the visit customer is the primary activity that involves travel.

STEP 5: ASSIGN THE EARNED VALUE VARIANCE TO INDIVIDUAL ACTIVITIES

The next step is to reverse the analysis and assign the variance back to the individual activities. The preferred method is for the work group to assign the variance based on group members' experience amid the events of the analysis period. The work group will be aware of any extraordinary problems that caused the variance.

An alternative approach is to allocate the variance to the activities based on the relative magnitude (proportion of time spent on each activity) of each activity to the total department cost. Pareto's law—the 80/20 rule—increases the relevance of the variance allocation method. Pareto's law capitalizes on the observation that workload is rarely evenly balanced. During any period of time, a limited set of activities will consume the bulk of a group's time. During another period, a different set of activities will take over the group's time.

The reason Pareto's law is important is that minimal earned value variance should be expected where a particular activity dominated a group's time and that activity is in control. When this variance is allocated to the activities of the dominant activity—which is in control—the result is a minimal variance allocation. Conversely, where an activity is out of control, a large earned value

Table 4.3 Earned Value Cost

Process	*Resource*	*Process Rate*	*No. of Outputs*	*Cost*	*Salary and Wages*	*Depreciation*	*Software*	*Facilities*
Apply cash	Clerk	6 minutes	965	$1.25	$1,206.25			
	PC workstation	6 minutes	965	$0.05		$48.25		
	Software	6 minutes	965	$0.05			$48.25	
	Facilities	6 minutes	965	$0.07				$ 67.55
Research error	Clerk	20 minutes	100	$4.17	$ 417.00			
	PC workstation	20 minutes	100	$0.20		$20.00		
	Facilities	20 minutes	100	$0.35				$ 35.00
Total earned value					$1,623.25	$68.25	$48.25	$102.55

Table 4.4 Earned Value Variance Calculation

Cost Account Description	*Actual $*	*Earned Value $*	*Variance*
Salary and wages	$2,000.00	$1,623.25	$376.75
Depreciation	83.33	68.25	15.08
Software cost	62.50	48.25	14.25
Facilities cost	112.50	102.55	9.95
Total	$2,258.33	$1,842.30	$416.03

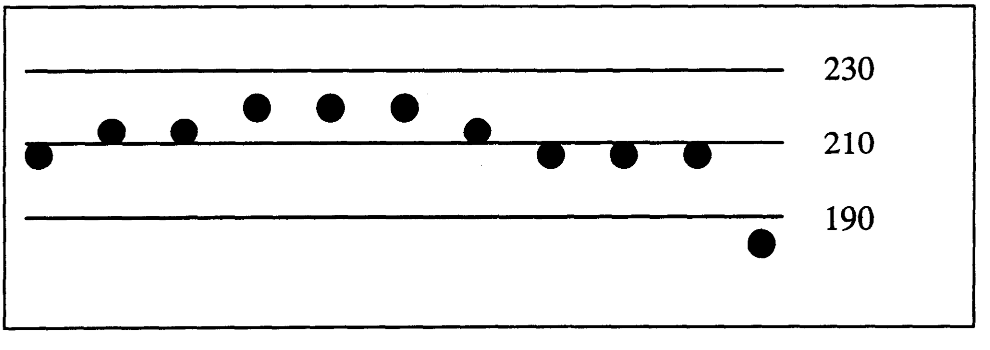
variance can be expected. Using the same logic, the dominant activity—which is out of control—would get a large variance allocation. Thus Pareto's law causes variance to be generally correct.

STEP 6: TRACK EARNED VALUE VARIANCE ON A CONTROL CHART

The next step is to plot the activity variance on a control chart. The control chart helps to determine whether the earned value is within control limits. The control chart provides management with confidence in the predictive costs where processes are in control (see Figure 4.1 for an example of the control chart used within a process-based accounting system).

To illustrate the use of a control chart, if there is one full-time person assigned to applying cash, that person could be expected to apply cash to an average of 210 invoices per day (60 minutes per hour / 2 min per invoice × 7 hours per day). A control chart could be used to monitor the actual number of cash receipts applied every day. Statistical analysis would suggest that the actual number of invoices processed would rarely equal exactly 210, but rather that a range of expected values could be determined.

Figure 4.1 Earned Value Control Chart



An out-of-control process should cause the work group to launch a root cause analysis (see Chapter 3) to determine the source of the problem and prod management to resolve the problem.

STEP 7: INTERPRET EARNED VALUE RESULTS

The final step is to interpret the results. Typical comparisons include the following:

- Compare the budgeted cost with the cost of budget earned for work accomplished. This provides an indication of the reason for the cost variance.
- Compare the planned amount of time by resource with the actual available resource time for the same work. This provides a measure of capacity variance.

Comparing the value of work completed to the value of work scheduled during a given period of time provides a valuable indicator of dollars' worth of work accomplished. This variance may not, however, clearly indicate whether schedule milestones are being met because some work may have been performed out of sequence or ahead of schedule. Schedule variance does not indicate whether a completed activity is a critical event or if delays in an activity's completion will affect the group's performance. A formal time-phased process map, therefore, provides the means of determining the status of specific activities, milestones, and critical events.

Senior management needs visibility, at least monthly, of any significant differences between both planned and actual schedule performance and planned and actual cost performance. The work groups must provide the reasons for the variances at the detail needed by the management team. The analysis should include a summary of the improvement projects underway and other managerial actions taken as the result of earned value information.

Identify the impact of changes in the operational departments that affect support department requirements. The support departments should continuously adjust their activities in response to permanent changes in demand derived from operations. Management needs these changes to the service level for effective control of support department cost and performance, along with the reasons for any significant variances.

A cost variance is determined by comparing the actual cost of completed work with the activity standard value for that work. Analysis of these differences reveals the factors contributing to the variances. Examples include poor initial activity analysis, technical difficulties that require additional resources, the cost of labor or other resources are different than planned, differences between planned and actual workloads, and process efficiency that is different than planned (perhaps due to product features or other factors). Analysis of significant earned value variances can lead to one of several courses of action:

- The variance appears to be an aberration or the trend is not stable enough to draw any conclusions about the performance. Action: continue to monitor future performance.
- The variation indicated corrective action is necessary to correct a problem. Examples include scrap, test rejections, unanticipated test quantities, and the like. Action: initiate improvement project.
- The activity standard appears to be incorrect. Action: update the activity standard.

The greater the process variation, the more uncertain will be the expected results. Effective financial performance is possible only where there is minimum process variation. Thus monitoring earned value on a timely basis is critical. (See Figures 4.2 through 4.5 for various sample reports to management.) Too-frequent monitoring results in wasted effort in responding to normal "noise" caused by random variations. Too infrequent monitoring results in the "trail" going cold when investigating the root cause of problems. Thus it is important to have a good activity standard and to keep track of performance against it. The identification of excess usage that is expected to continue for future units is key in validating activity quantities and performance. Based on this analysis, appropriate action should be taken to ensure activity variation is reduced and financial performance is more predictable.

SUMMARY

Predictive accounting aids in the daily running of a business. The operational employees can communicate with accountants in a common language—the language of processes. Accounting reports will become more relevant by providing feedback in a manner consistent with how the organization performs its work. Process information will increase management's awareness of new opportunities. As long as organizations measure with the old tools of controlling types of cost (for example, travel, salary and wages), they won't "see" the new opportunities to eliminate non-value-adding work.

Predictive accounting focuses an organization in the future. It relegates traditional financial reporting to the role of meeting fiduciary responsibility and validating the process results. The ensuing management attention is on managing processes. Process management reaps the dual benefits of improving process performance—with the resulting increase in profitability—while simultaneously shaping the future rather than reacting to events.

Organizations will not have to wait until the implementation is complete to achieve performance improvement. It will receive tangible benefits at each step in the implementation process. But how can one be sure that new concepts such as predictive accounting are worthwhile to pursue? One criterion is that any new idea that suggests to replace a successful older one, at the very minimum must account for all the results that the old one explained, and at least as well

Figure 4.2 Process Control Chart Statement

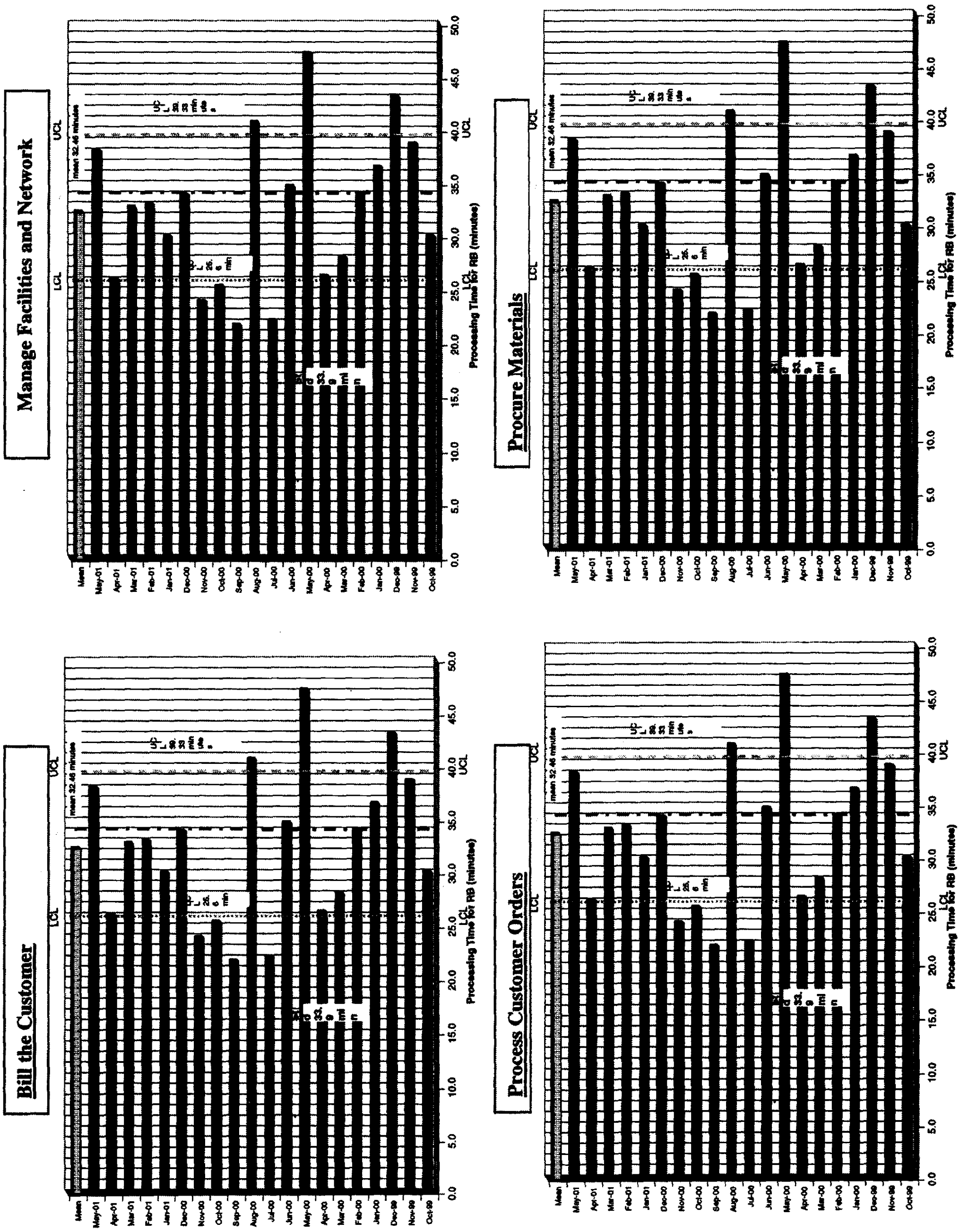


Figure 4.3 Detail Process Performance Statement

	Amount (000's)	Output Measure	Workload (000's)	Cost per Output	Target Cost	Cycle Time	Time
Sales	$40,000						
Less:							
Raw materials	9,000						
Less:							
Understand markets and customers	280	No. of customers	4.0				
Develop vision and strategy	110	Net cash flow	11.3	$110	$65	5 days	3 days
Design products and services							
Research and development	600	Patents/trademarks	11.3	$110	$65	5 days	3 days
Introduce new product/service	250	No. of new product	11.3	$110	$65	5 days	3 days
Refine existing products/services	400	No. of ECNs	11.3	$110	$65	5 days	3 days
Market and sell							
Market products	860	No. of leads	11.3	$110	$65	5 days	3 days
Sell products or services to relevant customer segments	1,250	No. of sales order	11.3	$110	$65	5 days	3 days
Process customer orders	320	No. of sales order	11.3	$110	$65	5 days	3 days
Produce and deliver for manufacturing/service organization							
Procure materials	1,500	No. of line items ordered	11.3	$110	$65	5 days	3 days
Convert resources or inputs into products	18,300	No. of items produced	11.3	$110	$65	5 days	3 days
Deliver products	380	No. of product shipments	11.3	$110	$65	5 days	3 days

(continued)

Figure 4.3 Detail Process Performance Statement (continued)

	Amount (000's)	*Output Measure*	*Workload (000's)*	*Cost per Output*	*Target Cost*	*Cycle Time*	*Time*
Invoice and service customers							
Bill the customer	220	No. of AR invoices	11.3	$110	$65	5 days	3 days
Provide after-sales service	150	No. of customers	11.3	$110	$65	5 days	3 days
Respond to customer inquiries	90	No. of inquires	11.3	$110	$65	5 days	3 days
Develop and manage human resources							
Manage deployment of personnel	480	No. of employees	11.3	$110	$65	5 days	3 days
Develop and train employees	310	No. of training days	11.3	$110	$65	5 days	3 days
Ensure employee well-being and satisfaction	290	No. of employees	11.3	$110	$65	5 days	3 days
Manage information resources							
Manage information storage & retrieval	490		11.3	$110	$65	5 days	3 days
Manage facilities and network operations	310	No. of PCs	11.3	$110	$65	5 days	3 days
Facilitate information sharing and communication	290	No. of telephones	11.3	$110	$65	5 days	3 days
Manage financial and physical resources							
Process finance and accounting transactions	400	No. of cost centers	11.3	$110	$65	5 days	3 days
Develop budget	260	No. of cost centers	11.3	$110	$65	5 days	3 days
Conduct internal audits	140	No. of cost centers	11.3	$110	$65	5 days	3 days
Manage the tax function	150	No. of tax reports	11.3	$110	$65	5 days	3 days
Execute environmental management program	100	No. of environ processes	11.3	$110	$65	5 days	3 days
Manage external relationships	90	No. of external reports	11.3	$110	$65	5 days	3 days
Manage improvement and change	120	No. of activities	11.3	$110	$65	5 days	3 days

Figure 4.4 Summary Root Cause Statement

Consolidated Activities	*Root Cause Problem*	*Value loss ($000)*
Sales contract	Unprofitable/disruptive business	120
Check credit	Credit problems/lost business	125
Enter order	Entry errors	85
Check inventory	Incorrect data	49
Issue inventory	Incorrect inventory issued	50
Ship product	Incorrect shipments/high ship costs	75
Prepare invoice	Incorrect data	105
Customer service	Poor service/resolve problems	120
Collect cash	Poor cash flow	40

Figure 4.5 Detail Root Cause Statement

Credit Department Location	*Consolidated Activities*	*Root Cause Problem*	*Value loss ($000)*
Sales	Sales contract	Unprofitable/disruptive business	120
Credit	Check credit	Credit problems/lost business	125
Order Entry	Enter order	Entry errors	85
Warehouse	Check inventory	Incorrect data	49
Warehouse	Issue inventory	Incorrect inventory issued	50
Shipping	Ship product	Incorrect shipments/ high ship costs	75
Accounting	Prepare invoice	Incorrect data	105
Customer service	Customer service	Poor service/resolve problems	120
Accounting	Collect cash	Poor cash flow	40

as the old one did. It prevents the loss of what has already been achieved. Therefore, it guarantees that progress is real. Predictive accounting passes this test with flying colors.

Part 2

Using Process Tools in the Process-Based Accounting System

The goal of this book is simple: to help you to create forward-looking accounting information. Part 2 of this book enables you to explore in greater detail the concepts that underpin process-based and predictive accounting. You can read each topic or choose the topics for which you seek greater clarification. Some of the topics include how processes create value and how to use the value-creation measurement model; how to integrate processes and product management into the process-based accounting system; process variation, root cause analysis in process-based accounting, and how to use control charts in the accounting system; how to use, simplify, and make performance measurement more effective; and the important concept of earned value reporting and how to use it to make dramatic improvements in the accounting system. Each chapter serves as individual process tools that can be used in an overall process-based accounting system.

5

Determining Value Creation

Do you know what your company is worth? Most companies record their revenue and cost at the dollars-and-cents level. Yet, the same companies, when asked the value of their organization, could not even begin to estimate it to the nearest million or hundred million. It is important to husband revenues and conserve costs, but it is value creation that separates the winners from the losers. Without measurement, you may find it difficult to determine value, isolate the factors that most affect value, and see whether growth is being effectively managed.

Determining value remains elusive. There are numerous examples of companies that, in one or several periods, have reported excellent profits and were cited as excellent organizations, only to sustain critical problems within a few years. Companies in Tom Peter's *In Search of Excellence* jump to mind. Obviously, the seeds of failure were hibernating in place while the reports of excellent performance were in bloom. Unfortunately, the yield from those seeds was recognized by neither the internal nor external reporting system.

A common practice of many management gurus is to assume that company value is synonymous with shareholder value creation and that it is the only *raison d'être* of an organization. Others believe that a broader definition of value should be applied. In either definition of value, however, external appraisers and internal managers must share a common definition of what value is and how it is created. If this commonality does not exist, the economy will face two types of problems. First, resources will be allocated inefficiently because external evaluators are not able to correctly anticipate value creation. Second, internal managers will trigger inefficiency when they try to please the market instead of improving their value creation process. It seems value perception is entering a new age. After managers internally assess the amount of value created, then Wall Street must make its assessment of the value the organization created. To properly determine value creation, a much more multifaceted approach, one that combines internal and external information into a standardized reporting framework, appears to be needed. In spite of the difficulties in measuring value, there is no greater service an accounting department can provide to its organization than to introduce value measurement into the accounting system. The worth of a particular organization depends on its capacity to create value. Predictive accounting uses a value creation model to measure and report the value created by an organization's processes. Predictive accounting also uses the model to measure the value creation potential.

This chapter proposes that accounting should abandon the traditional asset valuation model and replace it with a product and process value creation model. A process model is a dynamic model that measures business flows. The new paradigm is that processes create value. Assets are an important element of a process, but there are other components that equally influence value creation. This chapter discusses the concept of value creation with particular emphasis on quantifying the role of intangible assets in creating value. The concept of processes will be more fully developed in the next chapter (see Chapter 6, "Process Management—The Key to Creating Value").

WHAT IS VALUE CREATION?

Organizations exist to create value. *Value,* in a universal sense, is to rate something highly and consider it to be important—the worth of something. In the business community, value is defined as a positive net cash flow that exceeds the cost of capital—revenue being greater than cost and the cost of capital during the life of the business. In business, the customer is the final arbiter of value. In government, the public and politicians are the final arbiters of value, and value is what gets funded.

Value is defined as a measure of choice. People have discretion where they spend their money. People have to make trade-off decisions when purchasing an item or service. Most minor purchase decisions are made subconsciously by weighing the perceived needs against the features and price of competitive products. Most products possess similar functions but have unique features and performance attributes. For example, not all tomato soups are the same. The taste varies depending on the ingredients, the packaging differs among competitors, the ease of access depends on shelf position, and of course, price differs. Organizations are constantly searching for the features and performance attributes that will give their customers a reason to buy their products.

Value, when viewed from the enterprise perspective, is still a measure of choice. Shareholders decide whether to invest in an organization. Employees and the organization jointly choose who does the work. The management team decides what product mix to offer and configures the processes to deliver the product/service. The choices to be made are unlimited. However, the criteria of choice as a definition of value are too ambiguous. So, instead, cash flow is used as a surrogate measure of value. Value creation is defined as the ability of an organization's processes to deliver positive cash flow (cash inflow less cash outflow) that exceeds the cost of capital.

Emphasis on creating value explains why so much of management's attention is placed on measuring and managing the financial progress of an organization. An enterprise that creates value prospers. Accounting plays the central role in measuring an organization's revenue and cost; now they must play a central role in measuring the value created by operations. Traditional accounting adopts a static value creation model, in which businesses acquire assets that are consumed in creating a revenue stream. The income statement, many believe, measures the wealth created or lost in the most recent period of time. Correspondingly, the balance sheet measures the accumulated wealth created by an organization over its life. An organization with a healthy balance sheet—a strong reserve of assets in excess of liabilities—is said to be financially strong. Evaluation tools, such as return on assets, emerged to measure the efficiency of firms in using their asset base.

ACCOUNTING FOR VALUE—THE TRADITIONAL APPROACH

Predictive accounting quantifies in monetary terms, the cost and value created by processes that are triggered by events. Predictive accounting is intimately intertwined with measuring value creation. Conventional accounting practice recognizes worth when a transaction occurs that establishes a market value. The value realized is the money that is transferred from one party to another. Value is revenue to one party and cost to the other. This limited definition of value creation has two major flaws. First, to the seller, the real value created is more than the sales price. Value is the net cash flow between the revenue received and the cost of delivering the product or service. Second, it ignores the unrealized value creation potential of an organization's product mix and processes. It is essential to predictive accounting to measure the value creation potential of a product/process since it seeks to quantify future financial performance. (See the sidebar "Value Creation: Incremental Over the Product/Service Life Cycle.") To ignore the issue would invalidate the effectiveness of predictive accounting.

The first problem in measuring value creation is a timing issue. Processes that are begun in one accounting period are often not finished producing an output until subsequent periods. Value creation goes unrecognized because value is created but not realized. Thus there is an inventory of unrealized value creation that goes beyond the balance sheet. The amount of unrealized value creation and whether it is increasing or decreasing relative to past periods have a significant impact on the future value of an organization.

A second issue is how to determine a market value when there is no direct market transaction. Government programs are an example. A food stamp program provides financial assistance to the needy. The cost of the program is highly visible. Nevertheless, there is no revenue to complete the value realization process. Thus the value is considered intangible and must be justified by political rhetoric even though people believe there is real value to the program. The problem with intangible value is how to make a funding trade-off. Too often the most powerful political voices, rather than the greatest value creation propositions, prevail. In spite of the flawed value creation process, funding remains the primary criterion for realizing value.

Value Creation: Incremental Over the Product/Service Life Cycle

Accounting reports revenue and cost at regular time intervals such as monthly, quarterly, and annually. However, value creation occurs irregularly over the various stages of the product life cycle. Products in the early stages of their life cycle typically have greater value creation potential but also greater risk. Thus it is important to attribute value creation to every stage in the product and process life cycle.

Risk varies with each stage of the product life cycle. The potential value creation of new products depends on estimates that must be continuously adjusted as the markets mature and experience replaces estimates. However, life cycle risk never goes away. As a product moves from research and product development into the operational phase, unforeseen operational problems may develop, marketing problems may arise, market targets may change, and competitors may gain an unforeseen advantage. Thus risk is significant at each stage.

One important factor that affects life cycle risk is the degree of product differentiation in the market place. In cases where there is a low degree of product differentiation, such as milk production, value creation risk is less important during the product introduction phase but much greater in the commercialization phase. The value creation potential (and therefore the present value of future cash flows) is lower during the product introduction phase because there are minimal product design issues. The major challenges occur during commercialization where capital must be invested and operational problems quickly resolved. Competitive advantage in industries with low degree of product differentiation accrues to those organizations with the most effective operational performance—not those that design the better product.

In the other case where products are more unique and scarce, such as biotechnology products, the risk is high during the product introduction phase but decreases dramatically in the commercialization phase. Thus more risk is attached to the product development phase and the increases in value at successive operational milestones will be correspondingly smaller.

A third issue is that of process decay. Process decay causes the value creation potential of processes to deteriorate over time. The deterioration is caused by changes in the factors that influence value, such as the economy, competitors, technology advances, changing product mix, process capability, and capacity, among others. All processes decay at different rates depending on the rate of change of external factors. Value creation potential depends on the degree of process decay and how effectively an organization overcomes process decay by way of process improvements.

All processes experience process decay to a greater or lesser degree. A process is designed and implemented at a point in time. A set of conditions exists at that point in time that form the basis of the assumptions about the future state of the economy, competitive products, technology, and a mix of products that will use the process, among other factors. The assumptions shape the setting of life cycle performance targets. The targets represent the minimum value creation requirements.

Performance targets are incorporated into the design of a process. They represent process capabilities and capacity. The process imbeds a set of resources, technologies, and processing steps. The process capabilities, resources, technologies and processing steps are locked into the process design in the early stages of the process's life cycle. Thus it becomes increasingly difficult to implement radical changes to the process in later stages of the life cycle. Thus most process improvements are incremental as the process matures.

Achieving the targeted performance milestone at each successive life cycle stage is critical in creating value. As the future unfolds, the process efficiency will degrade if action is not taken to overcome changes external to the organization. External process decay occurs because the future does not unfold exactly as predicted. The actual conditions that influence the processes will be different from the assumed conditions, yet the ability to make major changes to process capabilities is increasingly difficult over time. These economic and competitive changes can cause value growth or sudden value destruction. They will largely occur independently of an organization's activities.

The greater the probability of external changes, the more flexibility is needed in the process design. The processes must be agile to exploit newly presented opportunities and to avoid newly threatened catastrophes.

Other factors that cause process decay are within the control of an organization. Business decisions are often at odds with the original process assumptions. The product mix will be different; employee turnover will lower efficiency; the technology might not work as promised—in other words, bad things happen. As a consequence, the value creation potential will not be achieved if employees don't continuously improve the process to overcome process decay. You can't sit back and let the assumptions come true with the passage of time.

The easiest way to understand process decay is to measure process variation. Mismatches between process demands and process capabilities result in process variation. The process will take longer than targeted and quality problems will become more frequent. An organization cannot afford to drop its vigilance in improving processes. If the organization becomes sloppy in its research work or marketing does a poor job in negotiating sales, it will not realize the projected value.

A fourth issue is the problem of determining the intrinsic value of the products and processes. What is commonly referred to as "economic cost" involves searching for the "true" intrinsic value of a product, service, or asset. Accounting uses the market transactions as a surrogate of economic cost. It might be argued that the "true" value might be greater or less than the market value, but it is usually impractical to determine a product's intrinsic value.

A fifth issue is how to record value creation potential on the financial statements. Using the value realization principle, revenue is recognized at the net sales price. Cost is recognized at actual or standard value. Assets are recognized at actual cost less depreciation. This practice fails to recognize the value creation potential of the organization's processes and assets. A machine that is highly used now and in the future with minimal down time and process variation clearly has more value creation potential than a machine that has low use with frequent breakdowns and significant process variation. This issue is often referred to as the intangible issue.

A sixth issue is the time value of money. Money received today is more valuable than money received in the future. Assessments of economic value should consider the cost of capital and use discounted cash flow techniques to compute the value creation potential.

The static accounting model of value creation is of little value in today's modern world. Much of an organization's worth lies in intangible assets. Anyone who has participated in a business acquisition can attest to this difference. No rational person would look strictly at the financial statements when determining value. Instead, the acquisition team adjusts the value for intangible assets. This book explores two special cases of value that require particular attention: measuring brand value and measuring intangible value. These issues are discussed in greater detail in the next two sections.

RELEVANCE OF BRAND AND PROCESSES

Brand value is a crucial element of an organization's aggregate value. Brand value reflects the future worth of an organization's image with buyers. Brand value enables an organization to charge a premium price for its products and services. The challenge facing an organization, and accounting in particular, is how to measure brand value. Predictive accounting measures how much an organization's processes are capable of creating or destroying brand value.

What is your image of a government organization—the epitome of effectiveness or a bureaucratic tortoise? What about your image of a cable company—a highly customer-sensitive organization or one with poor customer service? In the private sector, company image is often referred to as brand value.

An organization's brand is one of its most important assets or liabilities—more than one organization's value has risen or fallen with its brand image. A brand is important because it helps to differentiate a company in a competitive market. Customers have an incredible number of purchase options. A trusted brand name gives an organization a competitive advantage. It acts as a reference point for customers with multiple options as they make purchase decisions. Other products must exceed the established brand's attributes to be considered. A strong brand lures customers when companies enter new markets or offer new products.

A brand gives a conglomerate organization a unified and consistent persona to its customers that cuts across product lines, services, and geographic locations. A brand image calls for consistency in the way an organization deals with the marketplace. This involves creating a logo and an advertising theme that will be fixed in customers' minds. When customers see the logo or view an advertisement, they immediately gain a sense of confidence in the product. How many times has a visitor to a foreign country—or at least his or her children—seen a McDonald's golden arch and sought the comfort of a consistent product and service?

A strong brand also imparts a sense of mission inside an organization. Since processes embody the brand to consumers, it's vital that every process embrace brand values. Brands help organizations recognize what products they should make and which they should avoid. They give a set of operating priorities to an entire enterprise. When managers have a clearly articulated sense of brand, it can also help to guide strategy.

Conversely, a poor brand image can devastate a company. A product with a tarnished brand fights an uphill battle when competing with similar products. A brand's power to attract customers and command top prices diminishes, and an organization must work hard to restore a favorable image.

There have been many attempts to measure brand value—mostly on the revenue side (see the sidebar "Measuring Brand Value"). Revenues are more difficult to manage than costs. Organizations themselves cause costs. Revenue depends on consumer buying patterns and competitors. Management often applies less quantitative measures because of the inherent difficulties in measuring the value of marketing. This is a major faux pas. One former CEO is reported to have said: "I know I am throwing away half of my marketing budget. But as I don't know which half, I'd better continue to do so." Tools such as predictive accounting are changing this attitude—marketing is a process and should be measured with the same rigor applied to any process.

Achieving excellent brand performance requires an organization to artfully manage the relationship between a brand and its processes. Processes deliver a product or service to a customer. As an example, consider a person shopping for clothes. Assume the person is loyal to certain brands. Competitor's advertising hasn't swayed the loyal shopper—yet! But perhaps this shopping trip might be different. The buyer may look at a new brand by virtue of the last few purchases that didn't quite fit the way the buyer expected. Also, the trend setters have the buyer looking at a more up-to-date style. This example illustrates the importance of processes. Poor process performance, whether it is market research, manufacturing, or customer service, can destroy a brand's image very rapidly. The advertising, package design, and promotion processes must be structured to deliver a certain brand image. The brand image must be understood and used to set process performance targets. Brands convey a

Measuring Brand Value

The important factors to determine when measuring brand value are:

- How much a brand enhances an enterprise's value
- How stable that enhancement is to future performance
- The present value of these future earnings

In Britain, measures of brand values must be included on the corporate balance sheet.

sense of trust and shared mission that is as important as a product's technical competence (see the sidebar "Microsoft").

Perhaps the most important factor that affects a brand's image is the organization's relationship with the consumer. The most common reason a customer contacts an organization is to resolve a problem. Customer service is one of the most important customer-facing processes. An organization must staff these positions with knowledgeable, empathetic employees who can listen to a problem and be empowered to resolve the issue. Instead many organizations have surly employees who rigorously follow a preprogrammed script. It does not make any sense to jeopardize a long and profitable relationship—over, say, a $25 charge—when one considers the high cost of acquiring a new customer. Examples abound of poor customer service from organizations with strong brand names, such as Southwestern Bell, USAA, and American Express. Strong customer relationships can be maintained only through understanding the economics and value of brands.

Companies that don't skillfully manage their brands run the risk that a brand will degenerate into commodities that customers shop for strictly on the basis of price. This outcome can devastate brand value and market capitalization, sometimes with astonishing speed. The cost of recovering brand image can be staggering. Resurrecting a brand's image often involves increased spending on marketing, accelerated product innovation, and conceiving of other compelling ways to reach consumers. Some companies have learned the importance of the customer experience the hard way. These organizations have discovered the importance of monitoring and improving every process to ensure it is consistent with the core values of the brand.

Brands have a measurable value. If we accept the premise that strong brands have the power to increase sales and earnings, this fact will be borne out in an organization's performance vis-à-vis competitors. If a brand has the power to command a premium price, this is measurable. If a brand can garner a premium stock price among investors, this is measurable. If the brand can boost earnings and cushion cyclical downturns, this is measurable. Companies must understand how their brand creates value and then measure it using tools such as predictive accounting. Companies that make good on their brand promises will be rewarded with a more loyal customer base and a brand that steadily grows in value. This value must be measured and treated as an important asset.

Microsoft

Microsoft has built a huge intangible asset base. This base consists mainly of its brand image and a customer base that consists of millions of people who use millions of copies of its Windows operating system. These customers are "captive," insofar as it is difficult for PC owners to switch operating systems. Microsoft's customer base is therefore likely to continue to purchase its software in the future.

MEASURING AND REPORTING INTANGIBLES

Measuring the value created by intangible assets is especially challenging. Intangible assets are one of the most important factors in the value creation process. Yet accounting struggles with intangible assets because their value is significantly different from their cost basis. For many years, conventional "accounting think" has sought a rational approach to include intangible assets on the balance sheet.

The process of acquiring, safeguarding, and accounting for tangible assets was, and remains, a key element of a chief financial officer's job. Tangible assets have historically been the basis for determining a company's value. Tangible assets could be measured—value is equated with their cost basis—and used to calculate a return on investment. *Tangible assets* are, quite literally, physical things owned by a business: plant and equipment, buildings, and inventory. These assets are solid. They provide protection to the capital suppliers because they could be sold to recover part of the investment should the worst financial situation occur.

The Achilles heel of the tangible asset valuation model is that value is created in non-asset-intensive industries as well as asset-intensive industries. Instead of plant and equipment, companies today compete on ideas and relationships. Financial success increasingly depends on an organization's ability to leverage a channel of distribution, or to get a product to market quickly, or to build a strong customer relationship. These value drivers are intangible. Many service firms own little more than a small number of computers, and some even lease their office space. These types of companies are tangible-asset poor. Instead their assets come in the form of patents, knowledge, and processes—information that does not show up in the balance sheet.

The meteoric rise in the value and impact of intangible assets over the recent past is due to the fundamental changes in the structure and scope of business enterprises. We have entered a new economy where a greater proportion of the world's wealth has shifted from physical asset-intensive organizations to intangible-asset-based organizations. An *intangible asset* is one that cannot be touched and is not recorded on the balance sheet. Intangible assets are a major cause of the gap between the value creation potential of an organization and the cost recorded on the balance sheet. An intangible asset, while it does not have a physical substance, is expected to provide future benefits to an organization. Intangible assets can include the use of the product name, its business reputation, a trained workforce, noncompete agreements, and brand loyalty. Other examples include patents, trademarks, copyrights, franchise fees, secret processes, trade names, and goodwill.

Investors need to be aware of an organization's aggregate value—derived from past, present, and future operations—and whether the economic conditions are adequate to support realizing its future value. If accounting cannot measure intangible value, executive management cannot allocate capital intelligently; stock analysts cannot evaluate the companies they cover, and investors cannot wisely purchase stock.

Intangible assets represent a particularly thorny issue for the accounting profession (see the sidebar "Accounting Practices"). Financial reporting presents a skewed picture of value creation potential for companies where there are few traditional assets. Obviously, it is more difficult to determine the value of brand loyalty than to determine the value of a copy machine. However, failure to address this issue has created a tremendous quantity of "invisible" assets in many organizations. The shift to "invisible" assets is evident in the very large return on equity (ROE) values at many companies that lack traditional tangible values. This equity "earns" a very high return because the physical asset base is very low. Such high ROE tells us that the numbers are incomplete because equity is understated. This new knowledge economy has created the need to expand the asset model of value creation to include intangible assets.

There is an increasing pressure on the accounting regulators to recognize intangible assets on the balance sheet as their magnitude has increased over the years. Yet today's accounting rules and practices have treated a business as essentially an assembly of tangible, tradable assets. The accounting regulators and the profession are engaged in a dialogue to develop a relevant and reliable way to measure intangible assets. Valuing intangibles, even using the most rigorous methodologies, calls for subjective judgments. What is rapid lead time for new product introduction worth? How is dollar value assigned to a chief executive officer's experience? How much is a customer database worth? A balance sheet statement remains silent about these and other components of a business upon which an organization depends for future earnings. The debate rages on without any resolution in the foreseeable future.

Accounting Practices

When a company invests in an intangible asset such as a research program or an entrance to a new customer segment, it is not generally permitted to record the value of these actions as an asset on the balance sheet. The investment thus appears both as a negative cash flow and as a cost item. Both types of investment are inspired by the same motive—to achieve higher profitability in the long term, by sacrificing cash flow in the short term. The difference in accounting treatment, however, is very confusing and is made more so by the fact that the "cost" of intangible investments can take forms other than direct payments from cash reserves. It may take the form, for example, of accepting an assignment that yields little cash revenue but has great publicity value, or seems likely to enhance competence. Here again the intangible asset is "financed" by "invisible" equity.

The Financial Accounting Standards Board has ruled that companies no longer have to amortize goodwill. That makes sense because time itself does not deteriorate those assets. Time doesn't wear out a strong research process or cause a good image to come to an end. Time doesn't deteriorate these assets—poor management does.

All this would merely be of academic interest if the information deficiencies concerning intangibles were not causing serious private and social harms. The deficiencies of improper intangible value disclosure cause inefficient capital markets. The results are overcapitalization in some industries and undercapitalization in others. Invalid valuation hinders investment and growth. An efficient capital market requires that investors be provided relevant information to judge the merits of investing in intangible-intensive enterprises, particularly those that have not yet reached significant profitability. Such a continuing deterioration in the usefulness of financial information comes at the expense of outside investors; it may erode confidence in the integrity of the market and may lead to volatility and excessive risk of securities. Finally, inadequate intangible accounting can lead to the potential manipulation of financial information vis-à-vis intangible assets. The potential harms are indeed serious.

A significant factor in this intangible asset valuation standoff is that we are trying to create a patch to our traditional value creation model rather than fundamentally challenging the model. We need to move from a static to a dynamic value creation model. The perspective of how value is created is critical to addressing the question, Is value created by an asset (static) or by a process that employs assets (dynamic)? Superficially, the information deficiencies are the result of accounting shortcomings—expenditures on intangibles are expensed while those on physical and financial assets are capitalized. The real debate should revolve around whether assets or processes create value.

Market Value of Intangible Assets

Intangible assets are not very liquid and, unlike the tangible fixed assets, they are both owned and not owned by an organization. Assets such as knowledgeable people are not owned by the organization. These intangibles derive their value from the rights that possession and use in processes confer on the organization that possesses them.

An important ancillary issue of valuing intangible assets is their market value. Market value becomes an important issue when an enterprise has failed and is heading to bankruptcy. All assets must be liquidated and used to offset an enterprise's obligation to its debtors and investors. The challenge is to identify assets that are, by their very nature, not easy to define in traditional terms. Intangible interests often require scrutinizing the legal rights of the holder or giver of the interest. A variety of arrangements can be made to sell a brand image or a customer list.

HOW ORGANIZATIONS CREATE VALUE

An organization creates value through its products and processes that follow from an excellent strategy. An organization realizes value when a customer purchases a product/service or uses a nonprofit service. For a commercial organization, the amount of value realized is the difference between its life cycle cash inflow (revenue) and cash outflow (process costs). In not-for-profits, value is the amount of funding available.

An organization has value creation power when it has the ability to:

1. Proactively create the necessary environment. It must be able to sustain a stream of profits (or funding) that provides a positive cash flow. It must enable an organization to understand and bond with its customers, to relentlessly ferret out and eliminate waste, to be realistic and, most of all, to develop market intelligence that enables an organization to predict the impact of macroeconomic factors. These actions are necessary to meet forecasted earnings.
2. Maximize cash velocity. Cash velocity is time between a cost outflow and the corresponding cash inflow. The best possible cash velocity is zero or even negative (where an organization is prepaid before it must incur the cost of providing the product or service). A zero-cash velocity eliminates the need to distinguish between accounting earnings and cash flow. The two values become synonymous.
3. Maintain cash flow at the minimum threshold of cost of capital. An organization's cash flow must meet or exceed its cost of capital as the minimum threshold of value creation demanded by investors or an enterprise's owners.
4. Isolate value drivers that management can influence. Many macroeconomic drivers, such as raw material prices and interest rates, affect value significantly but are not directly controllable by management. Predictive accounting requires that organizations monitor critical but uncontrollable drivers and take actions to hedge business risks. An industry's market growth reflects its value creation opportunity. It is difficult for older, more established firms operating in a highly competitive industry to consistently earn surplus value. While newer industries in their initial stages enjoy excess returns, it is inevitable that they will eventually attract other entrants. Competition leads to excess capacity, price competition, and, finally, lower returns for all participants in the industry.

Value is driven by long-term, risk-adjusted cash flow performance, not purely short-term earnings. Enterprise value is the composite of the past, present, and future set of products and processes to deliver value.

- *Past.* Equity is a measure of how much value was created by past operations and reinvested into the enterprise. Equity is the net difference between an organization's assets and liabilities. A strong equity position provides a reserve of funds that ensures an organization can weather short-term economic swings and it provides a security blanket to debt and capital providers.
- *Present.* The value of current operations is a measure of the current strategy's capability, current product mix, and processes to create value.

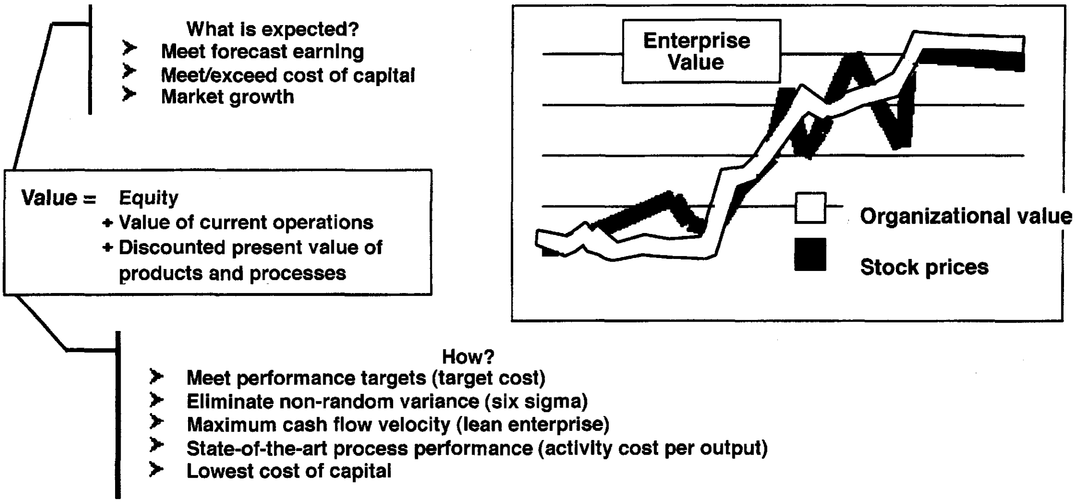
- *Future.* The discounted present value of products and processes measures the storehouse of value of the current and future set of products and the current and future processes to deliver value.

Value analysis provides senior management with a value creation scoreboard and enables it to monitor the value delivery capabilities of the enterprise (see Figure 5.1). Value is created by meeting customer needs (market growth), achieving stakeholder objectives (meet forecasted earnings), and having efficient and effective processes (meet or exceed the cost of capital). Value can be measured as the sum of the equity (past operations), value created from current operations and the storehouse of future value (discounted present value of products and processes). Value is created by meeting performance targets (target cost), eliminating nonrandom variance (six sigma), maximizing cash flow velocity (lean enterprise), achieving state-of-the-art process performance (activity cost), and having the lowest cost of capital. An organization that creates value should see the fruits of its efforts in higher stock prices for publicly held companies and an increase in the storehouse of value for all organizations.

How Is Value Created?

Value creation begins with an understanding of what an organization's stakeholders expect. Clearly, all stakeholders are interested in an organization's ability to generate cash flow. How much cash flow is needed and how it is used depend on the stakeholders' perspective. The primary stakeholders and their needs include:

Figure 5.1 Why and How Organizations Create Value



- *Stockholders.* Value is generated from capital gains and dividends. Investors seek the best possible stock price and/or dividends that meet or exceed the average stock market returns of other investments with a comparable risk.
- *Owners.* Value is created when owners are able to withdraw a targeted amount of cash in compensation for their investment. Cash flow should be sufficient to enable the cash withdrawal without adversely affecting future growth.
- *Debt holders.* Value is generated by payment of interest and principal on loans when due.
- *Employees.* Value is having a safe, fulfilling work environment with a steady income that is competitive with employee skill level and experience. Additionally, the cash flow should provide a performance bonus commensurate with their contribution to achieving performance targets. Employee loyalty is a measure of value. Executive management measures value by achieving strategic targets.
- *Community.* Value is providing a tax base adequate to fund needed government programs.
- *Environment.* Value is providing clean, safe, and healthy processes.

It is, of course, much easier to talk about achieving adequate cash flow to satisfy all the organization's constituencies than it is to actually achieve such a result. The value creation potential of an organization depends on the efficiency and effectiveness of an organization's ability to create, sell, and deliver products and services. Accounting measures the actual cash flow, but an organization must be aware of the "hidden" cash flow lost to inefficiency (see the sidebar "Cash Flow"). Constant vigilance is necessary to minimize lost value. Models can measure the lost value creation potential of an organization (see Figure 5.2).

Organizations can take a series of actions to meet the above objective. Foremost among these actions include:

1. *Meet performance targets (target cost).* Operating decisions, such as product mix, pricing, promotion, advertising, distribution, and customer service level, feed sales growth rate and operating profit margin over a sustained period of time. The value growth duration is management's best estimate of the number of years investments can be expected to yield rates of return greater than the cost of capital.
2. *Eliminate non-random variance (six sigma).* Process variation creates waste and reduces predictability.
3. *Maximize cash flow velocity (lean enterprise).* The lean enterprise reflects the need to constantly lower process time. Lower process time reduces working capital requirements.
4. *State-of-the-art process performance (activity cost per output).* Processes must be performed as cost-effectively as possible.

Cash Flow

Financial Accounting Standards Board Statement of Financial Accounting Standards No. 95, *Statement of Cash Flows,* divides cash flow into three categories:

Operational cash flow	The cash effects of transactions and other events that enter into the determination of net income. In its simplest form: cash receipts from sales of goods and services less cash payments to acquire materials for manufacture, pay other suppliers, employees, taxes and duties, interest to lenders, and so on.
Investing cash flow	The cash effects of making and collecting loans, acquiring and disposing of debt or equity instruments, and other productive assets (such as property, plant and equipment) used in the production of goods and services by the enterprise.
Financing cash flow	The cash effects of obtaining resources from owners and providing them with a return on their investment, borrowing money and repaying amounts borrowed, and obtaining and paying from other resources on long-term credit.

5. *The cost of capital.* Both business risk and management's financing decisions govern an organization's cost of capital. Financing decisions determine the proper proportions of debt and equity used to fund the business, as well as the appropriate financing instruments. The discount rate used in capital investment decisions is based on an estimate of weighted average cost of capital. Discounting cash flow from operations yields corporate value.

An enterprise's equity position represents the difference between an organization's assets and liabilities. Equity represents potential cash flow reserves that can be deployed as required. A strong equity position represents a safety net to both debt providers and investors. Through the liquidation of assets and expansion of liabilities, cash flow can be generated even in the absence of earnings. Without earnings, however, the assets available for liquidation run short and sources of credit dry up rapidly.

Traditional financial analysis depends on a fair and honest appraisal of an asset's worth. An overvalued asset impairs financial analysis and the company's earning power. For example, an overfunded pension plan can be terminated, resulting in future cash flow, but it also represents lost opportunity from past operations. Even if the company elects not to terminate the pension plan, its overfunded status will allow the company to reap the gain indirectly as future pension expense and funding is curtailed.

Figure 5.2 Value Creation Measurement Model

Value creation potential = Value created + lost value

Value created (cash flow) =	Life cycle product/service cash inflow – Processes cash outflow
Lost value =	Product feature loss + Strategic loss + Cash flow velocity + Customer segment loss + Missed target cost loss + Non-value-added loss + Process state-of-the-art loss + Cost of capital loss + Effective tax rate loss
Cash flow loss (strategy) =	(Target cash flow – actual cash flow) × actual market share
Cash flow loss (product feature) =	(Target revenue per unit – actual revenue per unit) × (target quantity – actual quantity)
Cash flow loss (customer segments) =	(Target market share – actual market share) × target cash flow
Cash flow loss (target cost) =	(Target cost – actual cost) × (target quantity – actual quantity)
Cash flow loss (processes) =	(Target variation (six sigma) – actual variation) × activity cost per output × number of activity outputs
Cash flow loss (cash flow velocity) =	(Average daily cash balance × average days cash in bank) × daily cost of capital + (Average daily inventory balance × average days inventory) × daily cost of capital + (Average daily AR balance × average days AR outstanding) × daily cost of capital
Product feature loss:	Value is created by a superior set of product features offered at an appropriate price. Failure to offer the product features or failure to offer the product at the appropriate price will cause a cash flow loss. A product's features and service attributes influence how much they are demanded by potential customers (as measured by a sales volume and sales price). Successful organizations must segment their customer base, understand their customer's needs and offer a product at a competitive price. It is also crucial to invest in a portfolio of existing and future products that represent a storehouse of expected earnings. Target cost is a tool used to quantify the product features and product price.

Figure 5.2 Value Creation Measurement Model (continued)

Strategic loss:	A poor strategy will result in significant value loss. An organization that seeks to build an "Edsel" is doomed to failure no matter how effectively and efficiently its operations deliver the strategy. An excellent strategy should result in domination of an industry and achievement of cash flow objectives. Domination of an industry is reflected in the market share of the targeted customer segment.
Customer segment loss:	A failure to properly identify customer segments will result in a cash flow loss. A second important factor is to improve customer retention by recognizing just how much more expensive it was to get new customers than it is to retain existing ones.
Missed target cost loss:	A failure to achieve an organization's target cost will result in a cash flow loss.
Cash flow velocity loss:	Value lost to slow cash flow velocity (time). Slow cash flow velocity ties up working capital that could otherwise be used to create value. The cost of capital is used as a basis for determining the cash flow lost by cash flow velocity.
Non-value-added loss:	Value is lost by process variation. Process variation causes non-value-added steps. A non-value-added step is unnecessary and thus waste.
Process state-of-the-art loss:	Value is lost to processes that are not state-of-the-art. Processes use inefficient technology waste organizational resources.
Cost of Capital loss:	Value is lost to an unnecessarily high cost of capital. Organizations that do not arrange the proper mix of debt and equity (1) create situations that lead to financing problems and do a poor job of predicting performance results and (2) create a higher cost of capital than is warranted.
Effective tax rate loss:	Value is lost to an unnecessarily high tax rate. Waste results from a failure by an organization to pay the appropriate amount of tax.

The Importance of Equity as a Measure of Value Creation

Today equity is a dual-edged sword. On one hand, a strong equity position represents financial security. On the other hand, lean enterprise principles have placed a great emphasis on cash flow velocity. The lean enterprise seeks to increase cash flow velocity—to minimize inventory, cash on hand, accounts receivable, and other assets. As these assets are brought down, the organization's equity also decreases.

Another major force that is shaping equity is that the market value of intangible assets is difficult to determine. The processes that create intangible assets are not very liquid, and unlike the fixed assets, they reflect the value creation potential rather than the market price of these corporate assets. Intangible assets are an invisible equity. Financial accounting has difficulty recognizing invisible equity. Fiduciary reporting demands tangible, objective values but is of little interest to growing organizations that have no intention of liquidating their organization.

There is always an element of uncertainty with intangible assets. Reputations and relationships can be good or bad, and can change over time. Intangible assets, such as people, are not particularly liquid, and unlike the material assets, they may or may not be legally owned by the company. Yet, in spite of the problems in valuing intangible assets, the economic value of a customer relation is no more "invisible" than the market value of a house. The reasons why the value of a customer relation seems invisible are that there is no indisputable method of valuing intangible assets.

Because of the reluctance of banks to lend for investment in intangible assets, the development of intangible assets is mostly self-financed. The implication is that the invisible assets are matched, on the financing side of the balance sheet, by equally invisible forms of equity. Knowledge organizations have few tangible assets, such as machinery. Their assets are their employees. People are both the machine operators and the "machines," themselves. For example, the work of salespeople is to generate revenue, by solving customers' problems. It is this outward-directed energy that creates the relationships, networks, and image that constitute the organization's intangible value.

Cash Flow Velocity. Cash velocity is the time difference between a cost outflow and the corresponding cash inflow. As discussed previously, the best possible cash velocity is zero or even negative (where an organization is prepaid before it must incur the cost of providing the product or service). A zero cash velocity eliminates the need to distinguish between accounting earnings and cash flow. The two values become synonymous.

Assessing earning power requires an evaluation of the company's cash-generating ability. In practice, creating enterprise value is really about working smarter, refining or reducing the number of steps in a work process, reducing cycle times, and scrutinizing business expenses. Take for example a purchasing department: Much of its activity affects process velocity. Its activities can reduce cash outlays through cost reductions, discounted invoice terms, reduced inventory, and major reductions in material flow. These efforts will result in higher profits and improved cash flow.

The Value of Current Operations as a Measure of Value Creation

An organization creates value through its products and processes that follow from an excellent strategy. All processes are interdependent with all other processes. A synergism or disharmony exists where the various processes interface with each other. A new set of performance metrics is needed to measure changes in performance. It is fairly straightforward to measure the value created by current operations: It is the difference between actual cash inflow (revenue) and cash outflow (cost). The tricky part is to determine when cash outflows occur. Determining value requires that all activities and processes traceable to the product must be identified and quantified. All shared services must be traced to the product-traceable activities and processes that drive their consumption. The activity/process resource cost must be adjusted for the cost of capital. All assets must be separated into used and unused capacity. Only when all these conditions are met can an organization have a high level of confidence that it is properly measuring value. Accurately measuring value realization is greatly enhanced with activity-based costing (ABC).

While proper matching of cost to the correct time period presents a challenge, by far the biggest challenge is to understand the cash flow lost to the organization. It is through the understanding of cash flow losses that an organization can assess the efficiency and effectiveness of products and processes to deliver value. Highly inefficient processes cannot be relied on to deliver future value. Conversely, efficient and effective processes provide a high level of confidence in their ability to deliver value (see Figure 5.3).

Process cash flow begins with the organization's strategy. The organization must develop a suite of products and services to offer to the marketplace. Value is lost by a poor product/service design, mediocre marketing, or inferior customer segmentation. The result is a mismatch between the products and the internal capabilities to deliver them.

The next set of processes executes the strategic plan and delivers the products/services to its targeted customer segment. Some of the key processes include sales and customer service that deliver an organization's revenue. The operations, shared services, infrastructure, and treasury processes deliver the products and services. The goal of these processes is to create value by minimizing the process variation, product feature variation, customer requirement variation, service level gap, and state-of-the-art gap.

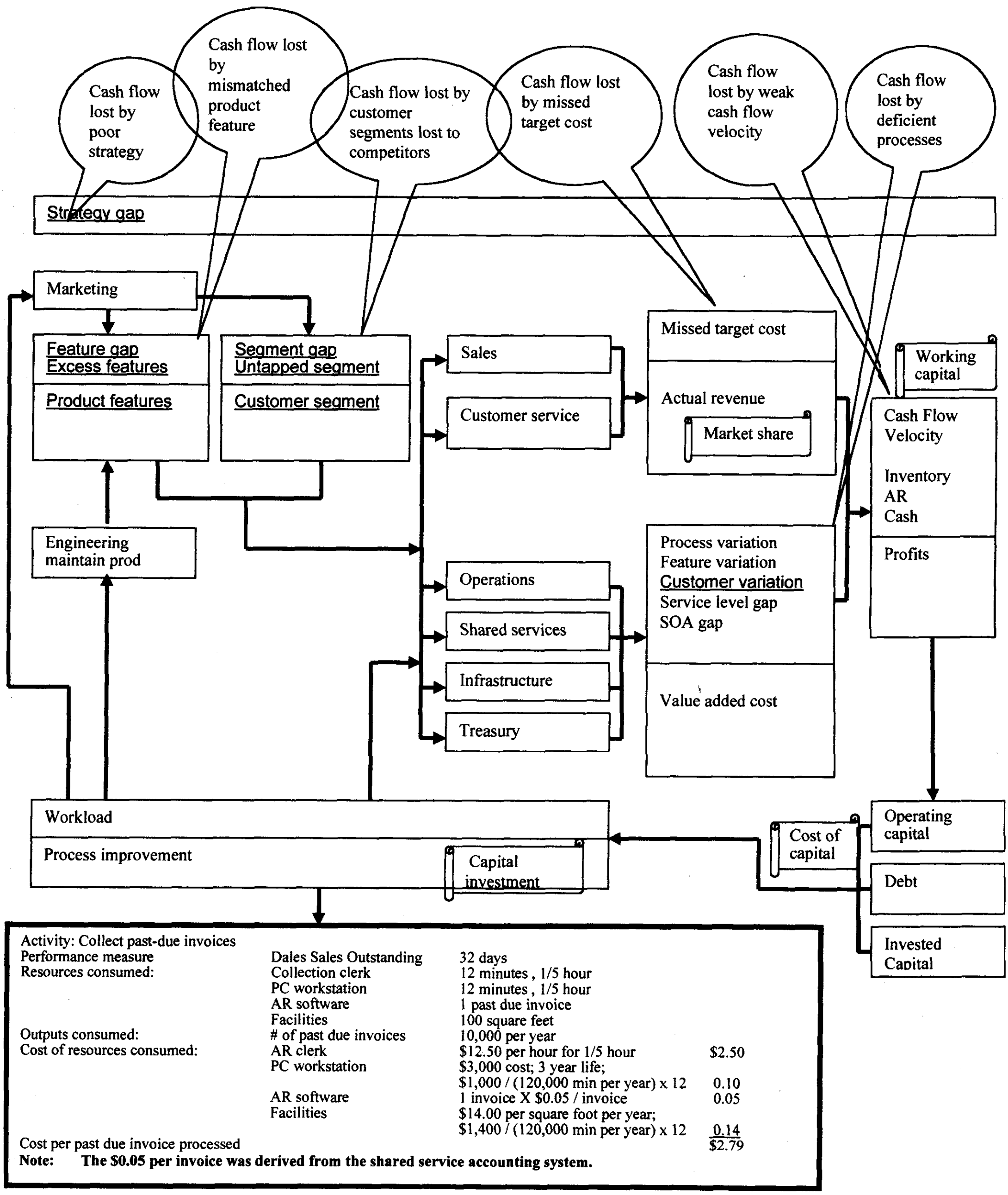
The net cash flow between the revenue and the organization's cost is funneled back into the organization as operating capital, debt retirement, or shareholder return. These sources of capital can be supplemented with investment capital. The cash completes the flow by funding process improvements or being reinvested in future cash flow streams.

CREATING FUTURE PRODUCT VALUE

Assessing an organization's earning power requires expectations about the future. For example, does the company have the ability to continue generating revenue? To what extent will those earnings result in cash flow? The need to answer these forward-looking questions poses a problem because financial statement information is historical in nature.

A business that wants to increase its market share and competitive position will likely acquire businesses, increase its new product development and market-

Figure 5.3 How Current Operations Create Value



ing spending, price aggressively, and invest in expanded production capacity. It is critical to get the right amount of capacity by investing in adding capacity that will at least offset the capital decay rate. While these activities are aimed at strengthening the organization's longer-term value reserve, cash flow may well be modest or decline during the investment period, even though such actions increase total enterprise value. This strategy will generate significant cash flows during the future period.

Creating future value involves a three-pronged approach. First, the organization must strive to have the lowest possible cost of capital. A low cost of capital enables an organization to fund a wider range of investments rather than repaying capital lenders for their risk. Second, it enables organizations to invest in a portfolio of new products that can sustain future growth. Third, it enables organizations to invest in enhanced process capabilities needed to support growth.

Armed with the best possible portfolio of products and processes, the organization must remain nimble and be able to react to changes in external factors. Plans that are continually blindsided by unanticipated events, such as technology changes and strategic moves by competitors, will hurt value creation. Being nimble involves knowing when to react. Reaction taken too soon or too late provides a window of opportunity to competitors to gain a competitive advantage. Being nimble requires an understanding of the key factors to measure and develop market intelligence, as well as evaluating the sensitivity of each contingency that upsets the current strategy.

Expenditure on research and development (R&D) generates future value. So it is reasonable to regard such expenditure as an investment. True, the economic value is uncertain, but the same can be said of any investment, including the value of office buildings, as many investors have learned the hard way in recent years. Value must be assessed at the completion of each R&D project. Remember that value is absolutely different than the cost expended on the project. The value of an R&D project is the market value of the project results.

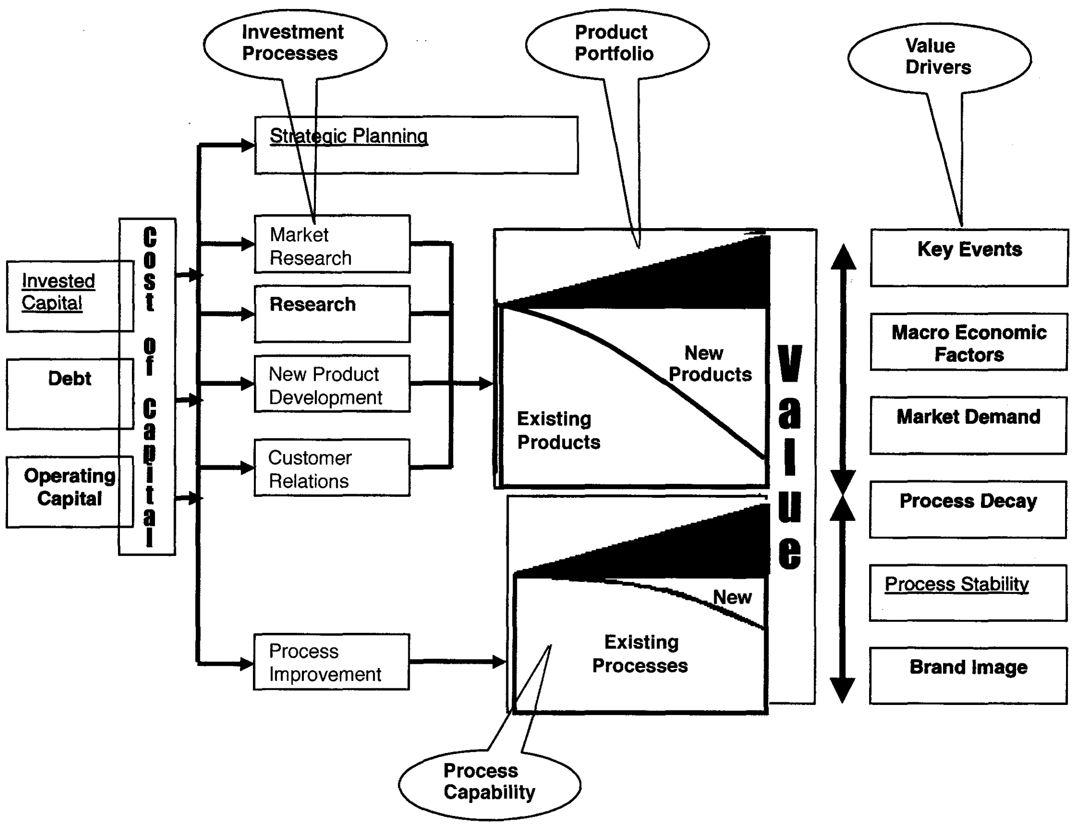
Organizations must invest in the future to remain viable. The success of an organization depends on striking a balance between these investments in the future and the need for adequate current period performance. The future value creation process begins with capital (see Figure 5.4). The sources of capital include investment capital, debt capital, and operating cash flow. The organization's cost of capital depends on the mix of these sources of funds.

The capital is used to fund the "investment" processes of an organization. The main investment processes include the strategic planning, market research, research and development, new product development, customer relations, and process improvement processes. The investment process results in either new or improved products or new or improved processes.

An organization creates a storehouse of value that is used to generate a future stream of revenue. The major factors that affect the future value include:

- Key events
- Macroeconomic factors
- Market demand
- Process decay
- Process stability
- Brand image

Figure 5.4 How Processes Create Future Value



How Products Create Value

Products and services create value by meeting or exceeding customer expectations. Target costing is a tool that not only measures product value creation potential, but also directs management attention to the factors that must be improved to achieve the value creation potential. Target costing begins with an understanding of what price the market (customer) is willing to pay for a specific product or service. From the market price, an organization can calculate how much cost is available to achieve a desired profit margin. The target cost provides a basis for directing an organization's efforts to improve operational performance in the areas that will create the most value (see the sidebar "The Mathematics of Target Cost").

How can value be measured? First the market must be defined. Customers must be segmented into categories with significantly different value needs. A separate value proposition must be prepared for each customer segment. Next, the product or service features and performance attributes appropriate to each customer segment must be defined. The combined effect of many individual choices approximates the value distribution for a customer segment.

The Mathematics of Target Cost

Target cost holds profit margin constant and the cost is variable.
Actual cost holds cost constant and profit as a variable

		Target	Actual
Product/service:	AAAA		
Product/service feature:	Feature 1		
	Feature 2		
	. . .		
	Feature n		
Quantity		a	b
Price		c	d
Revenue		(a*c)	(b*d)
Profit margin		e	((b*d) – f)
Cost		((a*c) – e)	f

Target costing is a tool that enables an organization to determine the allowable level of cost. The target cost procedure begins by assessing the market to determine how much customers are willing to pay for the features and functions of a product or service. The organization then sets a minimum level of profit that would meet its strategic objectives. Allowable cost (target cost) is computed by taking the difference between revenue and profit. This allowable cost is then systematically broken down into all the component processes, including support processes that are necessary to provide the product or service:

Price	(market driven)
Less:	Profit target
Equals:	Target cost or allowable cost

Several factors influence a product's value creation potential. First is the degree of fit between the product or service and the organization's processes. Significant differences inevitably lead to high life cycle costs and poor quality. Second is whether the product provides a competitive advantage. The revenue stream provided by products with a competitive advantage can mask a multitude of operational problems.

The same principles apply to a wider product mix and customer base. The more diverse the portfolio and the range of customers, the less the impact of losing sales for a particular product or customer. Again, risk is substituted for higher cost.

Product value creation builds extensively on work done in the ABC, shareholder value creation, and capacity management fields. The goal of value creation and predictive accounting is to better integrate these tools into a holistic management system.

Does the output have immediate or future value to the enterprise? An output that is used in ongoing operations has immediate value to the enterprise.

The value of operational assets is directly related to the gap between its actual cost and performance and the targeted cost and performance. Outputs that meet targets create value. Outputs with future value will provide a financial benefit in a future period. A well-run company will build a portfolio of outputs of future value, including a strong brand, patents, knowledge bases (such as customer lists), or software systems. It is important to measure the value creation potential of the existing product portfolio and the product introduction process.

How Processes Create Value

An organization's processes create or destroy value. A process creates value by consistently meeting or exceeding customer expectations, as expressed by performance targets, in the least possible time, with the least possible resources (cost). A process flows—it proceeds from one event to the next. As resources flow into a process, they are transformed and outputs flow out. Processes are dynamic. Processes have a time dimension. Processes have a quality dimension—sometimes the flow is smooth and orderly, while at other times the flow is turbulent and unstable.

Predictive accounting is predicated on the observation that value is codified in the process. The challenge is to interpret the meaning of the code. When a process flow is smooth and orderly, one can understand its purpose and capabilities. One can predict how it will behave. One can understand how it creates value and how much value it is capable of creating. When a process flow is turbulent and unstable, one can also understand how it destroys value. Many resources are wasted in resolving the problems created by unstable processes.

Process flows occur at two distinct levels within an organization. The first level of flow is between an enterprise's processes. Processes nest within other processes. A disruption in one process or a poor handoff between processes will ripple to other processes, destroying value on the way. Processes that coexist in a harmonious flow create a synergy. The sum of an organization's performance is greater than the sum of the individual parts.

The activity is the second level at which processes flow. An activity is a repeatable series of operations that consume resources to alter material, energy, or information into outputs that are provided to customers. The resources may be hard tangible assets, such as those found in manufacturing or transportation activities, or intangible assets, such as people in service activities. Resources are only a single ingredient in the process recipe. Resources need to be used effectively by the operational steps and they must produce an output valued by a customer. The failure of any component of the process will result in less value being created. To attempt to equate value creation only to the assets (resources) will create a woefully incomplete understanding of the important factors.

Enterprise Value Creation

Organizations create value by developing a cohesive set of processes that in totality craft a more powerful effect than can be ascribed to the individual processes. In the past, businesspeople tried to master a few functional disciplines—engineering and marketing, for example—and use that knowledge to clobber their competitors. The benefits were temporary. Competitors would emulate their functional skills to overcome any competitive advantage. The upshot was that many processes lay scattered in an organization, which were inconsiderable alone but when joined together by purpose could create high levels of value.

An organization's processes carry out the work to design a product or service, deliver it to the customer, provide customer support, and perform the internal services necessary to sustain a business. The more effectively these business processes are structured, the more the customers will value an enterprise's products and services. Today they must understand and optimize the entire business processes (see the sidebar "The Mathematics of Process Value").

Process Level (Both Business Process and Activities)

Understanding how a process creates value begins with target setting. Executive management develops goals and targets that must be met to achieve strategic objectives. Targets open the eyes of expectation. It is incumbent on the operational people to structure their processes to achieve the targets. They must deliver on the promises made by the executive team.

Processes must be capable of delivering the targeted performance. Each process must be evaluated to determine its ability—or, more important, its

The Mathematics of Process Value

Many accountants have endorsed the need for value-based—rather than cost-based—accounting. Rather than more rhetoric, this sidebar presents some suggested value calculations. By throwing down the gauntlet, the debate can evolve from discussing the need for change to discussing specific proposals.

Value loss factors

Value driver (1) Performance = Process actual performance – Process target performance

Value driver (2) Variation = Process actual cost per output – (process variation factors)

Value driver (3) Efficiency = State-of-the-art process cost per output – process actual cost per output

Value driver (4) Effectiveness = Process actual cost per output – (downstream process variation factors) lack of ability—to create value. Targets must motivate each work group to take steps to improve its performance in those areas that most hinder value creation. The important aspects of a process to evaluate include the following:

- Process cost per output
- Process velocity (time)
- Process capabilities
- Process variation
- Process conformance to brand targets
- Macro economic factors

Process Cost per Output. Outputs play a central role in processes and thus also in predictive accounting. An output is fashioned by a process where input is transformed from one state to something different. An output signals the completion of the transformation process. Outputs are what the customer receives and values. But outputs are only half of the productivity equation. Outputs must be cost-effectively produced.

Outputs are inseparable from the process that creates the output. To create value, outputs must be produced efficiently and effectively. Cost is the monetary measure of the resources consumed in the transformation process. Whereas outputs are the first half of the productivity equation, cost forms the second half of the productivity equation. Together the cost of creating an output is an important measure of productivity.

To measure process value it is necessary to determine the gap between actual cost per output and its targeted cost per output. Every process has an allowable amount of cost that is derived from what customers are willing to pay for a product or service. The targeted cost per output serves as a boundary between a process's value added and non-value-added elements. The gap can be thought of as the non-value-added component of cost. To achieve the target cost requires a continuous innovation of processes, products, and organizational design. Manufacturing companies have for instance measured their output in "tons per hour," hospitals and hotels measure beds occupied, schools measure average scores on standardized tests, and so on.

Process Velocity (Time). Time is a measure of duration. Time measures the interval between a process's start and completion. Time represents a particular quality of the present process—it is both an opportunity and a lost opportunity. Time is money. Time is value. The principle of discounted cash flow asserts that money today is worth more than money in the future. Process velocity measures the speed (time) of the process. The faster the pace, the greater the value created. Improving process velocity creates value for the following reasons:

- A greater number of outputs can be completed during any time period.
- Less working capital is tied up in financing a process.

- Revenue is more quickly turned into cash.
- Market momentum (speed to market) triggers a revenue stream for the company that makes it to market first. Being first gives an organization a big advantage in selling to customers and begins recovering the investment.
- Lower material and service cost accrues to organizations that streamline the workflow between its process and its suppliers.
- A nimble management team that can adapt strategy and management practices to a changing environment will create greater value than a management team that is slow to act. Failure to recognize when to deploy a new technology will devastate value.
- The product or service is delivered to customers when they need them. Meeting customer needs is important to building a strong customer relationship.
- Research-and-development operations must get new products and processes quickly to market.

Target cycle time is computed in the same manner as target costing. The target cycle time procedure begins by assessing the market to determine the customer's delivery expectations. The allowable delivery cycle is computed from these customer expectations. This allowable time is then systematically broken down into all the component processes, including support processes that are necessary to provide the product or service.

Process Capabilities. Process capability is a measure of the range of work that a process can cope with—it is the process's knowledge. Every process is endowed with certain "physical" powers to complete work. Process capabilities are a measure of the scope or breadth of work a process is qualified to effectively handle. Large profits, dominant competitive positions, and sometimes even temporary monopolies are achieved by the sound deployment of processes.

Capability goes hand-in-hand with susceptibility. Work that is outside of process capability cannot be effectively processed. Susceptibility in turn leads to flexibility. The more flexible a process is to deal with changing requirements, the more capable the process. All processes must become more capable over time.

Embedding peoples' knowledge into a process enhances process capabilities. People join and leave an organization, but processes remain. Organizations that fail to instill an employee's knowledge into its processes are at great risk when a person leaves. It must be kept in mind that an enterprise rents its people only for a period of time each day because the people are voluntary members of an organization. Because organizations don't own their employees, the value they provide to the organization cannot be considered a measurable asset until it's captured and converted into something that the company does own—its processes.

Thus it is incumbent on an organization to ensure the competence development—any new knowledge or skill that can be reused or applied in other areas—is incorporated into the process as an improved system, policy, and procedure. It is of utmost importance to capture their expertise and knowledge in the form of a tangible product or service that can continue to be sold long after the employees who conceived the idea are gone. Knowledge captured and turned into an asset (tangible or intangible) is indeed a commodity to be counted on, literally, to improve the performance of the company and help generate profits. The commercial value of intangible assets, such as well-known brand names and know-how built into internal processes, is that they are owned by the company and that they survive the individual.

This observation can be borne out by an example that deals with intellectual capital—people's knowledge, skill, and experience. Albert Einstein began his work career as a clerk in a patent office. As part of the patent processes, he performed his role adequately—a safe assumption because he was not fired. However, when he left the patent office, another person filled his position without any major decrease in efficiency. The reason was the process. While a company depends heavily on its human resources, the process remains intact even when the most valuable employees leave the company. The company simply finds another person with similar experience and skill or it trains another person on how to perform the process. The activities of a clerk did not require an Albert Einstein.

Furthermore, before joining the patent office, Albert Einstein had wanted to teach at a university. He accepted the clerk's job only because he was unable to find employment as a college professor. Many believe that had he gotten the teaching position, he might not have created his theory of relativity. The pressures of achieving tenure would not have allowed him as much free time to work out his ideas as was possible when he was a clerk. Also, his ideas did not correspond with the mainstream theories of his day. To advocate radical ideas again might have jeopardized his chances of getting tenure. Be these arguments as they may, the point is that every process has its boundaries and rules and regulations that govern it. Intellectual capital can be created only within the right process and within the right environment. A genius in the wrong process will never be recognized.

What this example depicts is that corporate knowledge is built into an enterprise's processes. The process can be very people-intensive, or not. Where the process is people-intensive, the process may be dramatically damaged when a person leaves. More often than not, the process will continue to execute for a period of time when a less competent person replaces the lost person—a true testament to the power of a process.

Some believe training and education costs should be viewed as an investment, but to whom or what does the value created by such investment accrue? When individuals pay for their own education, they are investing in their own personal capital, but when such education is paid for by the company, the link between payer and asset is broken. Unless that knowledge is incorporated into a process, the company is paying for an asset it will not own. Individual competence is "owned" by individuals, not companies.

The importance of incorporating competence into the process does not diminish, in any sense, the importance of motivating and rewarding the people in an organization. For people to work at peak performance they must be contented with their job and the organization. Unhappy employees do not work effectively and, as a result, create waste. They will execute a process robotically with little pride in their work. There is much written about enlightened workplace practices—such as offering employees regular training, involving employees in corporate decision making, and linking employees' pay to their performance. It can be concluded that companies that do a poor job of nurturing their human assets will have less effective processes and thus create less value.

An organization's value creation potential is empowered or hindered by an organization's management style, governance practices, and policies and procedures. It is important to consider intangible factors such as governance practices as an indicator of a corporation's value creation potential. It is important to understand the value derived from an organization's management style.

Process Variation

Process variation is waste. A process that is in control delivers good performance. Conversely, processes that are out of control or have a harmful relationship with other processes will deliver spotty or poor performance. The implications are profound to the capability of an enterprise to achieve its strategic goals. Long-term success accrues to organizations that best manage their critical processes. These world-class organizations measure process variation, constantly reduce process variation, and continually improve process performance to meet strategic requirements. When the process is in control, targeted performance results can be achieved. When a process is out of control, poor performance will follow.

The value creation potential of a process is embedded in its structure. A mismatch between a changing product/service mix and the process capabilities puts a burden on the process ultimately resulting in process variation. Total quality and six sigma are essential tools in creating process value.

Process Conformance to Brand Targets

How processes behave are a major factor in the way an organization is perceived in the market. An organization must understand and shape its brand image. The performance of every process must be brought into line with its brand image.

Macroeconomic Factors

The macroeconomic operating environment consists of the customers, competitors, industry practices, and economic conditions. It is important to measure the value provided by the growth, strength, and loyalty of an organization's customer base. A customer that recommends an enterprise's products to others creates value. The external operating environment provides a picture of how an organization's relationships with its customers affect revenues, growth, competence, and image. How do you bind customers to your company? Are you engaging them in an effort to help you improve your company and your products and services?

CHARACTERISTICS OF NON-VALUE-ADDED AND ITS IMPORTANCE TO VALUE CREATION

Non-value-added is closely aligned to the concept of value creation. Non-value-added is the flip side to value added. Non-value-added costs are costs or activities other than the minimum amount of employee time, equipment, materials, parts, and space that are absolutely essential to meet the targeted performance and remain a viable long-term organization. In a word, non-value-added is waste. Non-value-added is an important concept because it is sometimes easier to measure deviations from value creation than it is to directly measure the value created by processes.

Here are three dimensions to a non-value-added cost:

1. The consequence of not doing work correctly the first time. Examples of this criterion include:
   - Inspections
   - Process breakdown
   - Corrections
   - Response to crises
2. An unsynchronized process. Examples of this criterion include:
   - Bottlenecks
   - Things waiting
   - Things being stored
   - Things being moved
3. Activities that are not required by the customer and could be eliminated without affecting the output to the customer.

Another way to view non-value-added is to measure the value losses. The value losses for a process is the sum of all processes variation factors plus the difference between actual process results compared to the optimal state-of-the-art plus all downstream process variations caused by the process. As in the product value creation discussion, another way to view value creation is to measure the value losses. Value losses for processes can be visualized as follows:

Lost product/service revenue

Product/service revenue

Value Loss Factors
Competitive disadvantage (measured by market share)
Poor degree of fit between product features and processes
Economic factors
Technological change
Consumer preference change
Etc.

Lost process value
(Measured by non-value added)

Process value
(Measured by process cost)

Value Loss Factors
Process variation
Non-synchronized processes (excess time/bottlenecks)
Limited customer demand
Poor degree of fit between product features and processes
Resource price variation
Technological change
Etc.

ACCOUNTING FOR VALUE—A PROCESS APPROACH

Predictive accounting must provide reliable measures of value. The measures should identify changes in the value of a process as an organization evolves and renews itself. These value measures go beyond efficiency and stability. They measure the capacity of a process to create an inventory of value (see the sidebar "Share Price as a Measure of Intangible Value").

Solving the Gordian knot of intangibles is critical to enterprise success. If an organization is unable to make a meaningful assessment of the value creation potential of its processes, it is basing future success on the subjective intuition of its managers. An accounting system that fails to provide the management team with objective information is of little value. If organizations fail to recognize that their processes create value, how are they going to reliably improve them? Rather than improving them, they may damage them.

Share Price as a Measure of Intangible Value

Share prices are the only reasonably reliable measure of the market value of intangible assets. Organizations that are rich in intangible assets tend to have high share prices, relative to their tangible assets. The trouble is the value of intangible assets cannot be deduced, like the value of tangible assets, from routine market transactions. It only emerges in an indirect way, or when a company changes hands.

Much of the research that has been done on intangible assets has assumed it is possible to devise accounting systems that can generate dollars and cents values for intangible assets that can be recorded on the balance sheets. Various methods have been proposed for treating employees as balance sheet items and measuring them in dollars. Some introduce probabilities or discount a person's output during a life. While theoretically interesting, unfortunately, few attempts to convert people or competencies into dollars have proved useful. The challenge is not to design indicators; it how to interpret them.

Without proper process valuation, there is a risk that much of an organization's reported profit is derived from depleting process value. Failure to adequately fund processes that create future value will only sustain the myth of continued strong short-term performance while mortgaging the future. It is equally dangerous to slow down process enhancements that sustain a process's value creation potential. The potential benefits of properly managing process value is huge while the potential costs of doing nothing—or doing the wrong thing, or of doing the right thing but doing it poorly or too slowly—are also enormous.

Indeed, improvements in current results are actually based on slowing down or eliminating the destruction of future value. It is not uncommon to see this as firms liquidate market share. Reducing product development and training expenditures in difficult economic circumstances may be expedient to shore up short-term performance. However, it usually results in a reduction in a process's value creation potential with an adverse effect on future profitability. Likewise, eliminating much of middle management may improve a firm's current cost structure, but it also removes a great deal of the creative knowledge and experience needed to grow the organization and its products. Formally recognizing and valuing the intangible assets in the organization does not mean that value must always be preserved. Managers make decisions about how to exploit existing processes and about which to shed, run down, or invest in for the future. But at least when an organization identifies its processes and keeps score on their value, management can make well-informed decisions.

Ultimately, all efforts to value an organization's processes begin with an assessment of the future benefits that will flow from them. The process performance statement (see Chapter 1, "The Nature and Need for a Forward-Looking Accounting System: Process-Based Accounting") measures the value creation potential of an enterprise's processes. An enterprise can increase the value creation potential of a process by actively improving its processes. In the absence of the process performance statement, an organization may well be improving some processes, while deterioration in the value of others goes unrecognized. It follows that improvement in the value of most businesses is a somewhat fortuitous matter rather than one that is consciously directed and controlled.

In practice, organizations measure the results of processes. There are many factors that affect results. For instance, it is common to measure sales per representative. If that measure has improved, it is probably a good sign for current financial results. But why is it up? Has it improved because we have cut prices, the economy has improved, the golf course has closed, or a competitor has delivery problems? None of these reasons implies a real improvement in the sales process. Or are sales up because we now have a better system for targeting likely prospects, or we have improved sales skills or other support processes that helps the closure rate? In these latter cases, there is a real increase in a business value that is not reflected in the balance sheet. Nor will it typically be recognized in any internal management report. Process statements aim to create a new language for the dialogue of peers that focuses on real and measurable value creation. Such a system will fail when it becomes just another system for controlling subordinates.

This book proposes that accounting systems be expanded to include a process performance statement. The process performance statement will show the cost and performance of an organization's process and measure value creation.

SUMMARY

Creating value in today's highly competitive global business environment is an ever-increasing challenge. Companies that create value grow and generate new jobs, whereas those that do not must reduce employment and, in the worst case, close their doors. Value is achieved by continually providing better services and products to the customer and searching out and eliminating non-value-added and other unnecessary costs.

A prime objective of predictive accounting is to measure value creation. The process approach to value provides an organization with rigor and a consistency of analysis across business units, functions, organizational level, and supports a wide variety of business decisions. Thus managers who compete for resources share a common framework of analysis, a common goal, and a common language. All of this can enhance organizational communication substantially, which in turn improves management productivity by facilitating more efficient and more effective decision making. Managers rightfully will respond to the measures that bring them organizational applause and financial rewards.

6

Process Management: The Key to Creating Value

To provide a clear division of responsibility, most companies have organized into functional groups that report vertically to a multitude of levels of management. This structure provides a pool of experts with similar backgrounds and skills capable of completing the work assigned to their group and a strong chain of command. Unfortunately, most work activities do not flow vertically—they flow horizontally. Because management responsibility is vertical, so are the accounting systems. Financial accounting in a vertical hierarchical organization is often used to set pre-determined spending limits. Management systems are in place and well established. But vertical management systems are hollow because they do not consider workflow.

Many organizations have recognized this deficiency. Countless organizations map their workflow. They seek to understand the patterns of their business. They hope the insights provided by the process flow maps will provide the impetus necessary to elevate performance to the next level. They even attempt to streamline their processes. While the short-term returns of these efforts are often dramatic, few organizations have taken the critical next step and institutionalized process management into their routine management system. Predictive accounting is that next step.

Predictive accounting introduces processes (workflow) into the financial system. Predictive accounting creates process maps and resource consumption standards and monitors process variation as described in Chapter 2, "The Process-Based and Predictive Accounting Framework." Processes make understanding future performance a science rather than an art. This chapter will show you how to:

- Examine your process structure.
- Quantify your processes and how to incorporate them into a process-based and predictive accounting system.
- Create and apply a resource consumption standard.

Why is predictive accounting important? An enterprise is comprised of many interdependent processes. To survive in today's highly competitive environment, an organization's processes must be adaptable and able to respond quickly to changes inside and outside the enterprise. The days when Henry Ford said, "You can have any color car, as long as it is black" are ancient history. The assembly lines have been replaced with flexible manufacturing cells that permit a wide number of colors.

Organizations that proactively manage their processes are best positioned to adapt to evolving customer and stakeholder demands. Process management provides the foundation for understanding business dynamics. Process management seeks to see a business in terms of its significant inputs, operational steps, outputs, and products/services. While it is intriguing to describe an organization in terms of its key people, its power dynamics, or its culture, it is essential at some point to describe what it does and how it does it. This is because an organization behaves as a process, regardless of whether it is being managed as a process.

If an organization is not being managed as a process, it is not effectively managed. Why? If a process is a repeatable set of steps that convert input into output, then what is the opposite of a process? The answer is a nonrepeatable set of work. Nonrepeatable work is equivalent to random work. Random work is equivalent to chaos. In a nonrepeatable world, one could never learn from the past or predict the future. We need repeatable processes to bring order to the business world.

This is why the onslaught of change appears chaotic, unpredictable, and out of control to organizations that don't adopt process management. Managers see a current crisis as a situation-specific event rather than as part of a never-ending need to adapt. *Adaptation is a process, not an event.* Process management identifies the major forces of change and highlights the need to continuously adapt to these changing forces.

Process management stands in stark contrast to conventional accounting systems. Today's accounting systems consolidate the after-the-fact financial outcomes of events (processes) into groupings of cost. Consider a sales department that hires a sales representative. The sales representative was hired to perform specific work—such as generating sales leads, visiting customers, taking sales orders, and playing golf. The new sales representative is trained on how to perform the organization's unique processes. Thus the need for sales representatives is directly related to the need to perform an organization's work. In other words, a company that asks the question, "How many sales representatives does it take to change a light bulb?" has made the appropriate link between work and resource requirements.

Yet how does conventional accounting record these business events? Accounting records the salary and wages of the sales representative without any reference to the activities performed. The department creates a budget for the salary and wages and records the actual salary cost. Good performance is equated to not spending more than what's in the budget. Focusing only on cost does not differentiate the performance of an excellent sales representative from that of a sales representative with poor results. Does the organization maintain performance data on the sales representatives? Of course it has such data. However, performance and cost come from two separate sources that must be merged to truly measure the effectiveness of the organization's financial results. Such performance measurements require the financial system be expanded to include such process data as outputs and performance measures.

WHAT IS A PROCESS?

A process is a repeatable series of operations that consume resources to alter material, energy, or information into outputs that are provided to customers. Processes have several characteristics:

- Each process has its own unique function to perform in the enterprise. There are clear boundaries between the outcomes of an enterprise's various processes.
- All processes are necessary to sustain the organization. No process can be eliminated without jeopardizing the entire organization. This requirement does not mean that the process must be performed inside the organization; the enterprise can outsource the process.
- All processes must continue to function effectively over time. An enterprise's processes cannot remain static but must continually adapt to a shifting business environment.

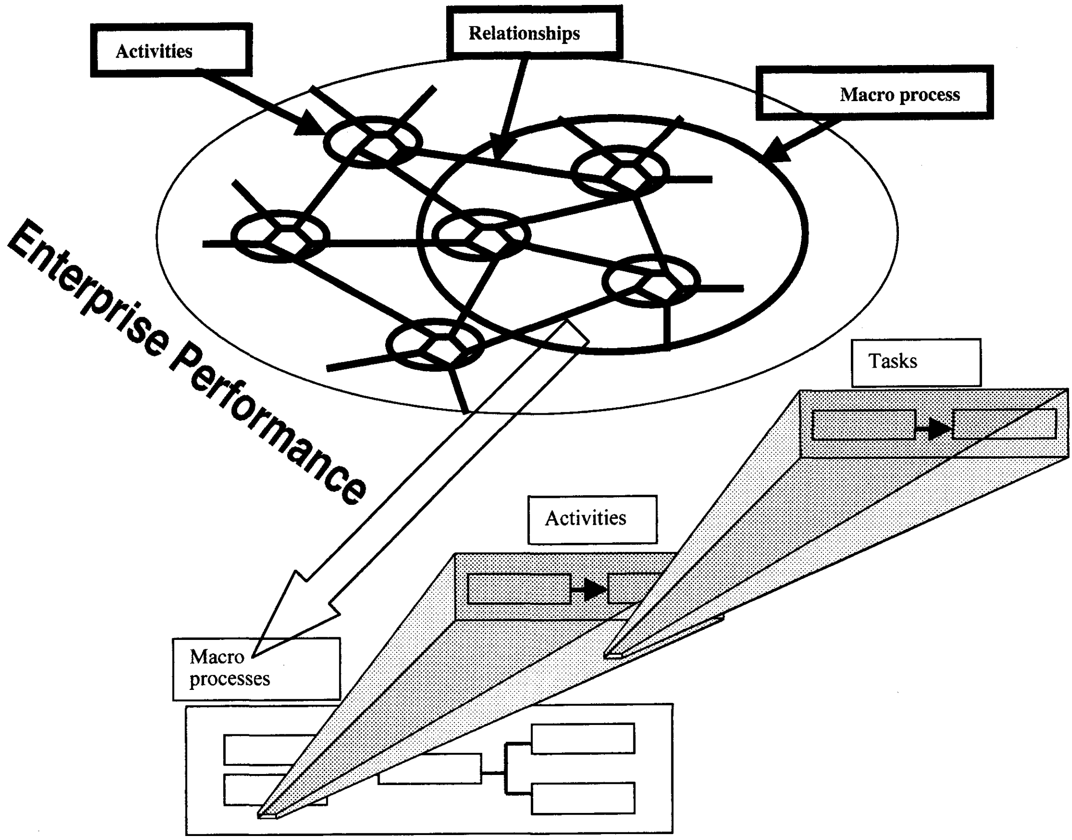
Processes are the way an organization works—its building blocks. Micro processes (tasks) feed into larger processes (activities) that feed into macro processes (business processes), creating a many-tiered set of processes (see Figure 6.1). What differentiates each of these is the level of detail. Any work done by an organization is a process, according to this definition! There are macro processes, such as maintaining the monetary system. There are micro processes, such as setting up the presses to print currency.

Each process interlaces with others to form an increasingly large yet interconnected tapestry. Everything in an organization's internal and external system is connected. To create value, we must manage these connections—that is, to manage the relationships that exist among processes.

A relationship is said to exist between processes where there is a codependence between interdependent processes. Relationships arise when the following conditions occur:

- When relationships are functionally necessary to the transformation process. For example, the activity "approve customer credit" is dependent on the previous activity "enter sales order." You normally approve credit after a sales order is taken. Relationships based on functional necessity are characterized as *first order relationships.*
- Relationships that indirectly couple multiple processes can create a synergy or disharmony. For example, the activity "enter sales order" is indepen-

Figure 6.1 Enterprise Process Hierarchy



dent but intertwined with the activity "advertise product." The more effective the product advertising, the greater the number of sales orders. Relationships based on indirectly coupling multiple processes that create synergy or disharmony are characterized *second order relationships.*

- Relationships are redundant where a process exists that duplicates components for the purpose of assuring continuation of the system function.

Each process performs an independent function from each other. Every process expects certain conditions to be met by the feeding processes (first order relationship). Problems occur where the actual conditions vary from the expected conditions. When we streamline and improve the connections between processes, we are improving the processes efficiency—that is, minimizing its value lost. One should also improve a process's value creation potential.

Process flow is the reason cost and performance are never static. The cost and performance varies dynamically depending on how well the feeding processes are coordinated. Understanding and quantifying process relationships is a major objective of process mapping and root cause analysis. Improving process connections has a positive effect on revenue: It creates value. Streamlining process connections creates a synergy that is valued by customers. Certifying vendors improves product quality and shortens the delivery cycle. All these actions create value for customers, which ultimately results in higher company value.

The work processes of a bicycle manufacturer illustrate the nesting of processes. The macro process is to fabricate the handlebars of a bicycle. The work steps (activities) might include: receive work order, get material, inspect material, set up machine, load material into machine, operate forming machine, unload handlebar, inspect handlebar and move handlebar to pick-up area (see Figure 6.2).

The process hierarchy is as follows:

1) Macro process: Manufacture component
    i) Sub macro process: Fabricate handlebar
        (a) Activities: Prepare for production
            a. Produce handlebar
            b. Move handlebar to pick-up area

Each *activity* detailed above is a significant element of work in the larger "fabricate handlebar" process. Each activity is a separate independent work step. Yet the overall performance of the process "fabricate handlebar" depends on a smooth flow of work between all activities. A breakdown anywhere will jeopardize the overall performance.

Every activity, in itself, is also a process. We can restate the definition of a process in terms of its essential elements: Processes convert input into output that in its final form is delivered to a customer. The customer specifies the features and operating specifications of the final product. An event, such as the receipt of input, triggers the process. The process steps are the procedures followed by the operator.

The process model (see Figure 6.3 for a description of a process model) is a generalized conceptual model of an enterprise.

Figure 6.2 Fabricate Bicycle Handlebar Example

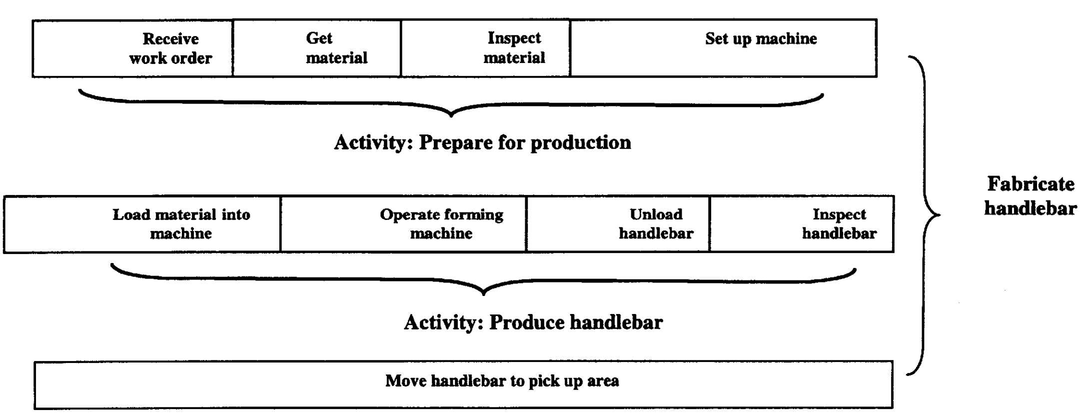
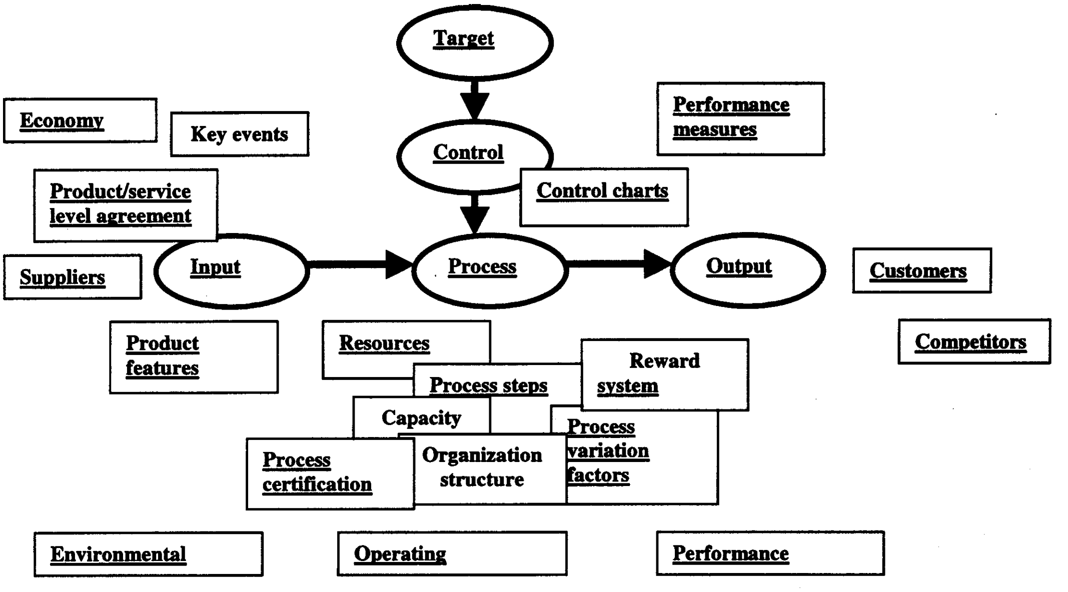


Figure 6.3 Process Structure



Key Terms:

Capacity—The availability of the process to provide outputs as required

Competitors— The organizations that compete for the customers' business.

Control charts—The graphical representation of process control data. The control chart computes upper and lower limits for the data that indicates when the process is out of control.

Customers—Those who receives the output.

Economy—The economic factors within which a business operates.

Inputs—The physical material and data that must be transformed into outputs.

Key events—The factors that can dramatically alter a process's behavior.

Organization structure—The reporting structure determines responsibility and accountability.

Output—Outputs are what activities produce. An *output measure* is the way output is counted; it is the workload of the activity. An output measure specifies the quantity or volume of output to establish how much work needs to be done and how many resources are consumed by the activity.

Process certification—The improvement of a process that brings it to a state where it consistently executes as planned.

Process measures—The financial and nonfinancial measures that evaluate the process's performance.

Process steps—A process is what is actually being done? The answer is expressed as a verb with a noun (e.g., "load trucks," "prepare proposal," "grind parts").

Process variation—The amount of variation that is inherent in the process.

Product features—An output feature is a major component of the final output. An output feature is important to the customer because it determines the fit, function, use, or safety associated with the product/service. For example, a significant feature of a car is the engine. Each output feature should be divided into sub-components that further refines the features functionality. The engine in this example may be categorized as gas or diesel. Next, the gas engine may be categorized by the number of cylinders. A feature should be decomposed until the process steps no longer vary with additional sub-components.

Product/service level agreement—The specifications of product and service requirements.

Resources—A business needs *resources* to perform its work. Resources include people, equipment, computer systems, material, and capital. A manager must plan how to accomplish the work with minimum resources. Opportunities are infinite but resources are finite.

Reward system—The policies and procedures to reward employees, both financially and nonfinancially, for excellent performance.

Suppliers—The organizations that supply the input.

Trigger—The factor that causes the activity to execute. The trigger of a bank deposit is a customer needing to deposit money while the end of the month triggers a month-end close in an accounting department.

- *Components* are the operating parts of a process. They consist of input, a transformation procedure, and an output. Each component is influenced by a variety of factors that restrict the ability of the process to achieve its targeted performance. Each component in the process should be monitored by some control action that subjects it to one or more restrictions.
- *Environmental factors* are the external dynamics that affect a process's performance.
- *Operating components* are the elements that perform the processing.
- *Performance measures* quantify the efficiency and effectiveness of the process.

Processes can be very physically dissimilar. Both an automated machine production line and a tax advisory service are processes. The automated machine process is structured to perform highly repetitive and precise work. The tax advisory service process is structured to answer problems that are uniquely different. The physical appearance of both processes is like night and day.

Processes can have dramatically different resources. The key resource needed by a tax advisory service process are its people. Their performance depends on how they apply their available capacity (work time) to access the tax reference material and their ability to interpret court cases to meet the needs of the customers. The tax advisory services are an example of a knowledge process.

A knowledge process depends on very competent and highly educated people who are experts in their functional field and possess extensive experience in their profession. Knowledge workers are provided with specialized information systems that increase their productivity. Take the recruitment process in a human resource department that attracts key people. This process is in stark contrast with an automated machine production process that relies on computers and mechanics to keep it running at peak efficiency. A key support process is the maintenance process. Yet the process model describes both the recruiting and maintenance processes equally well in spite of their striking differences.

Each process—whether a task, an activity, or businesses process—is distinctly different from other processes. Every process has a unique function to perform that is governed by its own internal and external forces. These forces restrict its behavior while simultaneously participating in the greater whole—very much like Chinese boxes.

Individual processes are highly influenced by external factors—universal knowledge and industry practices—as well as by internal factors. Functional knowledge is enfolded in every process. Think of all the different types of organizations in the world. Now look how the payroll process pays employees. Is there a dramatic difference other than size or the technology applied? The answer of course is no.

People are trained in vocational or college courses to perform work in a certain way. We apprentice with a person experienced in doing work in a specified manner. Experience is embedded in the process. Later, when we become experts in the process, we become the teachers to new apprentices. We change employment to companies that hire us for our experience. We read books and articles published by organizations that perpetuate the way we work. Technology vendors build standardized products—machines or computer systems—that they sell to all organizations in an industry. Management consultants speak at conventions that reinforce the way we work. It is no wonder that there is a worldwide harmonization of work practices.

A similar force harmonizes industry practices. We benchmark our peers in industry to level the playing field and offset competitive advantage. This harmonization is best understood by thinking of functional knowledge as a form of a genetic code. The genetic code for a rose contains different information from that of the lily. Similarly the genetic code of the hiring process is vastly different from a product design process. Functional processes are built from past experience and go through an evolutionary phase where "the strongest" practices emerge. These practices continue to evolve over time with the changing business environment. Short periods of competitive advantage accrue to organizations that rapidly and effectively improve their processes. On the other hand, an organization can waste time and resources by chasing mutant forms of knowledge that will not withstand the test of time.

Process knowledge is not limited by location. Good ideas can arise anywhere in the world. A pattern of thought or behavior is more easily produced once it has been produced before.

Enterprise Process Performance

Because processes are all connected in various ways—hierarchical as well as by flow—the resulting interconnected network of processes is rich in feedback loops. The individual processes directly and indirectly regulate and participate in the transformation of other processes. It is through the unique web of processes and their interactions that an entirely new property emerges—the enterprise's persona.

Every organization has a distinctive persona. An enterprise's persona reflects how the marketplace perceives the organization—commonly termed its brand image. At times the persona is comforting to its customers. At other times its persona is schizophrenic. If a holistic force controls an enterprise's development, the holistic force has a sense of humor.

A brand value emerges when an organization presents a consistent image to the marketplace. A brand image requires an enterprise to provide a seamless look from seemingly unrelated processes that must be woven together in the brand's image. Process relationships must be harmonious. Thus the image requirements act as both a target and constraint for each key process.

Process relationships imply a dynamic bond exists between processes. As the Greek philosopher Heraclitus said, "Everything flows." The essential properties of an enterprise's persona begin to emerge from the synergy that arises from the interactions among its processes. The performance of the whole enterprise is greater (hopefully) than the sum of individual processes. Synergy is not detected when an enterprise is dissected into its isolated processes. Accordingly, enterprise thinking concentrates not on basic building blocks, but on the basic principles of process relationships (see the sidebar "The Drive to Organize").

An example is the interaction of two billiard balls. Suppose that two such balls interact on a pool table—one strikes the other. At the instant of impact they exist as a single process that immediately disintegrates, sending its component parts in opposite directions. If we measure the position of one billiard ball we can infer the position of the other. Similarly, if we measure the velocity of one, we can infer the velocity of the other. The positions of the two balls are precisely correlated, as are their velocities.

Just as in the billiard balls example, process performance depends on the interaction of its processes. The processes either interconnect properly (the correct ball went into the intended pocket) or not. Improper process connections are typically seen as process variations. Root cause analysis identifies the factors that cause process variation. Resolving these connection problems has two immediate benefits. First, it reduces the cost of the individual process. Second, it improves the enterprise's persona, which translates into higher revenue.

It takes a focused and dedicated management with the right tools to keep an enterprise on track to meet its targeted performance. The process network concept asserts that all processes can be understood in terms of three basic mechanisms:

1. The structure of the individual processes
2. Its relationship with other processes (its flow)
3. Its cultural management style

The key to a comprehensive process management system lies in a synthesis of these three mechanisms—the study of structure (or outputs, resources, and process steps), the study of relationships (or flow, order, communications, and control), and the study of culture or management style and policies (see the sidebar "The Difference Between Structure and Relationships").

Macro Process

A macro process is a mega process that consumes a significant amount of resources from a variety of functions to produce a key output. It consists of a

> **The Drive to Organize**
> Ants are unable to survive in isolation. A few ants placed in a sand pile wander about aimlessly, apparently oblivious to each other. Continue to add new ants, however, and at a certain point they begin to organize themselves into a working organization, each assuming its particular role in the larger structure. They act with a collective intelligence and capabilities for adaptation far superior to those of the individual members.

The Difference Between Structure and Relationships

To illustrate the difference between structure and relationships, consider a bicycle. A bicycle requires a number of relationships among its components, known as the frame, pedals, handlebars, wheels, chain, sprocket, and so on. It is through the relationship of each of these functional components into a total system that constitutes a bicycle. In other words, all those relationships must be present to give the system the essential characteristics of a bicycle.

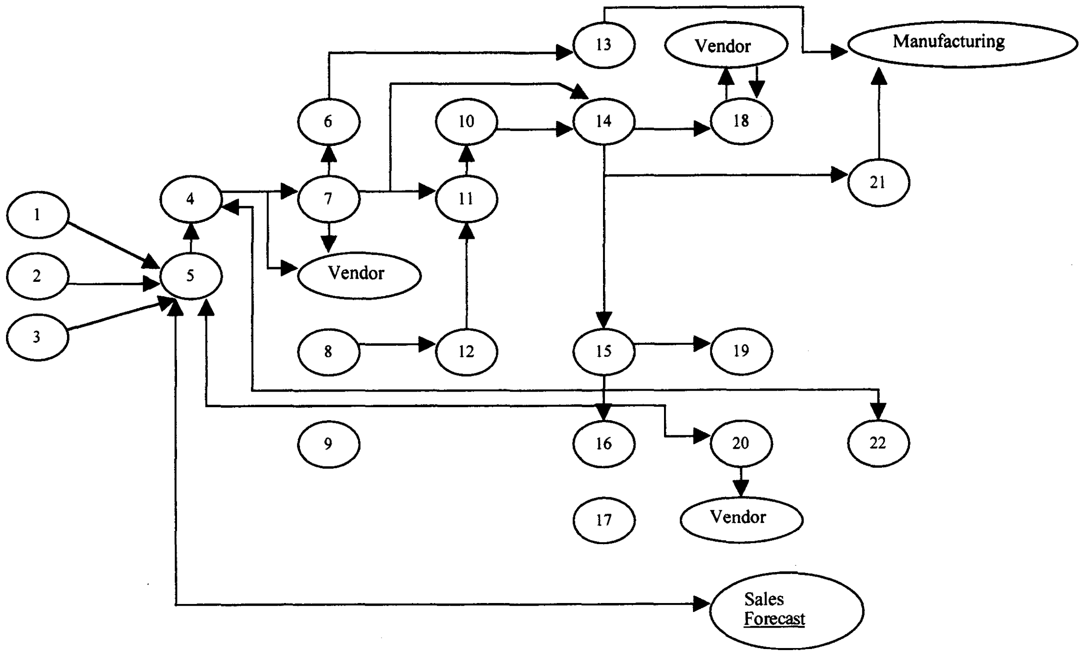
A critical adjunct to the relationships is the bicycle's structure. The structure is the physical embodiment of specific shapes, made of specific materials that defines each component. The same bicycle can be embodied in many different structures. The handlebars will be shaped differently for a racing bike, a mountain bike, or a touring bike; the frame may be heavy and solid or light and delicate; the tires may be narrow or wide, tubes or solid rubber. All these combinations of structures are easily recognized as the variations of a basic bicycle.

number of related and interdependent smaller processes and activities that accomplish a specific objective, such as marketing products, developing new products, or processing customer orders. The activities of a macro process are linked by the outputs they exchange. A specified event initiates the first activity in the process, which in turn triggers the subsequent activities. An output or information flow occurs where two activities interact. The exchange of an output or information flow defines the boundary between different activities within a process and links them through a strong cause-and-effect bond.

Macro processes are often analyzed by developing a flowchart of its component activities. Following the flow of outputs between groups helps an organization to understand its macro processes, because the outputs of one organization become the input to the next (for example, the physical documents that trigger an activity or that supply information to an activity). The resulting process model views an organization in terms of the flow of work—its dynamic behavior. The process model maps the activities in the sequence in which they deliver products or services to customers or support the delivery process. The process steps and the number of activity occurrences in turn determine the resources needed to execute the process.

For example, the purchasing process (see Figure 6.4) requires numerous resources (for example, people, PCs, phones, and information systems) in multiple functions working in concert to perform the necessary work and data manipulation needed to issue a purchase order. Other resources, such as office supplies and facilities, are also required. A customer order triggers the need for an organization to acquire and consume these resources. The organization purchases the resources and records their cost in the general ledger. The number of purchase order clerks, data processing resources, and office supplies depends on the number of purchase orders to be processed.

Figure 6.4 Procure Material Process Example



Activity No.	Activity Description	Department
1	Develop sales forecast	Sales
2	Take customer phone order	Sales
3	Take customer mail order	Sales
4	Issue requisition	Planning
5	Run MRP	Planning
6	Resolve vendor problems	Purchasing
7	Issue purchase orders	Purchasing
8	Expedite orders	Purchasing
9	Certify vendor	Purchasing
10	Move material	Receiving
11	Receive material	Receiving
12	Expedite material	Receiving
13	Expedite material	Quality
14	Inspect material	Quality
15	Reject material	Quality
16	Returns goods to vendor	Quality
17	Certify vendor	Quality
18	Pay vendor invoice	Accounting
19	Contact vendor	Accounting
20	Issue debit order	Accounting
21	Store material	Warehouse
22	Cycle count inventory	Warehouse

An important feature of a macro process is that it transcends organizational boundaries. For example, the procurement process requires:

- Sales to develop a sales forecast and then sell the product
- Planning department to schedule production
- Purchasing group to buy the material

- Receiving group to receive the material
- Finance group to pay for the material.
- Warehouse to ship the product

This requires effort on the part of many separate functional groups to work together seamlessly—no easy task. In fact, the traditional functional structure more often leads to inappropriate competition among departments. Sales wants inventory on hand to satisfy customer demand; planning wants stable ordering patterns; purchasing wants ample lead time to make purchase decisions; receiving wants firm shipment schedules; finance wants to safeguard the organization's assets; and warehousing wants ample lead time to ensure the most cost-effective shipment. When events go poorly, the finger pointing starts. Anyone who has worked in an organization that distributes products can cite examples where sales, planning, purchasing, receiving, finance, and warehouse activities were not coordinated with purchasing material.

Following is an all-too-familiar scenario: The financial people were surprised by the additional inventory required; sales promised an unrealistic delivery date; purchasing had to spend excessive amounts of overtime to get the purchase order out on time; the warehouse people had to send the product out by overnight express rather than by truck. The procurement process affected the productivity of the entire organization and, even worse, the customer was unhappy.

Focusing management attention on the process interdependencies rather than departmental responsibility can help alleviate these problems. Process management is intended to run horizontally through the organization, solving critical problems that involve many departments and making structural improvements to the whole organization that are often impossible for one department alone. Process management is an organization-wide activity. It aims to achieve organization-wide performance targets by coordinating the interdependent work in separate departments.

A process map forces a manager to recognize that his or her customers are other departments and the performance of his or her activities affects subsequent activities in the business process. It forces departments to communicate horizontally throughout the organization. It helps prevent people from thinking only of their own group. The intergroup communication should not be limited to the four walls of the organization. It is important that the firm extend its definition of the macro process to include links between a firm and its suppliers and customers, with a view to reducing costs or enhancing differentiation.

With macro-process reporting, individual department managers should not be penalized for "exceeding budget" if overall enterprise costs are lowered. For example, a maintenance department exceeded its capital budget by $75,000 because certain repairs that were formerly contracted out were brought in-house. However, the change resulted in cost savings of over $500,000 in a downstream department. The macro-process reporting portrayed the wisdom of this choice.

Macro processes can be classified into two categories:

- *Product processes.* This building block focuses on how to design and maintain product delivery processes so they consistently satisfy external or internal customers. It is directed at the product-design activities and the production process. (All organizations, whether they are classified as service or product industries, have production processes.)
- *Service processes.* The delivery processes for products and services are very different. These differences make it necessary to apply different improvement methods—and common methods in different ways—in the delivery of service. This building block focuses on how to design, implement, and improve the service delivery process in the service and product industries.

ACTIVITY STRUCTURE

Activities are the work that employees perform. Activities are how an organization structures its work to meet its customer demands. Activities are processes that delineate what workers do, how they do it, when they do it, how well they do it, where they do it, and the tools they use to do it.

Attributes are the properties of the activity. An attribute characterizes an activity. An attribute might include whether the activity output is value added or non-value-added. Activities can be classified into several categories, including:

- Primary activities
- Secondary or support activities
- Project activities

Primary Activities

When identifying the resources available to an organization, good planning and control require an organization to understand how much time is spent on primary and secondary or support activities. A primary activity contributes directly to the mission of a department. Designing and modifying products are two of the primary activities of an engineering department. Performing these and other primary activities are the reason the engineering department was created. A characteristic of a primary activity is that its output is used outside the organization or by another unit within the organization.

Primary activities are the reason a group or employee team is formed. These activities should directly relate to fulfilling the customer's requirements and should be essential to the ongoing nature of a business unit. Examples of primary activities include the following:

- Loading ships
- Servicing equipment
- Preparing monthly reports
- Writing software applications

Primary activities have a measurable output that can be quantified.

Secondary or Support Activities

A secondary activity supports an organization's primary activities. Secondary or support activities are general activities, such as administration, supervision, training, and secretarial work, carried out in support of the whole or a part of an organizational unit's primary activities. The employees in an engineering department, for example, are not hired to be trained, complete timesheets, or attend meetings. These activities take time away from completing the department's primary work.

An individual department's secondary activities should increase the efficiency and effectiveness of the primary activities in that department. Although these activities are essential to the effective execution of primary activities, they drain time and resources from the primary activities and must be carefully managed. A common characteristic of secondary activities is that they are consumed by the primary activities in an organization.

Secondary activities are not necessarily non-value-added or unimportant but should be considered when planning or staffing. An organization's major responsibility here is to ensure that these secondary activities increase the effectiveness of the primary activities and do not waste resources that could be more effectively used elsewhere.

The activity "train operators" is a secondary activity. Machinery operators must be trained so they can operate the machines more effectively and safely. For the human resources (HR) department, however, "train operators" is a primary activity. One of the HR department's objectives is to design, run, and coordinate training for operators. The operators who are trained are the customers of the HR department.

Project Activities

Project activities are one-time activities that have defined start and end dates. These activities consume significant time and resources. Project activities should be well planned to ensure that adequate resources are available to complete the project.

TASK STRUCTURE

A task is the detailed steps of how an organization performs its activities. For example:

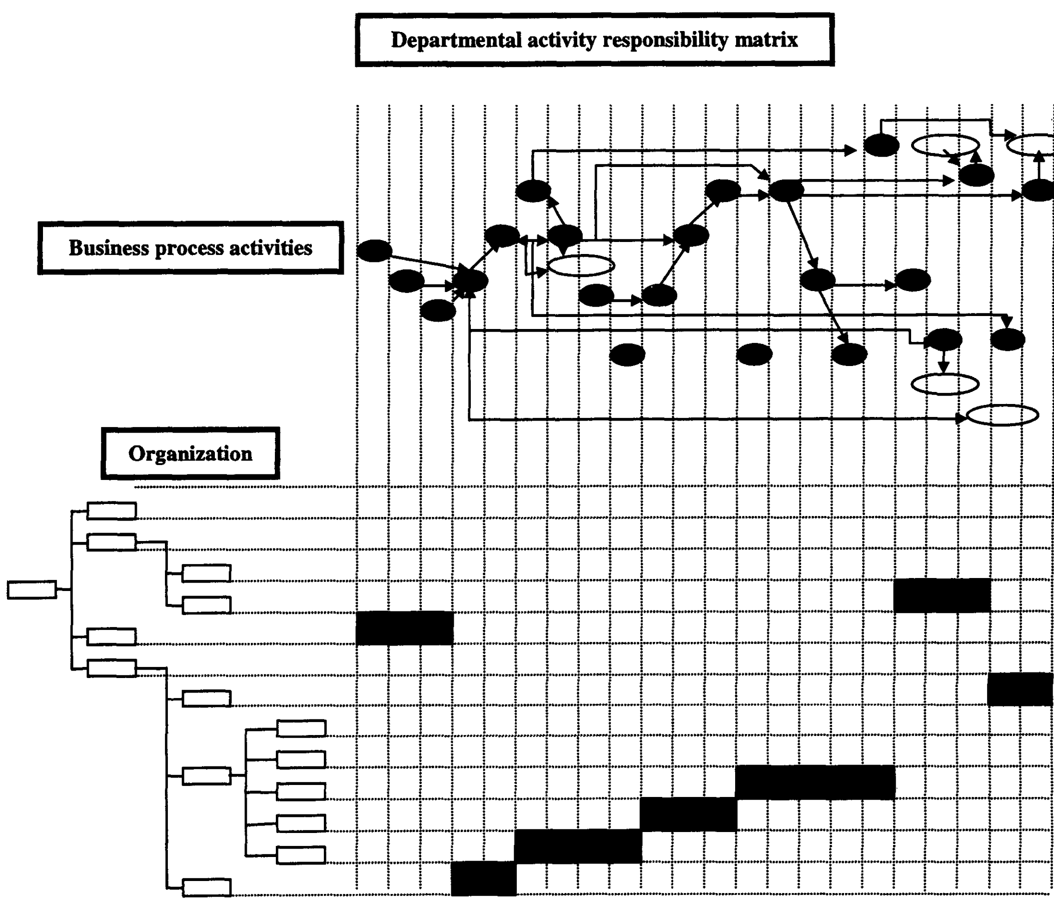
Activity	Drive car to work
Tasks	Open garage door Turn ignition key Back out of garage Steer car Park car Turn off ignition

The number of different tasks taking place in most businesses extends into the thousands. Attempting to map all tasks and assign costs becomes economically prohibitive. Therefore, it is recommended that tasks only be mapped either for instructional purposes or as part of an improvement process.

CONTRAST OF THE ORGANIZATIONAL AND PROCESS VIEWS

An organizational view describes who is responsible for getting work done, whereas the process view describes how the work is done (see Figure 6.5). A top-down hierarchical management system controls the network of processes in most organizations. Responsibility most often mirrors the organization's functions. The management system manifests itself in the organization chart, with its rigid separation of functional responsibilities and its distinctive management culture. Human hierarchies are fairly rigid structures of domination and

Figure 6.5 Organizational/Business Process Relationship



control. This complex structure creates conflicting aspirations and priorities that make it difficult to achieve organizational excellence.

An organization view emphasizes the static, stable, long-term aspects of an enterprise. The organizational view shows the hierarchical structure without explicit time frames. Resources are typically assigned to responsibility centers contained in the organization view.

While cause and effect governs behavior in the physical domain, the social domain is governed by the behavior of the cultural system. An organization's rules and procedures mirrors its culture. The crucial difference is that social rules can be broken, but process "laws" cannot. Human beings can choose whether and how to obey a social rule; processes cannot choose whether they should interact.

Enlightened management practices can bond an organization. The executive management team sets the strategic targets that launch an organization in the right direction or down a dead-end street. Management teams can either rigidly control or delegate responsibility to their employees—the choice is theirs alone. Eliminating communication barriers between functional groups is an important prerequisite to creating value. The management team establishes the policies and procedures that regulate an organization. The enterprise culture is reflected in these decisions.

INTEGRATING PROCESSES INTO A PROCESS-BASED ACCOUNTING SYSTEM

What distinguishes an accounting system built on process management principles (such as predictive accounting) from a conventional accounting system is that it incorporates operational data with traditional financial information. The process-based accounting system reveals such measures as cost per output that are unavailable to a conventional accounting system.

A process view of cost is an essential adjunct to the traditional organization structure, which most often equates management and accountability with a vertical manager/subordinate responsibility structure. Each department has its own roles and functions. These are written down in the job descriptions of the departments. The results and performance of each group are evaluated against the objectives of the specific function as they have been deployed from the strategy. Executives concede the interdependencies among different functions but are constrained by the lack of quantifiable information that verifies the performance impact.

A basic tenet of predictive accounting is that every process consumes resources in converting the inputs to their final form. An activity cost is influenced by three key factors:

1. *The resources, also known as factors of production, employed to perform an activity.* The factors of production consist of people, machines, travel, supplies, computer systems, and other resources. The cost of these resources is

customarily expressed as cost elements within a chart of accounts. Each significant traceable resource is included in an activity cost.

2. *The set of operating procedures that convert inputs into outputs.* The resources consumed and the process work steps are intimately intertwined. One cannot change either the resources or the operational steps without affecting the final output or the efficiency of the process.
3. *The amount of process variation.* Process variation is waste. It increases resource consumption and adds steps to the process to research and correct the effects of process variation.

Cost per output is a key performance measure of the effectiveness of a process. Process cost performance is directly related to a process's fundamental structure and its workload demands. An accounts receivable department will be used to illustrate predictive accounting. In our example, the cost of the activity is determined by tracing the labor, technology, facilities, and office supplies to the purchase order activity (see Table 6.1).

A Resource Classification Scheme

Certain resources that are considered fixed in the short-term are those that tend to continue regardless of short-term fluctuations in production activity-depreciation, rent, the manager's salary, property taxes, and the like. On a day-to-day or month-to-month basis, these are not normally sensitive to volume, though over a longer period they grow or shrink with the size of the business. Conversely, variable costs are associated to resources that are directly consumed in the production process—raw materials and production labor are but examples.

An activity or process is a structured set of tasks that consume resources to produce an output. There are six primary categories of resources:

1. Employees
2. Equipment
3. Facilities
4. Information systems
5. Material and supplies
6. Other resources

Employees are a critical resource assigned to departments. Employee staffing levels can be stated either in terms of job position/classification or the individual employees assigned to the department. Job classifications reflect the planned level of employee skills and experience necessary to perform the department's activities.

Process management is a system that focuses on the work processes of a business. Individual employees can change, but the department's activities must still be performed. Therefore, activity analysis should focus on the position/job classification rather than the individual employee. Another consideration is

Table 6.1 Resource Consumption Standard Calculation Example

Activity	*AR Clerk*	*Supervisor*	*PC Workstation*	*AR System*	*Training*	*Supplies*	*Total*
Collect past due invoice	$300,000		$12,000	$120,000			$432,000
Apply cash	50,000		2,000	25,000			77,000
Accounts receivable analysis	12,500		500	30,000			43,000
Vendor relations	12,500		500				13,000
Re-bill incorrect deductions	6,250		250	15,000		5,000	26,500
Process credit hold orders	25,000		1,000	8,500			34,500
Administrative tasks	9,375		375			30,000	39,750
Training	9,375		375		40,000		49,750
Supervise group		$43,000	1,000				44,000
	$425,000	$43,000	$18,000	$198,500	$40,000	$35,000	$759,500

Activity	*Output Measure*	*No. of Outputs*	*$ per Output*	*Time per Output*
Collect past-due invoice	No. of past-due invoices	120,000		
Apply cash	No. of cash applications			
AR analysis	No. of AR reports			
Vendor relations	No. of vendor visits			
Re-bill incorrect deductions	No. of re-bill invoices			
Process credit hold orders	No. of credit holds			
Administrative tasks				
Training				
Supervise group				

The calculation of a cost per output for one of the activities, collecting past due invoices, is illustrated below:

Activity: Collect past due invoices

Performance measure	Day's sales outstanding	32 days	
Resources consumed:	Collection clerk	12 minutes	
	PC workstation	12 minutes	
	AR software	1 past due invoice	
	Facilities	100 square feet	
Outputs consumed:	No. of past due invoices	10,000 per year	
Cost of resources consumed:	AR clerk	\$12.50 per hour for 1/5 hour	\$2.50
	PC workstation	\$3,000 cost; 3 year life; \$1,000 / (120,000 min per year) × 12	0.10
	AR software	1 invoice × \$0.05 / invoice	0.05
	Facilities	\$14.00 per square foot per year; \$1,400/(120,000 minutes per year) × 12	0.14
Cost per past due invoice processed			\$2.79

Note:
(1) The \$0.05 per invoice was derived from the shared service accounting system.
(2) The PC and facilities cost are stated in terms of cost per time in order to separate used and unused capacity.

that an employee's pay is usually considered confidential information. This confidentiality can be maintained by using the average pay rate for each job classification. Thus, it is the recommended employee pay rate to use in a process cost.

The organization chart and its corresponding job descriptions provide an excellent starting point for identifying employees assigned to a department. An organization chart shows the key operating personnel and the reporting relationship among and between them. Job descriptions identify the title, reporting relationship, limits of authority, primary job responsibilities, and qualifications for the job. This description should include an identification of the duties of the job, performance requirements, and the general level of difficulty associated with performing the assigned duties.

Equipment includes machines that improve the productivity of an employee in performing an activity or that are a substitute for labor. The extent to which capital assets are used in place of labor is referred to as operating leverage. There are three levels of operating leverage:

1. *Operator paced.* The machine is used by the employee. The machine hours correspond to the operator hours.
2. *Machine paced.* The machine operates independently of the employee. The role of the employee is to monitor, maintain, and set up the machine.
3. *Job class allocated.* The operator uses the machine as an occasional adjunct to performing the activity.

The *facility* is total area occupied by the department. A starting point for determining the actual space used by a process is the office layout or plant diagram. The facilities rate can be either an actual cost or a standard rate. Facilities include the cost of buildings, land, leasehold improvements, and furniture and fixtures. A cost per area is calculated by dividing the facilities cost by the area occupied. Every dollar paid in rent should bring in a proportionate return in income.

Information systems are a critical resources in many activities. Virtually everyone in the office requires access to the electronic tools that keep the office humming.

Information systems include the acquisition and installation cost of information systems. Services associated with information systems, such as debugging a new computer system, may be capitalized as well. They also include the cost of the computer network, mainframe, help desk, and the like.

Material costs include all supplies and sundries consumed in the process.

Other resources include all other costs not classified in the previous categories.

Shared services costs include all support services consumed in the process.

One important consideration in developing an activity cost is whether to include shared service cost in the cost per output. A discussion of this issue follows in the next section.

The Importance of Shared Support Service—Costing in a Process-Based Accounting System

Most organizations centralize support functions to achieve economies of scale. There is no question that the work of support groups is critical to an organization's survival. The more difficult challenge is to judge how much to spend on support functions—what is the value of their work? Many management scholars have termed support function as non-core and suggest that they should be outsourced. However, it makes no difference when problems occur whether the work is performed in-house or out. In either case, management must respond to the crises. The more appropriate question is where the activity can be most efficiently performed.

Accounting is embroiled in the support department dilemma. There are two inevitable consequences. First, support groups are usually among the first groups to be cut when cost reductions are directed—organizations simply don't understand the value support groups provide, so they assume support groups offer less than the more obvious operational activities. Second, support groups are continually trying to transfer their costs to operational groups in an effort to justify their costs.

Today many organizations do not allocate the cost of their support departments to the user groups—it is simply too much work for over-burdened accounting departments. Where organizations do allocate these costs, they most often employ very primitive allocation techniques that are termed chargeback or transfer pricing. The allocation process inevitably leads to conflicts between the support groups and the operational groups. The support group wants to transfer as much cost as possible; the operational group wants to pay the lowest possible price.

The transfer pricing mechanism that an organization chooses often has a critical impact on the organization's performance. A transfer price that is set incorrectly will provide negative motivation for reducing costs. An inappropriate transfer price may also inhibit the incentive to reduce activity cost or to apply a new technology.

How to Determine Demand Using Shared Service Costing

Transfer pricing has slowly evolved into shared service costing over time. The fundamental difference between transfer pricing and shared service costing is that shared service costing is based on the "pull" concept that is an integral part of the *kaizen* philosophy of the lean enterprise. The shared service costing approach aims to better understand the value created by support organizations. Traditionally, support departments have tried to "push" their services to the operational departments. Symptoms of a push system is where, during the budgeting process, the support group begins with its existing resource base and tries to allocate its costs to the user groups. The best method of allocation is the one the users of the shared service will accept. Many information technology (IT) departments have campaigned for programming work that was to go outside because the departments needed the jobs to keep their people fully employed. The consequence is often higher cost and worse performance than would have been otherwise achieved.

A "pull" system begins with the assumption that the support department needs zero resources. The support department then offers its services to the user groups. The service offering is stated in terms of explicit outputs and predefined levels of service. The service offering provides a basis for measuring user demand. Users are in control of the quantity and level of service they demand. The service department makes the user department demand the basis for calculating the resources it needs. The workload and agreed service level triggers the need for resources using an activity resource consumption rate. This system is called a "pull" system in the sense that activities are drawn from the support departments only when the user demands the service.

A critical element in establishing a shared service cost is to determine an objective output that users understand and to establish meaningful levels of service. Significant problems arise when managers have the ability to manipulate the quantity of output demanded in order to increase their advantage at the expense of the other groups. This manipulation damages the company's performance.

For example, consider the activities of an IT department related to providing a computer network. Assume the organization agrees that the output measure is a fully functional PC workstation. Under this example, the user department determines how many workstations it requires and the level of service it needs to operate its workstation. The IT department uses this information to determine the resources it needs to provide the workstations and its corresponding service. The advantages of using workstations as part of the service agreement are that the information is verifiable and not subject to manipulation.

A pull system is achieved through synchronizing each operational activity with the support activities. Synchronizing of activities require a level, balanced, and repetitive workload.

The pull system has two functions:

1. Bring the service to the user department when it is called for
2. Authorize resources in the support department

Setting Shared Service Prices

After demand is determined, the next challenge is to set a service price. The support group "sells" a quantity of a service to another group at a set price. This price (the service price) places a value on the transaction between the two groups. The using group factors the shared service cost into the activities that require the need for the shared service. Shared service costing improves activity cost traceability by including a "fair" cost of services provided by support groups.

The idea behind service price is mainly to:

- Evaluate work group's performance based on all the resources needed to operate.
- Help ensure goal congruence between the service providers and the work groups.
- Enable the organization to make better decisions using more objective information.

A key factor in setting an activity cost is resource capacity constraints. In predictive accounting, "capacity" is the production level that the division can achieve by optimal use of its current resources. The resources can be labor, machinery, or any other resources needed for production (except raw material, which is assumed to be unlimited). Constraints occur when the quantity of resources available is fixed. Capacity constraints are not an upper bound on the production level. Rather, constraints represent the production level achievable with the current resources—and using additional resources, such as overtime or purchasing additional resources can increase constraints.

In practice the problem of setting service prices is still more complicated. Support groups may have multiple services or may face capacity constraints. Occasionally, the service may have to be provided by a chain of more than two groups, thus increasing the complexity of the allocation. Or, some of the services may also be sold in the market.

Three common service-pricing methods are in common use today.

1. *Cost methods.* The service price is directly computed from the actual activity cost of the support group. The organization must use a consistent method of determining activity costs to avoid arguments about their fairness.
2. *Market price methods.* If there is a market for the service, the market price is used as the service price.
3. *Negotiated service prices.* The service price is reached by negotiation between the appropriate managers. The negotiated price is very sensitive to the managers' negotiation skills.

For support departments to respond rapidly and effectively to their customers' demand at the lowest possible cost, the support processes must eliminate, or streamline, the non-value-added activities by minimizing their variation. All support activities have different levels of waste associated with their execution and perpetuation.

REPLACING THE FIXED AND VARIABLE DISTINCTION WITH CAPACITY

Resources are often classified as fixed or variable. A variable cost changes in proportion to production volume (all costs are variable in the long run). A fixed cost does not vary with production in the short term. Fixed costs are items that recur, usually monthly, as part of business expenses and are not directly related to sales volume. For example, a manufacturer must have a building, machines, and equipment before products can be manufactured. These costs are incurred regardless of whether any products were sold. The cost of this equipment (depreciation or lease cost) is considered a fixed cost.

To illustrate the difference between fixed and variable costs, consider the process of inserting components in electronic boards. A manual insertion process employs laborers as the primary factor of production. The technology is unsophisticated—bins of components and a workbench. In this environment, there is a relatively direct relationship between the number of laborers and production volume because laborers are generally flexible and can perform other activities. A product would absorb the laborers' cost based on the number of hours consumed by the product multiplied by their hourly rate. Unused hours are treated as an efficiency variance.

Machine and equipment costs are treated differently. The cost of a machine is considered depreciation, which is commonly included in overhead and allocated to products. For example, an automated insertion process would employ machines as the primary factor of production. Machine tenders, maintenance personnel, NC programmers, and others are important but secondary factors of production that support the automated process. There is a stepped relationship between the machine cost and production volume. Additional production volume, where unused capacity exists, can be absorbed without the need to incur additional cost until full capacity is reached. Also, a machine is often inflexible and not easily changed for alternative uses.

A fixed resource has two important components—actual capacity used and unused capacity. Whereas the cost-effectiveness of a machine is relative to actual volume usage, the treatment of unused capacity has a dramatic impact on cost. A machine rate based on actual usage charges the entire machine cost to current period products and buries unused capacity cost in the actual rate. For example, consider a machine with a depreciation cost of \$100,000 and 7,500 actual production hours:

$$\frac{\text{Cost}}{\text{Actual usage}} = \frac{\$100{,}000}{7{,}500} = \$13.33/\text{machine hour}$$

A machine rate based on available capacity charges determines cost on total production hours available regardless of whether the hours are used or unused. The unused component represents either surge or excess capacity. Surge capacity is the additional capacity required for full production during a peak time of the year for seasonal or rapidly growing businesses. Excess capacity can be viewed as a non-value-added cost if there are no potential uses for the capacity or it can represent a growth opportunity. In either case, the cost of the unused capacity is separately identified and assigned to the source of the excess capacity. Common sources include plant management or sales. Continuing the example, assume the available capacity is 10,000 hours:

$$\frac{\text{Cost}}{\text{Available capacity}} = \frac{\$100{,}000}{10{,}000} = \$10/\text{machine hour}$$

$$\begin{aligned}\text{Unused capacity cost} &= (\text{practical capacity} - \text{actual usage})\\ &\quad \times \text{Available capacity machine rate}\\ &= (10{,}000 - 7{,}500) \times \$10/\text{machine hour}\\ &= \$25{,}000\end{aligned}$$

Classifying cost as fixed or variable is a practice that should be abandoned. Instead, costs should be classified as used and unused. The primary rationale is that if a resource is termed fixed it is often ignored by management. These costs simply appear month after month. Managers do not to see these fixed costs at all since they are buried in overhead. A fixed asset is a critical component of an activity or process. Managers should continuously think about alternative approaches to performing a process. Changing the process often requires alternative fixed assets.

In addition to depreciable assets, other resources are often considered fixed. They are largely to support the ongoing enterprise, the so-called overhead of management, accounting, finance, advertising, sales, R&D, and market development. All tend to build up as a business grows and are controllable.

USING PROCESS INFORMATION TO PREDICT FUTURE PERFORMANCE

While processes describe how an organization performs its work, the operational systems report process data that explains why financial results are what they are. For example, the balance sheet reports the final amount of accounts receivable during the reporting period. This information is valuable to an analyst for limited purposes, such as calculating ratios for comparisons with prior trends and with industry leaders. However, an analyst who understands the credit collection process used by the organization has a greater ability to understand why accounts receivable are at their reported levels.

For instance, in the accounts receivable example, two aspects of the process jump out immediately. First, there are a large number of past-due invoices (10,000 per year). Second, it takes a significant amount of time to process each invoice (12 minutes). These abnormalities are logical when one considers the industry in which the company operates. The industry is characterized by a large number of deductions. As a consequence, the credit collection process has a significant number of resources consumed in investigating why the deductions were taken and determining the appropriate resolution.

By monitoring a process's workload, predictive accounting can project future performance results. It is relatively easy to determine the upcoming need for resources by evaluating the past-due invoice backlog and sales projections. Accounting can become more predictive because much of the operational data used by processes is closely tracked and monitored by nonaccounting systems.

Output (workload) data provided by the operational systems is merged with financial data. In most organizations, workload is relatively predictable in the short term. Work backlog is known and demand patterns related to sales understood. By linking resource consumption to upcoming workload, future short-term financial performance can be projected.

In the example illustration collection of past-due invoices, good performance would be expected where the projected workload for the month matched well with the amount of time available to the collection clerks. However, assume that there was a recent significant increase in sales. Statistically, an increase in sales would result in an increase in the number of past-due invoices. Past experience shows that statistically, every $3,000 in sales results in one past-due invoice. The anticipated number of past-due invoices would be calculated as follows:

$36,000,000 sales for last month / $3,000 average past-due per sales volume = 12,000 forecast past-due invoices

This is a problem! The increased number of past-due invoices exceeds the available capacity of the collection department. The collections group must decide how to react to the new activity demand. One option is to work overtime. The financial consequence of this decision will result in $7,500 overtime cost (2,000 invoices × 12 minutes × $18.75 (base plus $6.25 overtime premium). Alternatively, a temporary collection clerk could be hired. The financial consequence is that the process time will exceed 12 minutes, due to the training requirements and a process learning curve. Also the temporary hourly rate normally exceeds the standard employee pay rate. In this example, the cost would approximate $9,000 (2,000 × 18 minutes × $15.00). A third alternative is to prioritize the collection effort. The organization could either only pursue the largest past-due invoices or, alternatively, pursue all past-due invoices but spend less time on each invoice by skipping certain procedures. In either case, the organization can expect a higher day's sales outstanding (DSO) due to less thorough follow-up. Higher-than-planned accounts receivable departmental costs and an increase in the backlog of past-due invoices can be forecast. Clearly, poor financial performance is anticipated under any scenario.

This example illustrates why process information is inseparable from performance measures as is discussed in Chapter 10, "How to Use Earned Value Reporting as a Feedback System." While processes predict future performance, performance measures analyze how well processes are performed. Not all organizations can or will implement a process equally well. Predictive accounting requires a comprehensive spectrum of measures, financial and non-financial (that is, cost, time, quality, and productivity), to provide a meaningful context for understanding past performance. Companies that seek to measure business performance solely by cost data will commit the serious error of measuring spending levels rather than the underlying factors that influence future performance.

Predictive accounting seeks to ensure that the actual performance of a process meets its targeted performance. Processes that fail to meet their performance targets are often restricted by their environmental and operating components. The interaction of the environmental and operating components result in performance attributes that in aggregate influence the overall business performance. The performance attributes of a process are termed performance measures and are described in terms of cost, time, quality, and so on.

EXTENDING THE TIME HORIZON OF PREDICTIVE ACCOUNTING

This book contends that it is essential to manage the processes of an organization. While workload is relatively predictable in the immediate future, what about the longer-term? Workload projections further out in time clearly become more subjective. However, several characteristics of processes make them useful in predicting the longer-term future. Some of the most important of these characteristics include the following.

Processes are repeatable. A process that has a good fit with its work requirements has adequate capacity and minimal process variation; it will have low cost and excellent performance and will be able to predict future performance results in a straightforward manner. Processes that are not a good fit must either be modified for their environment or become a constant source of problems. Understanding how well future requirements match to the organization's current processes provides the management team with an early-warning system of future potential problems.

Processes have a short-term inertia. An organization behaves as a process, even though it is usually managed by functions. An organization's processes incorporate knowledge of how it introduces new products or services, markets, sells, and provides its products and services. People come and go and new technology is introduced, yet processes remain largely unaffected in the short-term. It takes a major event or time to radically change how a process is performed.

Key events cause significant disruption to processes. Predictive accounting is based on the premise that an organization's future financial performance is the consequence of a series of interrelated cause-and-effect business events and activities. Given this premise, predictive accounting searches for the events that cause significant disruption to the processes. This enables organizations to monitor the initiating events, detect whether (or when) the events were expected, assess whether the events will cause process variation, and then use statistical analysis to project the potential impact of the events.

The impact of key events on the entire organization must be understood. You can't just reorganize, or just train, or just automate, as if you were merely adding some spice to the process. Each of these actions changes the recipe. A good performer, when pitted against a bad process, will be dominated by the bad process most of the time. Failure to deal with processes causes management to spend too much time "fixing" people, who are not the root cause of the problem, rather than fixing the broken processes.

Processes management helps an organization adapt. Process management helps an organization adapt to changes in the external environment (customers' needs, competitors' actions, and economic fluctuations) and in their internal operations (rising costs, inefficiencies, and process variation). Organizations that manage their processes are better able to adapt to changing demands. If an organization survives, it has adapted. However, its financial health is a function of *how well* it has adapted. An examination of the fallen organization shows that the majority have failed to respond adequately to the needed changes in their processes.

The agility to adapt depends on the organization's unique bundle of processes. Management must determine what product and service customers are demanding. Good financial performance can be anticipated where these product and service demands closely fit with internal process capabilities. Poor fit signals mediocre financial performance.

Excellent financial performance requires a vigilant process improvement practice. Process capacity must be constantly matched to process demand. Too little capacity results in bottlenecks and all the consequential non-value-added reactionary activities. Too much capacity results in high process cost. Process variation must be understood and constantly eliminated. High process variation results in poor predictability. The root causes must be identified and improvements implemented. Processes must be constantly evaluated to identify environmental, safety, and legal risks.

SUMMARY

Predictive systems are feasible when an organization manages the horizontal dimension—its processes. What this chapter suggests to be added to the traditional model—through showing the interrelatedness of processes and the importance of mapping their relationships—is to allow the unfolding of a horizontal dimension—the essence of the business process.

7

Process Variation and Cause-and-Effect Analysis

Predictive accounting is based on the premise that an organization's future financial performance is the consequence of a series of interrelated business events that repeat themselves in time. The events are predictable within a range of outcomes of differing likelihood. The process provides repeatable results until factors change that greatly disrupt the process. Given this premise, predictive accounting searches for the events that cause significant disruption to the processes. This enables organizations to monitor initiating events, detect whether (or when) the events were expected, assess whether the events will cause process variation, and then use statistical analysis to project the potential impact of the events.

This chapter will show you how to:

- Place process variation and root cause analysis in a process-based and predictive accounting system
- Employ the principles of process variation and root cause analysis
- Use control charts in an accounting system

PROCESS VARIATION CONSIDERATIONS

A business enterprise is constantly barraged by a ceaseless instability of events that affect the enterprise's performance. Each resource, whether human, machine, information system, material, or other kind, never executes exactly the same way every time. An important characteristic of a process is that there is variability in each of its outputs—no two items produced by a process are the same. No two Coca-Cola cans are exactly the same! No two renewals of a driver's license at a department of motor vehicles are the same! Such variation might be normal and expected; it might be a result of errors, which generally adds an element of chaos but sometimes creates new and originally unintended effects. The key is to ensure the differences are negligible and unobservable by the user (see the sidebar "Processes and Variation").

Processes and Variation

All processes vary.
A small amount of variation is normal and thus not controllable.
A large amount of variation is caused by environmental factors either external or internal to the process (cause and effect).
A process that is in control will have less variation.

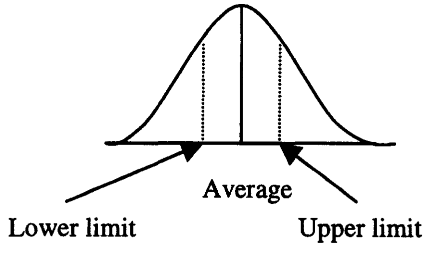
Variation is frequently shown as a bell-shaped probability distribution (see Figure 7.1).

The performance of an individual process can be expected to vary between the upper and lower process limits and to approximate the average over the long-term. The performance is predictable pending a catastrophic (or key) event that disrupts the process balance. In other words, key events will cause a process to become unstable and thus vary beyond its expected performance levels. The goal of process management is to maintain a process in a state of dynamic balance with the changing external environment fluctuating between the control limits.

A process that is in control delivers good performance. Conversely, processes that are out of control or have a harmful relationship with other processes will deliver spotty or poor performance. The implications to an enterprise's ability to achieve its strategic goals are profound. Long-term success accrues to organizations that best manage their critical processes. These organizations measure process variation, constantly reduce variation, and continuously improve process performance to meet strategic requirements. This simple formula will bring a process into statistical control. When the process is in control, targeted performance results can be achieved. When a process is out of control, poor performance will follow.

Predictive accounting has comparable objectives. It requires that process variation be managed—to be measured and minimized. A process that is in control and remains so is predictable—its future will be like its past. A process is predictable, in the sense that its outcome will vary within certain foreseeable limits. This cannot be said about an out-of-control process. Managers have no idea of what the future pattern of cost and performance will be. They simply

Figure 7.1 Statistical Bell-Shaped Probability Distribution



do not know what to expect from such a process, except that they have no idea of how the process will perform (see Figure 7.2).

The following are the consequences of an out-of-control process to a business:

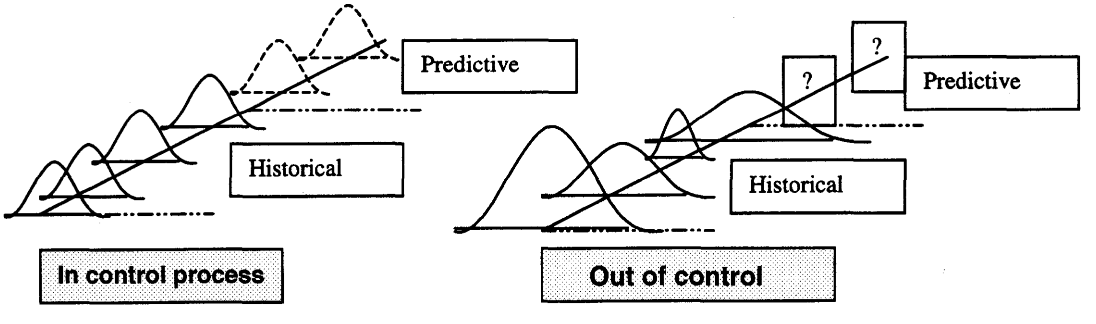
- The cost, as measured by the accounting system, is unpredictable.
- The performance, as measured by the performance measurement system, is unpredictable.
- The quality, as measured by the quality system, is predictable: It will be poor.
- The customer satisfaction is predictable: The customer will be dissatisfied.
- The company image, as measured by its brand value, is predictable: It will be damaged.

One of the most important objectives of a process-based accounting system is to measure all key processes to identify whether they are in or out of control. When it detects an out-of-control process, management needs information on the factors that disrupt a process. After corrective action has been taken, the process-based accounting system measures the new results of the process to ensure that the process is brought into equilibrium with the external environment. An effective process management system helps management to adapt quickly and effectively to changing business conditions.

Process management begins by understanding the sensitivity of each process to key external factors. Certain critical inputs, such as resource prices or availability, might cause sporadic fluctuations in process behavior, or the changes may be more universal to the entire enterprise. The emergence of a new form of competition (of, say, the Internet) will potentially affect all components of an organization. Certain activities are subject to more fundamental and more frequent external factors and are less tolerant to change than other activities.

There are several critical factors that influence process stability. The process model described in Chapter 6, "Process Management—The Key to Creating Value," embraces these factors:

Figure 7.2 In-Control Versus Out-of-Control Process



- Any unpredictability of a process's trigger. Unpredictable workload will require significant unused capacity to compensate for the lack of certainty.
- Any significant changes to product or service requirements, the supplier's capacity, or the supplier's processes. Disruptions in the supplier's processes can cause unpredictable supplies and materials that in turn will cause significant process variation.
- Any significant change in supply and a material's price, availability, or quality.
- Any changes in the output features that increase the difficulty of executing a process.
- Any changes to the process steps. The process steps must be documented and consistently followed. So says the ISO Certification process and seconded by process management.
- Any significant change in resource (for example, people, equipment, information technology system, facility or other resource) price, availability, or fit to the process.
- Any significant change to the factors that cause process variation.
- Any significant changes to the process capacity.
- Any significant change to an output's form or fit.
- Any significant changes to the customer mix or requirements.
- Any significant changes to process performance targets.

Wouldn't it be helpful to know the exact cost all of these costly chronic (repetitive) failures? Root cause analysis provides a way. It looks into the future to ascertain the probability of process failures.

THE SOURCE OF PROCESS VARIATION AND TWO APPROACHES TO MANAGING VARIATION

The business world is never stable. Change is the norm rather than the exception and problems are never ending. We solve one problem, only to be confronted by another challenge. We plan and budget for the future, and the only certainty is that our assumptions will be wrong. Events will not be as expected, but rather they will vary over time. That which is subject to time, space, and causation is changeable.

Time, for instance, means succession and space means coexistence. One thought following another gives us a conception of intervals that we call time. When two events occur simultaneously, that which separates them is space. Anything that takes form in the mind and is conditioned by time and space must change.

To achieve its performance targets, an organization must be nimble and transform its processes when necessary—but only when necessary. An enterprise structures its internal processes to cope with this changing world. A process is structured to accomplish a desired outcome given the unique set of conditions under which it operates. A process is designed to deal with a range of product or service features. The operating steps are determined. Next, the resources—people skills, equipment, information systems and others—are selected based on their availability, cost, and consistency. Finally, the output of the process is provided to a customer. The resulting process design reflects the organization's best effort to function within the constraints of its operating environment.

A process will operate effectively as long as the demands placed on the process by the operating environment are within the process's capabilities. A process has the capability to deal with a range of external conditions but not with an infinite set of conditions. A process's capabilities can be limited (a specialized process) or more inclusive (a flexible process). A process is said to be in statistical control when the conditions of the process are as expected—an equilibrium exists between the process and its external environment. Problems occur when one of the conditions varies beyond the capabilities of the process. For example, customers could change their requirements, resulting in a new product feature. Or the price or availability of a process resource could change, affecting the economics or performance of the process.

All processes expect, and accept, a certain amount of variation in each of the external factors. A process gets out of control only when a new condition disrupts the equilibrium of the process. A key to process management is to filter out the normal, expected fluctuations from major disruptions. Knowing when a process is in control helps to direct action to find and remove abnormal problems and when to leave the process alone. When you take action to remove problems that do not exist—called tampering with the process—you may end up increasing the variation of the process and hurt performance.

Problems that affect a process fall into two categories: one-time problems and chronic problems. A one-time problem has a very low probability of occurring. A fire in the office or a terrorist attack are examples of a rarely occurring problem. While an organization should be prepared for these events—with, say, fire hazard inspections and evacuation training—the identification and prevention of these problems should not be at the forefront of the management system.

Most problems and failures that plague an enterprise, however, are ever present. This means that the same problem will happen more than once for the same reason. Furthermore, certain of these chronic problems will account for the vast majority of the performance failures (see the sidebar "Influence of Industry on Chronic Problems"). Experience shows that out of all of the

Influence of Industry on Chronic Problems

The types of problems that confront an enterprise are generic to an industry. Growth in the housing industry, for example, is influenced by fluctuations in interest rates. Yet each firm in an industry configures its strategies and processes to be more or less sensitive to these factors. A homebuilder may compete only in the upscale home market, which is less sensitive to interest rate changes.

persistent failures of an enterprise, 20 percent of those failures represent 80 percent of the performance loss. The implication is that if you resolve the 20 percent of the failures that represent 80 percent of your losses, you will reap quantum benefits in a short period of time. Also remember that these failures are chronic, so if we do not eliminate them, they will happen again.

Organizations deal with chronic problems by (1) developing a sophisticated problem response modus operandi or (2) by proactively identifying the root cause of the problems and changing the process to eliminate or minimize these problems.

Crisis Management

The first approach is known as crisis management and, unfortunately, is the most widespread practice. The crisis management culture is characterized by organizations waiting for problems to occur, assessing the potential damage, and throwing resources at the most pressing problems that might keep the enterprise from meeting its business objectives.

The steps of crisis management often follow a pattern:

1. Assemble a crisis management team.
2. Determine the cause of the problem.
3. Solve the immediate problem at almost any cost.
4. Apportion blame—name a culprit.
5. Punish the culprit.
6. Celebrate the hero that solved the crisis.

A crisis is a highly visible event that demands immediate action at the request of senior management. Because time is of the essence, the problem-resolution team must make an educated guess about the answer to a difficult problem. Crises do not permit the luxury of a well-studied analysis of the problem. Most often, resources, time, and money become a secondary issue because of the high level of management visibility and anxiety.

The emphasis on crisis resolution is best understood through the economics of a crisis. Say an organization has ordered a new machine that provides an innovative process capability. The sales department has already taken orders for products that require the new capability. Failure to have the machine up and running by the scheduled date will result in lost revenue and unhappy customers. The cost of failure is very visible to the organization. It is little wonder that such crises get resolved.

It is not hard to picture an environment where management attention is always aimed at keeping the processes running. When a machine or process is down, the pressure is clearly to get it up and running again. This is the environment that most organizations encounter every day. Hence, many organizations define success by honing their capacity to confront problems and to consistently resolve the problems in a timely manner. These organizations believe that problems are inevitable. Managers are promoted on their ability to resolve crises. In this culture of reactive work, it is virtually impossible to be proactive in preventing problems. Successful resolution of crisis where management attention is focused on the problem of the moment is rewarded. Crisis resolution work is always going to take precedence over proactive work.

Crisis management will ultimately alienate people both inside and outside the organization. Customers are alienated because of the disruption in service. Employees are alienated because a crisis requires a significant investment of emotional energy. A crisis is also doomed to repeat itself because the root cause of the failure often does not get resolved.

Crisis management too often focuses on the people rather than the process, which results in solutions being short term. They often involve on-the-spot evaluations and quick decisions on courses of corrective action. The crisis management environment lacks the precision of a careful analysis. It is wasteful because the lost time can never be recovered for the resources expended to restore an enterprise to its previous state. In today's environment of reduced staffs, such resources cannot afford to be frittered away on resolving crises rather than permanently resolving the source of problems.

Proactive Process Variation Reduction

A totally different approach is needed to deal with chronic problems. The costs of chronic problems are both small and usually invisible to the management team. Yet these costs are dramatic to the enterprise. These chronic problems account for between 20 percent and 35 percent of the total operational cost of an organization. These costs overshadow crisis costs in total magnitude. These costs are so large, it is hard to imagine why they do not get their proper management visibility.

Herein lies the problem. Chronic events are rarely aggregated on an annual basis. They are typically viewed on their individual effects, which are often small in magnitude. What makes them large over time is their frequency. Assume that an organization is in the apparel industry. When a sewing operation is given material that is thinner than the sewing operation's capabilities, quality problems inevitably result. The material bunches up in the sewing machine because the guides are ineffective. Operators must manually adjust the material in the sewing machine but lose productivity in doing so. Failure to properly adjust the material, however, results in quality problems that often are not detected until subsequent sewing operations.

Assume the individual impact of the thin material on a sewing operation is one additional minute per garment. This extra one-minute period requires a person's attention, which at a typical standard rate ($18/hour with benefits included) results in an additional cost per garment of $0.30 (1/60 hour × $18/hour labor rate). Because of the small magnitude of the problem, these types of problems are invisible to the management team. The sewer accepts the problem as a part of the job and often becomes very proficient at working around such problems—perhaps the best sewers lose only 45 seconds per garment.

What management fails to understand are both the effects of frequency and the downstream impact of these one-minute problems. Assume that 10 percent of the products have thin material and the total yearly production is 6 million garments. The total cost of thin material is approximately $180,000 (6,000,000 × 0.10 × $0.30). The real cost is much larger than $180,000 when you consider the impact of quality problems to sewing operations downstream, the scrapped material, and the inspections needed to detect the problem.

Organizations can no longer afford to plan and budget for chronic waste. Nor can they afford to hide chronic waste. Management must seek out these hidden opportunities and assess their annual impact in monetary terms. Management must remember the Pareto principle, that 20 percent or less of the events identified account for 80 percent or more of the lost performance.

Eliminating or minimizing chronic problems involves a two-phased approach. First, the problems must be made visible through the accounting system. Second, management must act on the information. The first step requires a process-based accounting system. The second step involves implementing a root cause analysis system that focuses on eliminating or minimizing the root cause of problems. Frustration is inevitable when employees are working on the wrong events and where an organization's culture does not support the proactive elimination of problems. It is easy to fall into the paradigm that "if management does not care, then why should I?" Once this attitude sets in, complacency with a reactive culture is the norm and overall profitability suffers.

Predictive accounting plays a critical role in avoiding chronic failures. These problems would receive proper attention were accounting systems to provide management with the relevant information. The chronic event is many times more costly than most crises. The broken down machine gets the attention because it is highly visible and requires an urgent response. The chronic event has been accepted as a cost of doing business and is considered part of the operator's job. Predictive accounting will quantify and thus highlight the negative impact of chronic problems on value creation. The new process-based accounting system tracks how much each process varies.

What is the difference between the crisis management and proactive cultures? In simplest terms, it comes down to the first question asked when a failure occurs. The crisis manager asks, How can we fix it? Predictive accounting asks, Why did the failure occur in the first place?

To change a culture takes courage—the courage to be bold. Management must focus on avoiding failure. This new culture does not accept failure, particularly chronic failure, as part of the norm or routine. Every process failure and every chronic delay must be analyzed for root causes and solutions implemented.

PATTERNS OF PROCESS VARIATION

Process variation is detectable because it forms visible patterns in time. Process variation patterns take place even before numbers are reported—we often intuitively become aware of a problem when we subconsciously detect a pattern. We live by patterns.

An analogy of process patterns is the pattern of ripples that can be seen on the surface of a pond a few seconds after you toss in some pebbles. These ripples create complex figures as they expand, crisscrossing over the surface of the water, each spreading from its own source where a pebble fell. If we could freeze the pond instantaneously, these ripple patterns would contain the information necessary to reverse the process, and recreate the original configuration of pebbles as they struck the surface. The configuration of falling pebbles, we might say, is enfolded by the pattern in the ripples.

On a grand scale, we might envision the entire enterprise as a vast pond with ripples spreading, overlapping, and creating complex patterns of interaction throughout. Some of these patterns may seem relatively stable, others may not.

Process variation can best be understood by plotting process outcome data in a time series plot. Graphs are an excellent tool for understanding variation because the human eye is one of the most sensitive tools that seeks out patterns in the data. We look for such patterns as: Do the data points tend to drift steadily upward or downward over time? Do they oscillate—high to low and then back again (see Figure 7.3)?

A probability distribution describes the most probable values for a given process. A process can and will change over time. One positive change is where the process results improve. This condition occurs where the probable results shift to higher levels of performance over time. The change will occur to the mean (average) (see Figure 7.4).

Figure 7.3 Oscillating Point Pattern

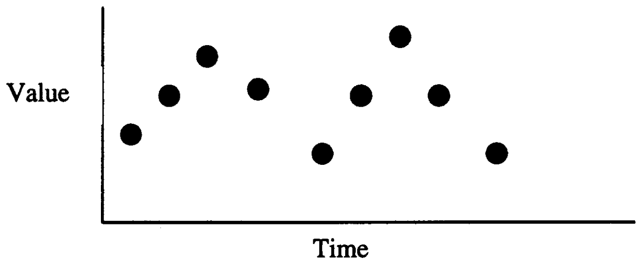
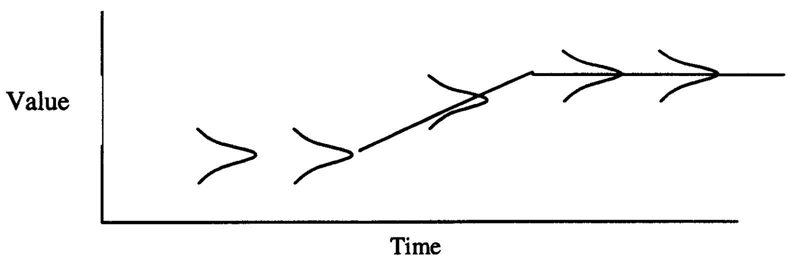


Figure 7.4 Change to the Mean When Performance Is Positive



The reverse condition is where the average performance degrades over time—the mean average is unchanged but the distribution (the shape) gets wider over time. This negative condition means that there has been a fundamental change to the process that causes individual performance points to be further from the mean than previously—there is a wider range in potential performance results. The wider the distribution, the less predictable the process performance (see Figure 7.5).

A final situation is where both conditions occur simultaneously. The performance is improving but is becoming more unpredictable (see Figure 7.6).

Each of the above conditions has a dramatic implication to the management team. A change in the process causes a change in the process variation pattern over time. Thus, if the mean shifts to a higher value, the process performance has also shifted.

USING CONTROL CHARTS TO MONITOR PROCESS VARIATION

A control chart is a special type of graph that helps detect changes to a process and is used to characterize the behavior of process data—that is, is it predictable or not? A control chart also provides the manager with an expectation of future performance based on the behavior of the process. Control charts are used to

Figure 7.5 Change to the Mean When Performance Is Negative

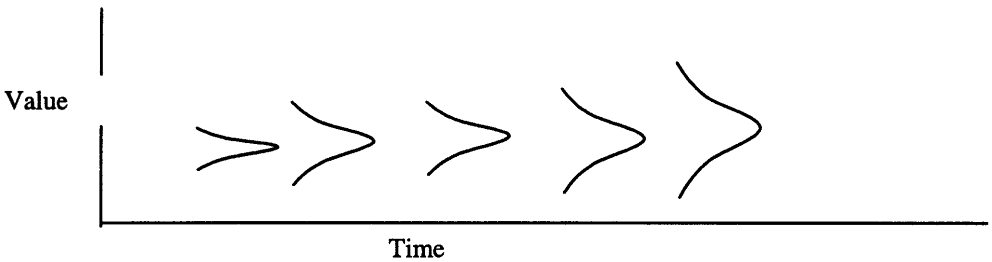
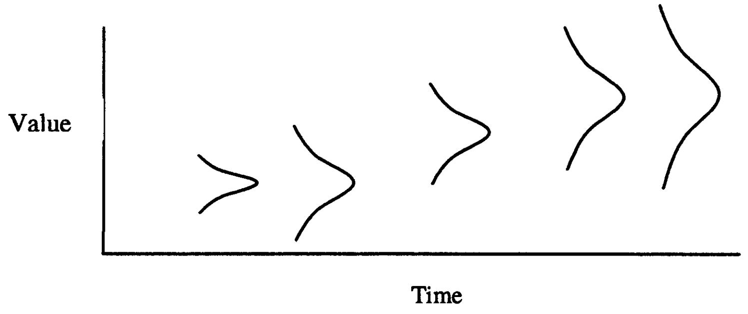


Figure 7.6 Change to the Mean When Performance Is Unpredictable



monitor process variation, to identify when to take action to improve the process, and to assist in diagnosing the causes of process variation.

The control chart concentrates on the behavior of the underlying process instead of attempting to attach a meaning to each specific performance result. The control chart is essential to predictive accounting because it gives the management team confidence to safely extrapolate into the near future. Moreover, whenever it is reasonable to make this extrapolation, the control chart also defines the range of values that is likely to come about in the near future.

A control chart is simply a time series plot of the individual measurements of process outcomes, to which a center line and two horizontal lines, called control limits, have been added. The center line is the average value of the set of process performance data. The average—the mean value—is drawn as a horizontal line on the graph. This center line provides a point of reference in seeking out patterns in the data. Upper and lower control limits are placed equidistant on either side of the central line. The upper and lower limits represent the maximum and minimum process performance values that can realistically (statistically) be expected. The next step is to connect the data points in time sequence using a straight line. The lines helps display the sequence of the measurement. There are three common patterns of variation that the center line can detect (see Figure 7.7).

Figure 7.7 Three Patterns of Variation in a Control Chart

Type	**Description**	**Accounting Impact**
Oscillating/cyclical	The points alternate above and below the center line.	The data displays seasonal or cyclical pattern.

Type	**Description**	**Accounting Impact**
Up trend	The points steadily increase in value over time.	A process whose mean is gradually shifting upward over time. Gradual shifts are common where the process is slowly improving effectiveness. This may be due to such a factor as a machine is being used more effectively.

Type	**Description**	**Accounting Impact**
Down trend	The points steadily decrease in value over time.	A process whose mean is gradually shifting downward over time.

The upper control limit and the lower control limit are positioned so when the process is in control, the probability of an individual value of the output variable falling outside the control limits is very small. Most practitioners position the control limits a distance of three standard deviations from the center line and refer to them as three-sigma limits. If the process is in control and following a normal distribution, the probability of an individual measurement falling outside the control limit is .0027 (less than three chances in 1,000). Thus, a control chart is simply a time series of data with three horizontal lines added. How far the control limits are from the central line provides a measure of process variation.

The control chart defines the effectiveness of the process and characterizes the behavior of the time series. Some time series are consistent and thus predictable and stable over time. More commonly, time series are inconsistent—they are unpredictable and change over time. The upper and lower limits on the control chart provide a reference point in deciding which type of behavior is displayed by any given process.

Control charts help distinguish between signals and noise—a distinction that enables meaningful analysis of data. A process where a time series displays unpredictable behavior gives rise to a signal and is said to be "out of control." Signals are indicated by points that fall outside the control limits or by obvious nonrandom patterns of variation around the central line. On the other hand, a process is in control where:

- The time series remains within the computed upper and lower limits.
- There is no obvious trend, nor any long sequence of points above or below the central line.

An "in control" process gives management an insight into what to expect of future performance, at least within limits. If the time series continues its current behavior, management will naturally become more confident about using the process to predict future performance. Thus, the essence of statistical control is predictability. A process that does not display a reasonable degree of statistical control is unpredictable.

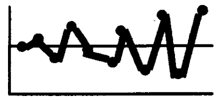
Control charts are useful for evaluating the past performance of a process and for monitoring its current performance. We can use them to determine whether a process was in control during, say, the past month or quarter. Our goal is to detect whether process data can be relied on to project future performance. Keep in mind that one of the primary prerequisites of predictive accounting is variance reduction.

The power of control limits is that they signal when to take an action to improve the process. There are common patterns of variation that the control limits seek to understand (see Figure 7.8).

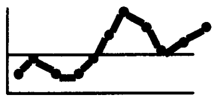
Identifying Key Events With the Control Chart

A key event is a factor that causes a dramatic change to a process (see Figure 7.9). The occurrence of a key event will cause a process to go out of control.

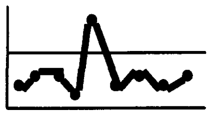
Figure 7.8 Common Patterns of Variation in the Control Chart



Type	Description	Accounting Impact
Increasing variance	The points steadily increase variation over time.	The data is increasingly unpredictable.



Type	Description	Accounting Impact
Meandering	The points have no consistent trend over time.	The data is unpredictable.



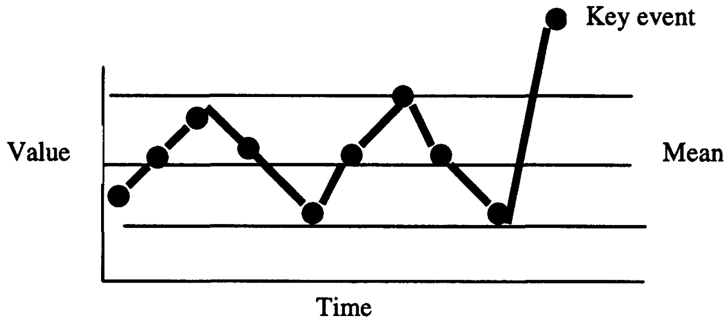
Type	Description	Accounting Impact
One off/Outlier	A single performance value that *does not represent a change in the process.*	A one-time key event has occurred. *Ignore the single abnormal data point.* The process remains predictable.

Type	Description	Accounting Impact
Level shift	The points show quantum improvement in value over time.	The data displays seasonal or cyclical This condition occurs where the probable results shift to higher levels of performance over time.

The effect of a key event can be temporal and the process will return to its normal condition, or the effect can be permanent and the process will remain out of control until process changes are implemented. Many key events are predictable. Through an understanding of key events, the rate and direction of change can be anticipated and built into the organization strategy. What will we do if a change in government results in lower entry barriers to potential foreign competitors? What if our major competitors merge? What if customer demands pattern changes? What technology breakthroughs could have a significant effect on meeting our strategic objectives?

There are several categories of key events. These categories include major changes in the following factors:

Figure 7.9 Dramatic Change Due to Key Event



- Workload. A major workload shift will cause significant shifts in used and unused capacity. Bottlenecks will result, with cascading effects on enterprise performance, or vast amounts of unused capacity can occur.
- Product features. Processes are established based on a certain mix of product features. Major changes in product features can cause a mismatch between the required work and the process capabilities.
- Economic and environmental factors. These include changes in interest rates, foreign exchange rates, and government regulations.
- Prices for key resources.
- Technology.
- Customer requirements.
- Competitor products/services/practices.

Key events should be measured and plans and process standards updated as appropriate.

Planning Control Chart Illustrated

The challenges of meeting performance targets are significant. Organizations are influenced by powerful external forces but have limited ability to influence those forces. These external factors present a unique challenge to predictive accounting. On one hand, they dictate the effectiveness of a process-based accounting system—failure to understand external factors means planning is similar to a roulette table. On the other hand, an oganization has little control over these factors. Predictability is less effective without the ability of an organization to control the process. In particular, this chapter has delt with the important role control charts play in monitoring the process and triggering necessary improvements.

The planning control chart is a tool the author developed to address this challenge. The planning control chart applies process logic to monitoring the key environmental factors that influence an organization. The planning control chart uses the concepts of a central line and upper and lower control limits. However, rather than using statistical analysis to rigorously compute these three values, the planning chart uses planning assumptions and sensitivity analysis. The central line is the planned value used by the strategic plan. The upper limit is the maximum acceptable value that, if surpassed, will trigger the need to update the plan. Similarly, the lower limit will be the lowest acceptable value that, if passed, will require replanning.

Let us use interst rates to illustrate a planning control chart (see Figure 7.10). Assume that we used a 7 percent interst rate to develop our plan. We determined that if the interest rates varied by more than 2 percent from the planned rate, we would need to update our plans. The organization would use the planning control chart to monitor interest rates using the same principles as a control chart.

A key aspect of the planning control chart is that significant changes to either side of the control limits would trigger a new plan. In our example, an interest rate that exceeded our upper limit would cause our cash flow projections to be in jeopardy. The interst rates for current and future debt would increase. Capital investments might have to be delayed or require a higher hurdle rate. The impact on customers might be to dampen our sales forecasts. All these factors, and others, would need to be considered in the updated plan.

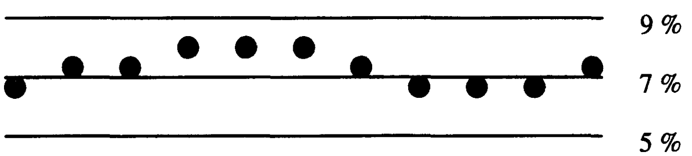
Similarly, a new plan would be necessary if interest rates were to drop below the lower limit. The opposite conditions would occur. We might have excess cash flow that would need to be allocated. Perhaps the hurdle rate might be lowered and capital investment that did not meet old hurdle rates might now be justified. Possibly, customers who had been holding off on purchases might cause a spike in sales.

In this example, as long as interest rates remained within the upper and lower bounds, there would be no need to trigger a new plan. The power of the planning control chart is that it forces an organization to explicitly identify and monitor the key events that could cause it a major business disruption. As long as the planning assumptions remain within control limits, the management team need not concern itself with minor changes. Management must become involved only when the factor shows a clear trend or exceeds the contol limit.

AN OVERVIEW OF ROOT CAUSE ANALYSIS

The first section of this chapter dealt with process variation and concluded that all processes vary. It also presented the concept of the control chart, which detects changes to the process and filters out random variation from

Figure 7.10 Planning Control Chart Using Percent



fundamental changes to the process. But detection without action is a waste of time and resources. It is the role of root cause analysis to determine the source of an enterprise's most chronic problems, to quantify its monetary loss and lead the work team to institute corrective action. No performance monitoring system can be effective unless root causes are constantly identified and eliminated.

Root cause analysis answers the question, "What causes process variation?" There are three levels of process knowledge. The first level is knowledge of the process performance as events unfold. Today's accounting systems are based on this type of knowledge. They can tell an organization what cost was incurred and where it was incurred. Accounting can tell whether performance targets were met. But such knowledge is incomplete because the organization does not understand why results are as observed.

The second type of knowledge, root cause analysis, provides the answers to why things are as they are. If we analyze the nature of a failure, we find the factor that caused the process breakdown. Armed with this information, we can prevent the next failure rather than merely reporting the failure occurred.

The third level of knowledge is foresight. Predictive accounting provides the knowledge that enables us to predict the probable future outcomes.

To illustrate the three levels of knowledge, if there is a machine breakdown, the operator will be idle or reassigned to another task while the machine is repaired. In either case, the department's performance will be adversely affected. The machine breakdown is an event. The first level of process knowledge is to understand the financial impact of visible events. Accounting fulfills this role in the management system. It assigns the operator time and its associated cost, to the manufacturing location where the operator worked. The operators cost will appear in the accounting records as an unfavorable variance to manufacturing because there was a cost without any corresponding output. Did the machine breakdown result in productivity loss to manufacturing? The answer, of course, is yes. Thus, according to event-incurred logic, performance is attributable to the specific location and business events, as they are detected by the accounting system.

However, the knowledge provided by accounting for visible events is limited. We do not arrive at an understanding of why these events occur—we simply record that they did occur. We get the incorrect idea that events are separated and thus see our processes as distinct from each other. The first level of knowledge leads us to crisis management. We do not have the knowledge to anticipate, only to react. At every step we report this commonplace knowledge, ignorant of the cause of our problems. We leave our employees in a state of darkness—to be accountable for results without the tools to perform. But when we go below the surface and seek the cause that produced the variation, tracing it back to its original cause, we inevitably arrive at the knowledge that enables action.

Throughout the enterprise, we find processes nesting within other processes. All processes are interrelated with other processes and the operating environment. This web of relationships links processes together in a universal chain of cause and effect that determines how well a business performs. No event can occur without having a definite cause behind it. Good or bad process performance is but the effect of some cause, whether the cause is known or unknown.

If we analyze why the machine broke down, we find, among other reasons, that preventive maintenance was not performed. The machine would not have broken down if proper preventive maintenance had been performed. More important, the machine will break down again at some point in the future if a preventive maintenance system is not implemented. Process management cannot predict the exact date the machine will next break down, but it will unequivocally provide statistical probabilities of when to anticipate the next breakdown.

Predictive accounting monitors the key processes to determine whether they are in control. A machine breakdown decreases the efficiency of a process. Processes with a wide variation would be prone to more problems such as a machine breakdown than would be processes with less process variation. By coupling the management focus on the need to continuously reduce process variation with root cause analysis that identifies the problems that must be fixed, management should see a significant reduction in process variation over time.

Once processes are stable, one would expect fewer machine breakdowns. Should conditions begin to change, management would get an immediate signal of the changed conditions and initiate appropriate action to resolve the problem. Thus machine breakdowns become predictable.

Root cause analysis is very much like watching a movie in reverse. We see a customer yelling into a phone complaining that the critical part he ordered was the wrong part. The customer replaces the phone and the box reseals itself. The expeditor comes through the door and walks backward to the receiving dock. The truck that delivered the part drives backward to the plant. The box containing the part is unwrapped and placed on a forklift that drives backward and replaces the part in storage. The picker walks backward to the scheduling office and replaces a computer printout onto the printer. The printer prints backward and removes all the printing on the report. The scene pans to a computer room, where magnetic tapes are spinning in reverse. Again the scene changes to an order processor entering a sales order. The data erases itself from the computer screen. The order entry processor stops and squints while concentrating on trying to read a faxed copy of a sales order. The movie stops here. The root cause has been detected—faxed sales orders cannot provide the needed reliability.

Thus proper analysis has carried us from the first to the second level of knowledge. If we continue to permit faxed orders, we will continue to occasionally ship the wrong quantities or parts. To understand performance, we must know all the key conditions that affect our processes. Thus root cause analysis enables us to move accounting from the limited knowledge of cost as it appears to be, to knowledge of the conditions that caused the cost. When we go below the surface and seek what produces variation, tracing it back to its original cause, we inevitably arrive at the knowledge that leads to action.

In the chain of cause and effect, it can be shown that each effect is latent in the cause and each cause is latent in the effect. With this understanding, we can easily explain why one individual process varies in a certain pattern, or why performance is excellent or terrible. One event is both a cause and an effect at the same time. A process that is affected by a previous process will, in turn, affect other downstream processes. The cause of the variation that is the effect of some cause becomes in turn the cause of some other variation. This produces some other still grosser effects and again a finer one, and so on, as the chain of cause and effect continues to spread without stopping. Thus an event can affect the whole enterprise, producing various kinds of effects.

Current performance is the effect of previous action. Our present is the result of our past, and our future will be determined by our present acts. Every effect is measured by its cause. Today's performance is a consequence of past events as much as future performance is a consequence of today's performance. From this endless chain of cause and effect, we can neither separate one single link nor call it useless or unnecessary. In the same manner, it can be shown that the law of causation produces different effects that govern every action, however minute, trivial, and invisible, that affects the whole enterprise. No action can escape this law, that every cause must be followed by an effect.

The law of cause and effect is the one law that governs all processes, however macro or micro they may be. All the forces of business obey the law and can never transcend it. From the matching of purchase orders to invoices to be paid to the budgeting process, every event is the effect of some invisible force working in harmony with the law of causation.

Under the sway of cause and effect, there is no room left to chance or accident. What we call random or accidental is, in reality, the product of some definite causes that we may not know or cannot trace on account of our limited knowledge. Therefore, the law of causation just as much governs all chance events as any ordinary result of some known cause.

Root Cause Analysis Methodology

Root cause analysis is a methodology to find out which particular failure or problems cause a process to vary and to correct the source of the problem. It looks into the problems, whether they arise from poor execution or workflow problems, machine quality problems, purchased materials, sales, secretarial, and other operational problems. Therefore root cause analysis involves all departments of an organization. Having looked into the problems, the process then aims to find the source of the problems and tries to fix the problems. The aim is to achieve a smoother system flow by seeking ways to eliminate problems, keep watch on them, or reduce their frequency because we will never be problem-free. Root cause analysis is a powerful tool for reducing process variation. Root cause analysis forces employees to open their eyes to the conditions under which they work. Employees must not accept that errors are inevitable. They must view anything that causes the process to vary as unacceptable and ferret out and eliminate the root cause. To do so they must separate the work from the problems. The employee must become an unattached, witness-like observer of the process.

To aid employees, an enterprise must build a methodology for responding to process variation. The methodology must be flexible to deal with a wide variety of problems. The approach involves three steps that should be executed by the work group:

1. Quantify the amount of process variation.
2. Identify the significant factors (root causes) that explain the process variation.
3. Choose a problem to resolve and institute process improvement.

Step 1: Quantify the Amount of Process Variation

The first step in a root cause analysis is to quantify the amount of process variation. A simple method to approximate the amount of variation is to identify the difference between the actual process performance and the optimal performance level (see Table 7.1).

To illustrate this method, consider a person who applies cash receipts to outstanding customer invoices. Assume the person spends his or her full time on this task and applies an average of 30 cash receipts per hour. The actual process performance is two minutes per cash receipt. Next, assume that the person can complete a cash application in 30 seconds when there are no errors or other problems with the process. We can now estimate the process variation to be $1^1/_2$ minutes of the total two minutes of the process.

Fabricating a bicycle handlebar provides another example. Assume the actual process performance for the activity was 22 seconds. The process standard set by an industrial engineering time and motion study was 16 seconds. The six-second difference represents the process variation. The reasons for the variance will be analyzed in the second step.

A more precise method would be to perform a statistical analysis of the process and to calculate its standard deviation. The standard deviation is a measure of process variation.

Table 7.1 Process Variation Estimation Technique

Actual process performance	
Less:	Process performance without errors
Equals:	Process variation

Step 2: Identify the Significant Factors (Root Causes) That Explain the Process Variation

Process variation is due to external and internal influences. The cause-and-effect chain must be constantly acknowledged and, where possible, minimized or eliminated. What saves business performance is the fact that many of these factors are controllable. Returning to our example of the six-second variation in the "produce handlebar" activity, the work group developed a simple fishbone diagram to determine the root causes of the process variation. They drove the analysis down to, among other factors, a process design deficiency. They then went back to the original process design to verify their hypothesis. They found that the industrial engineer had misplaced a decimal, resulting in the feeder turning faster than intended. Once the problem has been analyzed down to its mechanical cause, the solution was simple: Change the sprocket sizes, align them, and install new chain. A portion of process variation disappeared.

Root cause analysis identifies three key factors that cause process variation:

1. A product feature may cause a process variation because every process is designed to process an input with certain parameters, such as thickness and type of raw material. When the input varies from the parameters, the process does not work as efficiently or effectively. For example, a drilling operation is designed to drill certain types of material of a certain thickness. Very heavy or thick metal will affect the efficiency of the process and result in quality problems.
2. Similarly, customers can cause a process variation. For example, accounting activities are greatly increased for contractors who sell to the U.S. government. In other cases, if you are a certified customer, many transactions and paperwork can be eliminated, resulting in more efficient activity performance.
3. Variation is also caused by poor process execution within the organization. These problems are often labeled quality problems.

Consider the key factors that affect the activity "produce component" (see Figure 7.11).

By combining these process characteristics, we can conclude that the fabrication of any individual handlebar will vary between two and four minutes, with an average of three minutes (see Figure 7.12). Even though a potion of this variation is uncontrollable, the vast majority of variation is caused by environmental factors that can be minimized or managed. Any value outside this range of times would be considered abnormal and should be monitored. Continued problems should trigger a process improvement.

A great deal of money can be saved and profits can be made through a constant attention to the process. Often, the results of a thorough root cause analysis demonstrate that the process does not possess the capabilities to perform jobs safely or properly.

Figure 7.11 The Root Causes of Process Variation

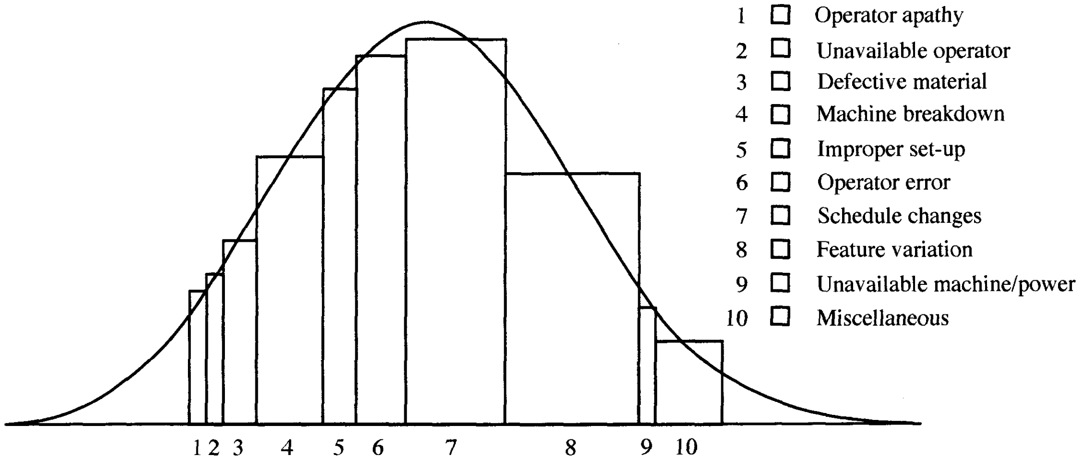
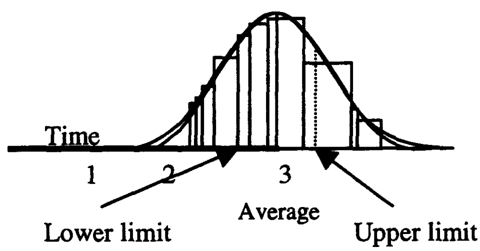


Figure 7.12 Average Activity Time



Step 3: Institute a Process Improvement

The work group chooses a problem to resolve and institutes a process improvement. The team must act on the findings of the root cause analysis. Too often management lacks commitment to take the actions necessary to improve the process based on the analysis findings. Management must be committed to not only evaluating and reviewing its processes—including its people, procedures, and training—but also taking the forceful action necessary to change the processes to ensure that they continue to meet their targeted outcomes. Thus, when deficiencies are determined, management must develop strategies that will eliminate the variation.

SUMMARY

Predictability is impossible when processes vary. The process-based accounting system recognizes processes, quantifies their cost, and determines how much they vary. It also shows the root cause problems that caused the process variation. Finally, it is presented in a format that leads to management action.

8

Creating Value with Product Management

Predictive accounting measures the value created by an organization's processes. The challenge of incorporating product management into a process-based and predictive accounting system is twofold:

1. How to quantify the future value of a product portfolio. Value is not equivalent to the money expended to develop products. Value is the discounted cash flow derived from selling a product over its life.
2. How to value the product introduction and maintenance processes. The value of future products depends on the effectiveness of the product management system.

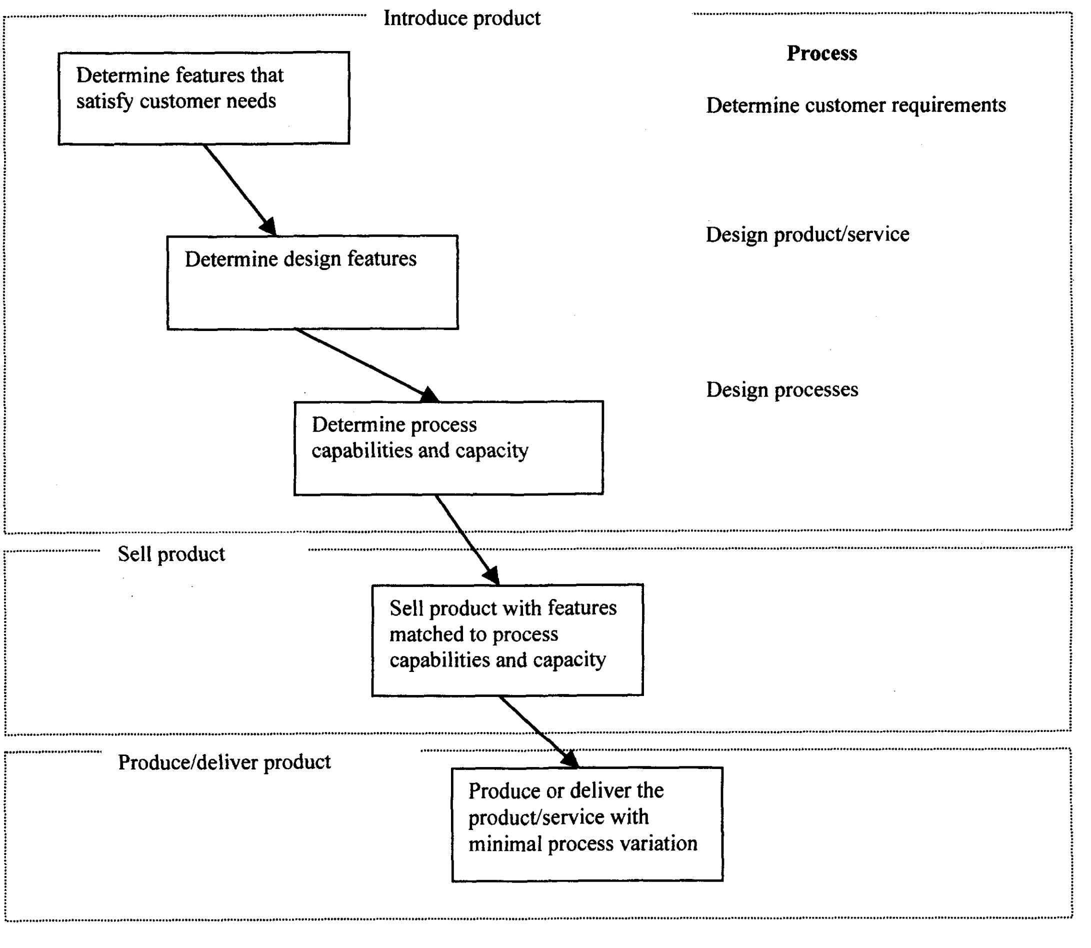
This chapter will explain how to:

- Identify the importance of product management in a process-based and predictive accounting system
- Adjust work according to the product or service's degree of difficulty
- Plan and manage the value creation potential by applying the product management concept
- Maximize that concept's value creation capability

The process of delivering a product or service from concept to market is a key element in creating value. Value, in this case, is the excess of what the customer pays for the product or service (life cycle cash inflow) over the cost of the processes necessary to deliver the product (life cycle cash outflow). The total amount of value is determined by the competitive advantage the organization creates with its product offering. Competitive advantage can be created in many ways. Chief among these is superior product features, low cost, image differentiation, and first-class customer service.

A common objective of many organizations is to bring new products and services to market sooner than the competition with low cost and superior quality. The role of the product management process is to plan and manage the value creation potential and value realization of products. The product management process begins with setting target costs to determine the products/services features, performance attributes, and prices that best meet customer needs. The products/services then must be designed so they provide the lowest life cycle cost, as measured by activity-based cost (ABC) systems while satisfying the performance targets. The product design must be synchronized with manufacturing to ensure the proper capabilities and capacity are available. The sales process must sell the targeted product mix at the targeted sales price in the targeted quantity. Once in production, the production and delivery processes must be continuously modified to provide the capability and capacity necessary to meet product performance targets with minimal process variation from target (see Figure 8.1).

Figure 8.1 The Product Management Process



AN INTEGRATED APPROACH TO CREATING VALUE IN THE PRODUCT INTRODUCTION PHASE OF THE PRODUCT MANAGEMENT PROCESS

Customers perceive an organization, to a large extent, by its product and service offerings. Products help shape a company's image. Rolls Royce clearly has a different image than does Toyota. What a customer is willing to pay for a product or service and in what quantity (cash inflow) depends on the standing of the product in its market niche.

The product introduction process also has a dramatic impact on the second element of value creation—the cost of the processes necessary to deliver the product (cash outflow). It has been observed that over 90 percent of a product's life cycle costs (conceptualize, evaluate, market, design, prototype, test, produce, deploy, operate, support, evolve, retire, and manage) are locked in by decisions made during the product development phase. Front-end planning is required to capitalize on opportunities to create value.

The product management process must provide information to enable the product introduction team to make sound decisions in light of the cost implications. The effectiveness of the product management process is measured by its ability to meet cost, quality, and cycle time targets. Enter a multitude of tools and techniques—design to cost, concurrent engineering, quality function deployment, ABC, target cost, and the balanced scorecard among others. Each tool by itself should help the product management team improve the product introduction process. Yet most product introduction continues to be plagued by missed schedules and cost overruns. So why do we continue to have problems in spite of these powerful tools? The answer is the lack of a unifying bond. The techniques are implemented independently of each other and managed by separate functions. The engineering group implements a design to cost system. Where do they get the cost data? They build cost tables using parametric cost data. Yet ABC data is more powerful and easier to maintain. Ask an engineer about ABC and he or she refers you to the accounting department.

THE TOOLS OF PRODUCT MANAGEMENT

Organizations need to develop a new enterprise-wide vocabulary. The new vocabulary should be based on processes because every organization and function performs processes. The key process tools that will form the basis of the new vocabulary are:

- Target costing
- ABC
- Feature management
- Product-induced process variation
- Perpetual planning

The integrated product management dream is that the product features will describe the products and services. Performance targets will be set based on customer-desired features. Accounting will provide up-to-date activity cost information on an enterprise-wide basis. ABC will provide activity cost by products, services, features, and customers. Process performance targets will be set and monitored. Process variation will be continually scrutinized. Improvement teams will constantly reduce process variation and improve the activity's capability to meet performance targets. Yearly budgeting will be replaced with key-event-driven planning (perpetual planning). Value creation and realization will become a management centerpiece.

Target Costing

Target costing determines the allowable amount of cost that can be incurred and still earn the required profit from a product. What distinguishes target cost from other costing tools is that it bases product cost primarily on market factors and secondarily on internal cost factors. Cost targets are established using the following procedures:

- Set a market-driven price and anticipated sales volume.
- Determine customer requirements; agree on the product features and performance specifications.
- Evaluate competitive offerings.
- Establish a profit margin that is acceptable to the management team.
- Determine a target cost by calculating the difference between the market-driven cost less management-decreed profit margin. Target cost considers product cost to be the independent variable rather than sales price or profit margin.
- Use ABC to determine the existing cost structures.
- Use process-variation reduction, six sigma, value management, and other cost-reduction techniques to ensure unnecessary costs are eliminated and achieve the target cost.

Note that the target cost is derived from market factors rather than from internal cost. The actual product cost should be determined using ABC. The target cost and actual cost are compared. Significant variations are resolved by evaluating cost and revenue trade-off by changing product features or performance specifications. Finally, the organization should proactively work to achieve target cost as the product goes into production.

ABC

ABC is a method for measuring an organization's activity cost and assigning it to products and/or other items where knowing cost is of interest. ABC is based on the observation that activities trigger the consumption of resources.

Resources are recorded as costs in the accounting system by the function that incurs the cost. Activities are performed in response to customer demands for products or services. Activities within an organization are identified and the resources needed to perform the activities are assigned to calculate an average cost for each activity.

Activities, in turn, are assigned to products and other cost objects based on their usage. The total cost of a product is the sum of the costs of the activities required to bring forth, sustain, and retire the product. Activity cost is assigned to a product using the average cost of the activity multiplied by the number of times the activity is required for that product. There are cost perspectives other than product cost of value to management. For example, who are the profitable customers? What channels of distribution are most profitable? ABC helps answer these questions.

ABC provides a far more accurate portrayal of cost than traditional product cost methods. Given a better understanding of cost, management can gain a competitive advantage by making better decisions. Furthermore, the improved understanding of cost can be used to eliminate low-value-adding activities to improve performance.

Feature Management

Feature management is an important tool that enables employees from different functions within an organization to understand and communicate how to create value through its products/services mix. *Feature management* defines a product by its features and relates the features to the operational processes needed to create the product and deliver the product to the market. The basic concept is relatively simple: Identify and group together related or similar features and assess their impact on manufacturing processes to take advantage of the existing process capability and capacity.

Feature management is a critical component of a process-based accounting system. A product/service feature is important to the customer since it determines the fit, function, use, or safety associated with the product/service. The future value creation potential of a product is based on the perceived value in the market relative to competitors, the degree of fit between the product design and the operational process capability/capacity, and the ability of sales to sell the appropriate features.

A product can be described in terms of its features. A *product feature* describes the final product. Take for instance a bicycle. The product feature comprises a set of component features. A *component feature* defines the physical properties of each major component that is joined with other components to create the final product/service. For example, the critical component features of a bicycle include the frame, wheels, seat, handlebars, gears, and brakes. This high-level feature description differentiates a bike from other products, such as an automobile or an airplane. However, it needs further refinement since it could describe almost any bicycle from a mountain bike to a racing bike. The component features are broken down into subcomponents to further differentiate the features. The component bicycle frame would be broken into male or female subcomponents. A feature should be decomposed until the manufacturing process steps no longer vary with additional subcategories, as follows:

Product feature:	Bicycle Type	
	City	
	Racing	(performance specification)
	Mountain	(performance specification)
Component features:	Bicycle frame	
	Male frame	(subcomponent)
	Female frame	(subcomponent)
	Bicycle wheels	
	Bicycle tires	
	Thin tire	(subcomponent)
	Thick tire	(subcomponent)
	Bicycle seat	
	hard or soft	
	Bicycle handlebars	
	straight or curved	
	Bicycle gears	
	lightweight or standard	
	Bicycle brakes	

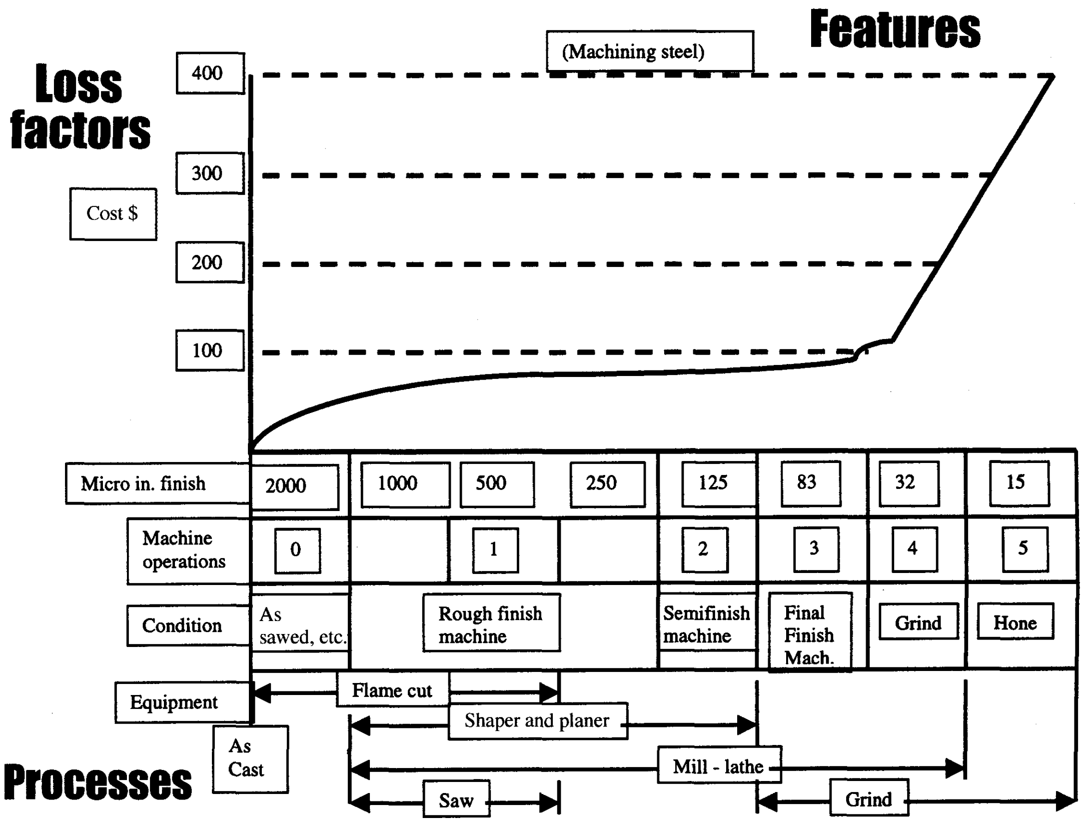
Component features are grouped by functionality. The functionality of a bicycle tire is to provide traction with the surface over which it is being ridden. However, a product's functionality cannot be treated in isolation. Functionality is inseparable from performance specifications.

Performance specifications clarify the functionality of the feature. Performance specifications are typically grouped by their characteristics, also known as attributes. Commonly employed attributes include dimensions, tolerances, shape, finish, and type of material. Let us again consider a bicycle. The performance specifications define the performance requirements, such as speed and type of terrain. The tire is a subcomponent of a wheel. A racing bike would need the bicycle tires to be hardy and lightweight, with minimal treads. Mountain bike tires would be dramatically different from a racing bike's. They would use sturdier material, with more and deeper groves.

The performance specifications limit the range of components as well as the operational processes capable of producing a feature. Take, for example, the finish to be applied to the bike. A very rough finish, as measured in micro inches, would be relatively inexpensive and have multiple possible processes available to provide the feature, including flame cut, shaper and planner, casting, mill-lathe, and saw (see Figure 8.2).

However, when the finish must be very fine, 32 micro inches or less, the cost increases dramatically and the process options become limited; the only possible processes are mill—lathe or grind. Each performance specification interacts with other performance specifications. In the above finish example, the shape of the part would interact with the finish and would have a significant

Figure 8.2 The Interrelated Nature of Performance Specifications, Components, and Operational Processes



impact on cost and potential processes. Flat surfaces would be the easiest to produce a fine surface. Curved surfaces increase the cost and processing time and limit the process options.

The lesson to be learned from feature management is that the product features, coupled with the performance specifications, are critical elements that fix in place the perceived customer value while simultaneously limiting the potential production processes and locking in the cost. The goal of product management is to improve the effectiveness of the evaluation process between the customer-defined feature and performance specifications and the cost of delivering the feature.

Feature Management Concepts

Components and subcomponent features consist of assemblies of dissimilar parts that require similar manufacturing or assembly operations. A part is the most basic unit of a product. A bicycle gear consists of chains, washers, sprockets, and other dissimilar parts. These parts must be manufactured, or procured, using significantly different manufacturing operations. What is critical from a product management perspective is that, when a new product uses the same or very similar product features, the organization possess the manufacturing capabilities to effectively make the parts. In other words, if an organization is currently making a bicycle gear, it currently possesses the manufacturing capabilities necessary to make a different but similar gear. However, different types of gears may require different manufacturing capabilities.

The economics of similar features are excellent. New products that use existing, mature capabilities typically will be low cost and high quality and will have a short product introduction cycle. Existing processes are normally stable because the kinks have been worked out. The key is that the bicycle gear must be different but similar. How does one determine how similar a new gear is to other gears produced in-house?

Determining part similarity begins by studying the process. Every process is designed to operate within a range of capabilities. Certain product attributes and performance requirements may interact with each other to constrain the overall effectiveness of the manufacturing process.

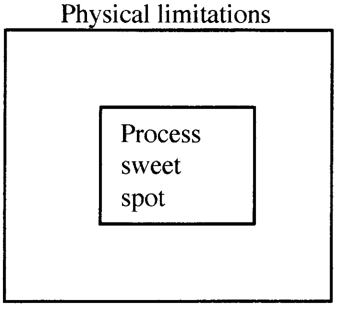
Consider the previous surface finish example. A sawing process can potentially provide a surface finish of between 250 and 1,000 micro inches. However, several attributes of the product might render the process incapable. The type of metal is one key attribute. Let us assume the sawing process was designed to saw soft aluminum to achieve the specified surface finish. If a new bike was designed to use a steel frame, the sawing process might be able to saw steel but would take longer and have inferior blade wear that would result in more frequent setups, higher cost and poorer quality.

The product's features and performance specifications constrain the potential processes and lock in cost. How much cost is locked in depends on the degree of fit between the performance characteristic requirements and the in-house processes. Every process has the capability to handle certain basic requirements. Any product that is within these basic specifications will be fully capable of being effectively processed. Take the sawing process discussed previously. The sawing process was designed to cut flat, square pieces of soft aluminum between $1/4$ inch and $1/2$ inch thickness with a 1,000 to 400 micro inch finish. Any feature within these specifications will be low cost and high quality and will have a fast throughput. This optimal set of feature attributes is termed the process sweet spot (see Figure 8.3).

The process also has physical limitations. The sawing process is incapable of sawing titanium or any material thicker than 4 inches. What is of interest to feature management is the impact of features with specifications that lie between the sweet spot and the physical limitations. These features are capable of being processed, but at a price. As you introduce feature attributes that exceed process capability, the process cost and cycle time increase and quality deteriorates.

For example, if the product feature were curved instead of flat, a jig or fixture would need to be devised to hold the part in place to ensure an accurate cut. Costs would increase as a consequence of the cost of the jig or fixture and

Figure 8.3 The Optimal Set of Feature Attributes



the setup and tear-down time. The jigs and fixtures have a capital cost; they must be stored, scheduled, moved, and accounted. Quality would also suffer. A characteristic that is a poor fit with in-house process capability will cause process variation. Potential quality errors due to potential misalignment or other factors are introduced every time a process is set up. Cycle time would also increase as a result of the setup and tear-down time.

Feature management recognizes the impact of feature attributes on a process. The extra cost and time needed to process features that are outside the sweet spot must be understood. Trade-off decisions must be made. Feature management sets up a loss factor cost table by studying the impact of varying product features on the processes. A loss factor table quantifies for each process the time and cost lost for each feature attribute. The loss factor table lists the product feature attribute, the specification range, and the loss factor. The loss factors can be stated in terms of a percent loss from the sweet spot or the reduction in output per hour.

The next factor to consider is process capacity. The ideal situation for new products is to use unused capacity of existing processes. Where there is not enough unused capacity, the organization has several options: acquire additional capacity, outsource the component, or eliminate less profitable products to free capacity. Each of these options has significant risk and life cycle cost implications. The key to world-class product management process is to raise these issues early in the design stage to allow adequate time to evaluate the alternative approaches and maximize life cycle profitability.

Product-Induced Process Variation

A significant source of process variation is due to a mismatch of product features to the organization's existing processes. The approach is based on standardization of product components, minimized material movement, and visual control of work itself instead of after-the-fact remote control by records. A process variation that is a direct result of a product/service feature must be foremost managed within the sales and product/service development processes and, consequentially, as a driver of capital investment in operating groups.

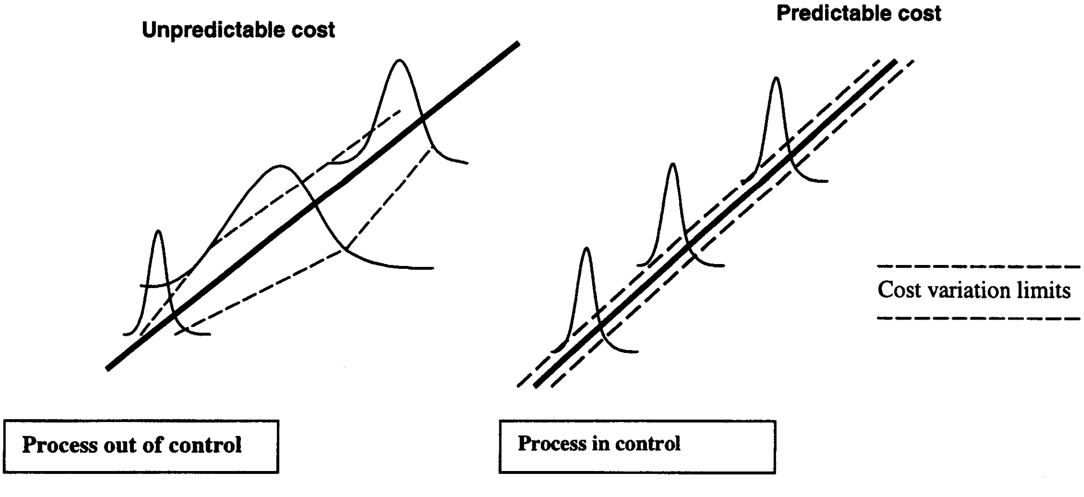
The impact of taking orders for products/services with features that are unsuitable with internal process capabilities ripples throughout many of the organization's processes, causing performance problems and thus directly affecting profitability.

A related problem with feature-induced process variation is that it causes variability in the output. An inconsistent output causes losses in downstream processes and ultimately in customers. The cost of process variation shows up in activities that deal with the consequence of the variation. Often these activities are later steps in the business process. Downstream activities that receive the output must adjust their processes to compensate for the output variation. In the best case, these adjustments slow down the process, resulting in unfavorable cost variances. In the worst case, the output must be scrapped or reworked, resulting in wasted resources. Repeated variations cause additional activities, such as inspection, that are not necessary if the output was consistent. These costs are typically "hidden" within traditional accounting systems are termed non-value-added.

Predictive accounting requires processes to be in control and consistent. Processes that vary widely result in unpredictable cost. Activity cost is an average of all occurrences of an activity during a period of time. A process that is out of control will have results that vary widely around the activity average. A process-based accounting system will be of minimal value when projecting cost for processes that are out of control. The projected results will be valid only where there is an equal amount of above-average and below-average performance (see Figure 8.4).

Conversely, a process that is in control has predictable cost. There is a small deviation around the average activity cost for processes in control. The resource consumption for activities in control is predictable. Thus, it is essential that a process-based accounting system be implemented in conjunction with

Figure 8.4 Valid and Invalid Results



a quality improvement system, such as six sigma or total quality management (TQM).

To illustrate why process variation distorts current accounting practices, assume an employee is paid $20.00 per hour, or $160.00 for an eight-hour workday. Also assume it takes a worker one-quarter hour to assemble a product. There is a planned cost of $5.00 per unit of product for the worker. As long as the worker completes 32 products per day (eight hours divided by one quarter hour per product), the planned labor cost is properly absorbed. If the employee assembled 34 products during a day, there is a positive variance and the labor cost per unit is lower than planned. Conversely, the next day the employee may complete only 30 products. Accounting reports an unfavorable variance; the labor cost exceeds the planned cost and explanations are expected. However, in reality the differing productivity is due to random process variation. The process is in control and producing as expected. Certainly the labor cost per product should not change since the product was not the source of the random variation—the process was the source.

Another important feature of predictive accounting is that the quality system must be implemented enterprise-wide. To install a strong quality system only in manufacturing is not acceptable. The quality system must also be implemented in all the support departments because predictive accounting seeks to manage all costs in an organization.

Perpetual Planning

Perpetual budgeting constantly calculates a revised estimate of resources needed by processes as events occur. It enables management to adjust actions immediately to respond to changes in key events.

Today, planning and budgeting are most often done on a fiscal year basis. As key events occur that obsolete planning assumptions, the plan and budget need to be revised and resources reallocated. A key element of perpetual planning is to be able to filter out expected events where the actions of one department affect other departments. Replanning should be triggered only when a key event is detected that necessitates an update to the plan. Another essential element of perpetual planning is to determine the true capacity of operations and how events influence the capacity.

Perpetual planning requires an integrated accounting system where a change in any key events ripples through the organization, sending new requirements to all the affected groups. Predictive accounting uses processes, products/services, and features to establish links between major events and the affected groups.

THE PRODUCT MANAGEMENT PROCESS

Let's return to the product management process. Using the new process vocabulary, several critical factors affect the product management process's ability to create value. Key among these factors include the following.

1. Determine customer requirements. Customer requirements should be stated in terms of product features and performance targets. There is a hierarchy of product features and performance attributes that contribute to customer satisfaction. The customer expects certain minimum features and performance levels. These include fundamental capabilities that must be present to meet the essential operational, safety, and reliability needs of a product. Failure to meet these basic requirements causes customer dissatisfaction. For example, coal must have a minimum level of BTU to provide the required heat. Dissatisfaction results when a product fails to satisfy a customer's basic expectations.

The next higher level of features and performance attributes is optional but helps differentiate products among competitors. The success or failure of a product normally depends to a great extent on this bundle of features. Customers often make purchase decisions based on these differential features. Alternatively, features that have minimal value to a customer merely drive up cost. Examples of differential features include the number of gears on a mountain bike, or the type of tire on a racing bike. Excitement features are innovations that the customer is not even aware can be achieved within the existing technology. Even seemingly minor items that customers perceive as superior value can represent a major competitive opportunity. An example is a new lightweight metal.

One of the first steps in the product management process is to determine the product features and performance attributes that satisfy customer needs. Marketing research starts by determining customer needs in an identified market segment. The customer requirements are often referred to as the "voice of the customer." Stating customer needs in terms of features avoids the common problem of general, vague terms; it is difficult to develop a product design without a further detailed definition. For example, a customer requirement for a bicycle might be "good ride over mountains." This requirement would be stated in terms of product features: mountain bicycle and performance specifications for a "good ride." These attributes might include the amount of human effort required per angle of grade and also smoothness of the ride.

Features are an integral part of a competitive analysis. The competitive analysis considers the strengths and weaknesses of the product features relative to the competition. It uses customer and market research surveys, customer meetings, or focus groups to compare product features against the competition. It identifies price points and market segments for product features under evaluation. It studies warranty, service, reliability, and customer complaint activities to identify areas of improvement. A technical competitive assessment compares product features of the best competitors' on the basis of conformance to the targets and specifications previously established for each of the design requirements.

The competitive assessment should be used to refine the customer needs. Where competitive product features rank high, even significant improvement would offer little opportunity for differentiation, because improvement would bring the product only up to the level of the competition. A strategy of imitation rather than innovation is therefore suggested. However, where competitors are vulnerable yet the feature is important to the customer, technical innovation can differentiate an organization's product from the competition's and create an excitement feature. Feature management illustrates how to migrate the product management vocabulary to terms that are understood by all groups in an organization.

The role of requirements in creating value is a double-edged sword. A product's value creation potential is directly related to the effectiveness of an organization in determining its customer's requirements—including their unspoken needs. Value can be maximized only when the product introduction team properly assesses customer needs and competitive products. However, requirements also constrain the product management process. Requirements limit the design and processing options. Where there are constraints, there is higher cost.

Unfortunately, constraints come not only from the customer requirements but also from the management team who controls the product management process. The constraints imposed by management, either explicitly or implicitly, have a far greater impact on competitive advantage than those imposed by customers. Management often ignores early warning signals in an effort not to rock the boat. In the past, these constraints have largely been ignored. The challenge for the product management process is to recognize and model these constraints as they relate to new products.

2. Set a target cost. A target price is set by estimating the demand for the product's bundle of features relative to competitive products. Features are defined, a price point is selected, and the targeted quantity to be sold is determined. The target price less targeted profit is used to set the allowable target cost.

Estimate the actual product cost. Today design engineers often use parametric estimating as the prime method of estimating product cost. Parametric estimating applies equations that describe the relationships between cost, schedule, and measurable attributes of a product. ABC combined with life cycle costing is a much more accurate and reliable tool for estimating product cost. Life cycle costing estimates the total cost of a product from concept to retirement.

3. Design products to meet performance targets. The design process involves activities that shape the product and create its structure in accordance with the product's form, fit, and function targets. Design provides a means of translating customer requirements into the appropriate technical requirements for each stage of product development and production (that is, marketing strategies, planning, product design and engineering, prototype evaluation, production process development, production, and sales). The design process establishes a measurable target or specification range for each component. Engineering translates design requirements into measurable target values. The product development process employs several commonly used design tools, including function analysis and quality function deployment.

Over 90 percent of a product's cost structure is locked in by decisions made during the development phase. The product design process translates customer-required features and performance targets into a product design by narrowing the design options to a final solution. The high-level product description is broken down into its components. The design process evaluates each component option relative to meeting cost and performance targets. This process continues until each objective is refined to a level that manufacturing uses to make the part. The best designs avoid having to make a later "fix" to overcome unnecessary production variation by using existing, stable processes. Activities that are required to "fix" a problem are non-value-added. Using existing processes also helps to avoid situations where the individual components fulfill their functional requirements without compromising another part of the product.

Cost data to support product design should be provided by an ABC system. Activity cost can be used to evaluate the degree of fit of alternative designs on an organization's manufacturing processes. ABC evaluates the impact of product features on available process capacity to highlight investment requirements. ABC data is needed when innovative product features result in the need for new manufacturing process capabilities. Each design feature locks in the potential range of manufacturing operations that are capable of producing the feature. Product features also expand or reduce production requirements, limiting manufacturing cost even further.

Design by features and ABC cost will help ensure that the product design has the lowest life cycle cost while delivering the targeted product features. Each design option selected should ultimately meet life cycle cost and performance targets. This involves making trade-off decisions to ensure the lowest cost while meeting quality and product introduction cycle time targets:

- The value created by products varies with the maturity of the product. In the early stages of a new product, value is based on product features that provide a new technology, concept, and/or service. As the product matures, competitors emerge and the basis for competition evolves to such factors as lower cycle time and improved quality and reliability. In the later stages of product maturity, price becomes the main basis of competition. Profit margins shrink as a consequence, forcing companies to focus on cost reduction.
- Match the product's features to manufacturing capability and capacity. The design process should use existing process capabilities and capacity to the maximum extent possible. Cost is lowest, quality highest, and cycle time minimized when existing processes are compatible with the product features. While the product may be new, the underlying processes must be capable and have sufficient capacity. A feature that exceeds basic capabilities of a process will be high cost and low quality and have long lead times. Features that require new processes will be subject to a learning curve until the process matures.

- Marketing uses high-level descriptions of product features and performance targets to describe customer requirements. Product features and performance targets are identified through market research that generates a clear understanding of customer needs and how the product will be used. To successfully develop product features requires the product development team to have a detailed and intimate knowledge of the customer, the fundamental function of the product, and actual conditions of product usage. Feature management and ABC help marketing communicate with both deign engineering and manufacturing.

How to Determine Necessary Modifications to an ABC System

Organizations that have implemented an ABC system are well on their way to adopting predictive accounting. These progressive organizations have recognized the importance of developing a process-based accounting system. They have defined activities and traced their general ledger cost to those activities. They have defined their cost drivers and routinely track the actual quantity of those drivers. All of these actions are commendable and essential prerequisites to adopting predictive accounting.

However, ABC systems have one primary objective—to better understand product and/or customer profitability. The objectives of predictive accounting are much broader. Predictive accounting seeks to understand an organization's underlying processes, how the processes create value, and the key events that cause variation in the processes. Because the objectives of predictive accounting are much broader than ABC, most ABC systems will need to be refined and expanded to meet the predictive accounting objectives. Keep in mind that it is not necessary to have implemented an ABC system to create a process-based accounting system. The use of process dictionaries and PC activity analysis tools will allow organizations to quickly and efficiently create the needed information.

The key factors in evaluating whether an ABC system is robust enough to support predictive accounting include the following:

- *Level of activity detail.* ABC systems often define activities at a high level. This approach has the advantage of being relatively easy to implement and maintain. Predictive accounting, on the other hand, requires a more detailed definition of activities.
- *Degree of process orientation.* ABC systems assign cost (activity) drivers to all activities. ABC systems permit a wide range of cost (activity) drivers. A cost (activity) driver can be almost anything that is quantifiable and where a reasonable relationship can be established with a product. Process-based accounting systems require the cost (activity) drivers to be output measures. Output measures mirror the process output and are both easy to measure and verify.
- *Degree of fit of the activity to process capability.* ABC systems calculate an average cost for a process. This average consists of mix of products processed during

the analysis period. The mix typically includes both easy and difficult work. In situations where the product mix varies, the activity average is skewed high if difficult work dominated during the analysis period or skewed low if easy products were most common. Use of an average activity cost will distort projected cost during a period with an entirely different work mix. Product features provide a means of differentiating between easy and difficult work. Few ABC systems currently have this capability. An ABC system can be converted to support feature management.

- *Capacity utilization of activity.* ABC systems trace general ledger cost to activities. This approach assumes full capacity utilization. Too little capacity results in bottlenecks and significant non-value-added cost. Too much capacity results in higher-than-expected cost. To measure capacity utilization requires the ABC system to identify resources assigned to an organizational unit. Predictive accounting requires a through understanding of capacity to predict future performance.

Each of these factors will be discussed in detail to enable you to determine the amount of work necessary to convert your ABC system to a process management system that is capable of supporting predictive accounting.

Level of Activity Detail

Process management underlies predictive accounting. Process management establishes the relationship between resource consumption and activity output. It seeks to understand a business in terms of its significant inputs, operational tasks and steps, outputs, and products/services (see Chapter 6, "Process Management—The Key to Creating Value"). Process data facilitates an accurate cost prediction by the insight it provides into what drives the workload, the root causes of process variation, and whether capacity is right-sized. Predictive accounting requires activities to be defined at a level of detail that separates significantly different processes. Significance exists where an activity consumes a substantial amount of resources—salary and wages, equipment, information systems, material, or other resources.

A technique for evaluating whether your organization has the correct level of activity detail is described below. The technique involves building a resource output table (see Table 8.1).

Table 8.1 Resource Output Table

Resources (general ledger accounts)	Outputs											

List the Group's Major Outputs. Through a brainstorming session, list the major outputs along the horizontal axis of the table. Limit the number of outputs to five to 10 depending on the size of the group.

List the Significant General Ledger Costs. The group's general ledger (GL) cost accounts and amounts should be listed along the vertical axis. Significance can be determined by using Pareto analysis. Pareto analysis requires sorting the group's GL costs from highest to lowest cost. Add the cost of the two highest cost GL accounts (resources). Calculate the percentage of total cost by dividing the sum by the total GL cost assigned to the group. If the percentage is greater than 80 percent and less than 90 percent, stop. Otherwise, choose the next most costly GL account and add its cost to the cost of the two highest cost GL accounts. Repeat the percentage calculation and comparison. Continue selecting the next highest GL cost account until the percentage of the total cost for these highest cost GL accounts exceeds 80 percent but is less than 90 percent.

Trace the Resource Cost (GL Accounts) to the Outputs. Through a brainstorming session, trace each resource (GL cost) to the outputs that consume that resource. One hundred percent of all resources (GL cost) should be traced to process outputs. Sum the resources (GL cost) for each output when you are finished with the tracing. The remaining 10 percent to 20 percent can be classified as "other output cost."

Sort the Outputs From Highest to Lowest Cost. Review the least-costly activities (bottom 20 percent of total group cost) for significance. Combine outputs where a low cost output can be reasonably classified as a suboutput of one of the more costly activities. Eliminate any low cost outputs that cannot be reasonably combined with a higher cost output. Even though you eliminate these low cost outputs and thus over-cost your high cost activities, the amount of over-costing is so small that it is insignificant.

Compare the Number of Activities to the Number of Activities Defined in the Resource Cost Table. Compare the current list of activities for the group with the number of outputs in the table. Where major differences between the number of activities and outputs (defined using the above procedure) is where there exists a need to update the activity analysis to support predictive accounting.

Degree of Process Orientation

Predictive accounting relies on a process definition of activities. You can use the resource cost table you developed in the previous step to evaluate if your organization's existing activity definitions are process oriented. You have a process-based activity system where there is a strong correlation between your current activities and the activities and outputs defined in the table. It is particularly important that the cost drivers in your current activity system use output measures. The evaluation would ask the following questions.

- *Is your activity cost driver the output of the activity?* A process-based activity defines the process in terms of its output. The activity describes how the output is produced. For example, some of the significant outputs of a payroll department would include payroll checks, processed time cards, maintained employee records, compliance reports, and internal reports. The corresponding process activities would include "pay employee," "process time cards," "maintain employee payroll information," "prepare compliance reports," and "prepare payroll management reports."
- *Is your activity output easily measured?* Review your activity outputs to ascertain whether it is easy to collect volume of outputs processed. For example, a common output of a help desk is the number of calls received. If you have an automated call system, the statistics are easy to collect. You do not want to manually collect the data—that would be time-consuming and is prone to error. Determine alternative outputs where volume statistics are impractical to collect.

Accounting for Process Variation

Ask the following questions to determine whether your ABC system considers process variation:

- *Have you tied your quality initiative—six sigma or total quality management (TQM), for example—into your ABC system?* An important role of ABC is to accurately trace your GL costs to activities and then to products, customers, and other cost objects. As previously discussed, cost is not predictable where a process is out of control. Unpredictable cost negates many of the advantages of an ABC system. Many progressive organizations have implemented six sigma or TQM systems to minimize process variation. However, very few organizations have tied their quality initiatives to their ABC system. The power of this approach is that it states quality issues in monetary terms. Many quality systems have failed due to their inability to communicate the relevant financial impact of the program. A second purpose is to provide a reference point for judging the reliability of the ABC system.
- *Are your quality initiative and ABC systems enterprise-wide?* Both the quality system and ABC system must be enterprise-wide to be effective. To determine whether the systems are universally embraced, go to each department and randomly ask employees about their knowledge and application of quality and ABC tools.

Input Degree of Fit With Process Capability

An important aspect of predictability is being able to understand a process's capability to handle easy and difficult work. Every process is designed to efficiently process inputs with certain characteristics. This is known as process capabilities. Problems occur when the inputs or the environment are radically different from the process capabilities. For example, during the Gulf War, several important weapon systems were less effective in desert conditions. The blowing sand adversely affected some critical equipment.

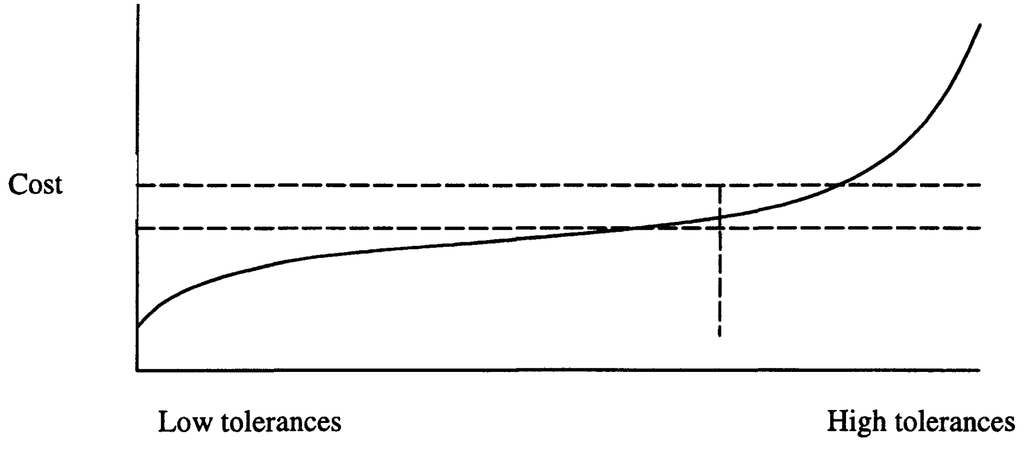
The average activity cost includes both easy and difficult work. Activity averages are meaningful as long as the mix between easy and difficult work does not change. Unfortunately, workload mix changes regularly in many businesses. Predictability requires that the activity average process time be adjusted for the degree of difficulty of processing the input.

To illustrate this point, consider a product's tolerances. Different milk products have diverse septic requirements (amount of bacteria allowed in the product). Milk products that are refrigerated have a higher septic tolerance than products that have a long shelf life and do not need to be refrigerated. Cost is fairly predictable for a wide range of septic tolerances. Only products with low or high tolerances need to have the average activity cost adjusted up or down to remain predictable (see Figure 8.5).

Ask the following question to determine whether your ABC system considers feature variation.

- *Do you use a cost estimating system that adjusts for product features?* Product cost estimation is the most common use of a quasi-feature management system. Many cost estimating systems assess the similarities of the features of a product and then use a "same as except" logic to adjust the cost of a similar product to an estimate of the new product. The problem with traditional cost estimating systems is that they do not analyze the effect on the process of different inputs for the new products compared with their current process capability. Although the product may be similar—milk versus cream in coffee—your choice will produce a different cost, required quantity, and taste.

Figure 8.5 Adjusting Average Activity Cost to Maintain Predictability



Capacity Utilization Determination

Cost predictability depends extensively on capacity utilization. Process analysis seeks to understand the resource consumed in producing a unit of output. Consider the situation in which a payroll group expends 400 hours to produce 4,800 payroll checks. It requires an average of seven minutes to process one payroll check. This resource consumption requirement to produce an output is independent of available capacity. In other words, it doesn't matter if you have too many or too few payroll clerks—it still takes seven minutes per check.

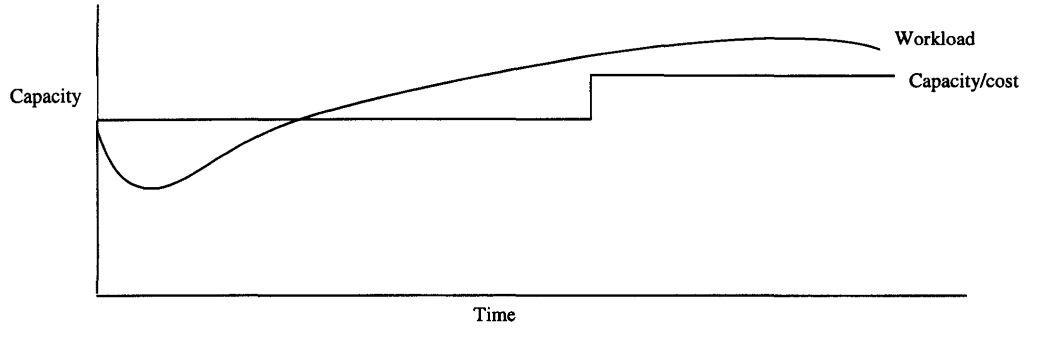
Process cost, however, is intertwined with resource capacity utilization. This is because most resources are purchased in discrete quantities. Take for example a worker. The worker is paid for being available to work during the workday. A person is paid regardless of whether there is sufficient work to keep the person busy. Conversely, when work exceeds the worker's available time, quality falls and performance degrades. Consistent cost depends on rightsizing capacity (see Figure 8.6).

Ask the following question to determine whether your ABC system considers capacity:

Does your ABC system take costs directly from GL to activities? ABC systems that take GL directly to activities do not separate unused capacity. An ABC system does incorporate capacity adjustments when it assigns GL cost to resources (with a quantifiable capacity measure) and then assigns cost from resources to the activities processed by the resource. To illustrate capacity adjustments, consider an employee as a resource. Assume a salary and wages of $40,000 for a payroll department. Let us further assume there is one payroll clerk that processes time cards (5,200 time cards annually), produces payroll (52 payroll runs), and maintains employee records (100 employees). A traditional ABC system might distribute the GL cost as follows:

GL	Salary and wages	$40,000
Activities:	Process time cards	$12,000
Produce payroll runs		$ 8,000
Maintain employee records		$20,000
		$40,000

Figure 8.6 Rightsizing Capacity



A process-based system would look at the resources and activities in a similar manner but would include outputs to be able to compute a process rate of resource consumption per unit of output.

GL Resources	Salary and wages PR clerk	\$40,000 (1 @ 2,000 work hours per year)
Process time cards:	7 minutes × 5,200 time cards	= 36,400 minutes/(60 minutes/hours) = 600 hours
Produce payroll runs:	7.69 hours × 52 payroll runs	= 400 hours
Maintain employee records:	10 hours × 100 employees	= 1,000 hours
Activities:		
Process time cards	\$12,000	(600 hours @ \$20 per hour; \$12,000/52 payroll runs = \$231 per run)
Produce payroll checks	\$8,000	(400 hours @ \$20 per hour; \$8,000/52 payroll runs = \$154 per run)
Maintain employee records:	\$20,000	(1,000 hours @ \$20 per hour; \$20,000/100 employees = \$200 per employee)
	\$40,000	

A process-based system would then use the rates and actual activity workload to determine resource use. Assume in our example that the workload volume doubled by the following amounts due to an acquisition:

Timecards	10,400
Payroll runs	52 (same number of payroll runs as before, 1 per week over 52 weeks)
Employees	200

Then the headcount requirement would increase to:

Timecards	10,400 × 7 minutes per timecard = 71,400 minutes/(60 minutes/hour) =	1,200 hours
Payroll runs	52 × 7.96 (hours per payroll run) =	400 hours
Employees	200 × 10 (hours per employee) =	2,000 hours

The new workload requirements come to 3,600 hours, or 1.8 payroll clerks. Many unsophisticated analyses would have assumed that since the number of employees doubled, then the workload for *all* activities in the payroll department must have doubled. What this example points out is that many ABC systems are at too high of a level to be useful for decision making. They come up with the wrong answer (double the number of payroll clerks) because they don't drill down far enough. They don't take into consideration that some activities (for example, produce payroll run) did not result in an increase in cost and time even though the overall workload for the payroll department doubled. The process analysis enabled the organization to consider the resource capacity as a basis for computing the capacity requirements before the acquisition.

Product Features in the Marketing Process

Marketing is a critical process for organizations that have products with significantly different features and performance attributes. It is important that the customer considers the product's features and performance attributes to be of significant value and that the customer clearly understands the value of the feature. Thus feature management (see the sidebar "Product Feature") is an important tool to help diagnose the market impact of an organization's processes on different customer requirements.

Product features should become an important part of a marketing department's vocabulary. Marketing is able to describe a product's requirements in terms of its high-level features and performance targets. The marketing staff uses its detailed and intimate knowledge of the customer, the fundamental function of the product, and actual conditions of product usage to effectively establish product features and performance targets.

All customer requirements should be stated in terms of an enterprise-wide product feature and attribute dictionary. Market research will show immediately whether the requirements are a good fit with current process capabilities. Product opportunities with a high correlation should be actively pursued. Products with a low correlation should be either abandoned or referred to a product development team comprising members from executive management, marketing, engineering, manufacturing, and finance. To provide one-stop shopping to customers and to prevent the competition from gaining a toehold, it may make sense to outsource production of components that are not a good match with current manufacturing capabilities. To introduce a new product with dramatically different process requirements is not necessarily a bad decision but it clearly is a strategic decision and must be fully considered by the management team.

Marketing must also perform a competitive assessment of other organization's comparable products. The degree of similarity among products can be determined by comparing product features and performance attributes. Competitive assessments reveal three conditions:

Product Feature

Bicycle
- City
- Racing (performance specification)
- Mountain (performance specification)

1. Products with similar features and performance attributes can be differentiated by price, company image, or customer service.
2. A competitive assessment of competitor's product features will reveal competitive disadvantages where certain features are highly rated by the customer. In this case a company has several options. First, it can try to offset the disadvantage by bringing the organization up to the level of the competition. This imitation strategy provides little opportunity for differentiation. The organization must bring in significant improvement to close the customer perceived gap. A second option is to innovate and overcome the competitive advantage by offering a totally different feature option to the customer.
3. Product features and performance provide a competitive advantage. The organization should ensure the competitive advantage is being exploited and improvements should be directed at maintaining the advantage.

Product Features in the Engineering Process

Design engineers use the product features and performance targets identified by marketing to build a detailed product design. The designer has a catalog of all component features needed to produce a product feature. In the bicycle example (see the sidebar "Component Features"), a product feature such as city bicycle can automatically be broken down into its component set of features. The component feature list provides a starting point for determining the degree of fit between the product feature and the organization's manufacturing capability.

The design engineers translate the performance specifications into component design specifications, in turn, with measurable target values. Referring to the bicycle example, assume the company wanted to introduce a new bicycle that would be used in the city and would have an additional gear that would make it easier to climb a hill. The design engineer would evaluate whether the new "five gear" feature was currently in use on other models. If so, the performance specifications would be studied to determine the degree of fit with current processes. If not, a new feature would be needed. The design engineer would work with manufacturing to create the new feature.

Component Features

Bicycle frame
  Male frame (subcomponent)
  Female frame (subcomponent)
Bicycle wheels
Bicycle seat
Bicycle handlebars
Bicycle gears
Bicycle brakes

Design engineers would next evaluate alternative component features that satisfy customer requirements while simultaneously being compatible with manufacturing capabilities. A feature's ease of manufacture depends on how close the feature requirements are to the process sweet spot.

Design by feature permits very complex relationships between components to be analyzed. A component might possibly create conflicts in different components of a product. For example, in the design of a bicycle, a significant change in the gear could affect other components. In this case, individual may work to implement their design without realizing that it is compromising another aspect of the product. Adding a fifth gear may require a heavier frame, making the entire bike heavier. The heavier bike might offset any value created by having a fifth gear. Similarly, features can help to avoid the situation where a "fix" is adopted to cure a recognized problem without realizing that this action itself will create new problems.

The component specifications are evaluated to determine the degree of fit with existing process capabilities. A numerical degree of fit factor can be calculated. Such evaluation also makes it simple to verify the quality of the design activity and cross-check the translation of consumer wants into design requirements. The numerical degree of fit factor helps ensure a design that considers manufacturing and assembly issues.

Feature management allows designers to use their time more efficiently and productively by decreasing the amount of new design work required each time a part is to be designed. When a new part is needed, its various features (such as a fifth gear) and attributes can be listed. Then, an existing product feature with as many of these attributes as possible can be identified and retrieved. The only new design required is one that relates to attribute targets of the new part (for example, not requiring a heavier frame) not contained in the existing part. Because this characteristic of feature management tends to promote design standardization, additional design benefits accrue.

Product Features in the Operational Process

A product feature directly determines the operational activities needed to manufacture a component feature. Each activity is studied as a process. The process outputs are recognized. The resources assigned to the process are identified. The component features (for example, fifth gear) and their attributes are studied to determine their degree of fit to the process. A feature cost table is developed that relates feature attributes to the time it takes to process the attribute (see Table 8.2). A cost table is built for each significant feature attribute that affects a process.

A product cost is easily determined for a new product. The product features and attributes are used to determine activity cost adjustments that must be applied for all new products. A low cost adjustment indicates the product is a good fit to existing manufacturing capabilities. A high cost adjustment indicates a poor fit. Not only will cost be high, but also process throughput will be

Table 8.2 Feature–Cost Relationships

Activity: Mill–lathe Feature attribute: surface finish	Output per hour	Cost
1000—33 micro inches	Base activity cost	
32—15 micro inches	30	+ 100%

limited, creating potential bottlenecks. Bottlenecks create synergistic problems even for products that are a good fit to the process.

Feature management also is a powerful tool for capacity planning. Sales will enter a forecast of product sales that can be exploded by feature (for example, bike speed). The product features are broken down into component features (for example, smooth ride, so there is less drag). Component features are, in turn, decomposed into the activities that build the component parts (for example, grind or lathe). The activity quantities are converted into required process time. Required process time is compared to available process capacity. Thus operational management has a continual understanding of upcoming bottlenecks or excess capacity.

Product Features in the Accounting Process

It is the role of accounting to provide activity cost to support feature costing. This requires an organization to have implemented an ABC system. The ABC system should be updated to ensure all activities are defined using process logic. It is also important to make certain the activity information is being updated frequently enough to ensure accurate activity cost information.

Next, the accountants need to build a bill of activity for all features in the organization-wide feature dictionary. The feature dictionary contains features for all significant products and product families. The accountants will work with the engineers and manufacturing to develop the feature cost tables.

SUMMARY

Product management is a key factor in creating enterprise value. Every organization requires a healthy portfolio of products and services to survive in today's highly competitive business environment. Predictive accounting seeks to measure an organization's storehouse of product value. It provides the data necessary to support the product management tools—target cost, design to cost, ABC, and feature management.

9

Using Reliable Performance Measures For Maximum Effectiveness

A performance measure assesses the actual process performance compared to a target. Conducting a performance evaluation involves a systematic and analytical appraisal of the financial and nonfinancial performance for a work group. It diagnoses the efficiency and effectiveness of the work group's operational results and measures the value its work creates. The objective of performance measures is to improve decision making, resource allocation, and accountability of actual performance. To be effective and constructive, the performance measures must be reliable, based on objective information, and lead to action.

The balanced scorecard advocates the importance of using a balanced combination of financial and nonfinancial performance measures. Strategic management advocates the importance of deploying strategy through the performance measurement system. Few in the business community would disagree with the importance of either concept in helping achieve world-class performance.

Yet in spite of the broad agreement in principle, few organizations rely on performance measures as the cornerstone of their management system. The reported financial results remain senior management's primary focus. While most companies experiment with performance measures, few elevate its importance beyond that of a tool—a tool to help improve financial performance.

A couple factors contribute to this diminished role. First, outsiders judge business success primarily by the financial numbers. The prominent importance of financial measures is reinforced by external reporting requirements that largely ignore nonfinancial performance measures. Second, an enterprise is composed of very complex relationships that make it problematic to select a limited yet effective set of performance measures.

In this environment, many managers bemoan the lack of relevant information that is needed to run an organization. To fill this void, the management team has turned to an increased usage of databases and spreadsheets to manipulate raw data. They often spend an inordinate amount of money on software that integrates business system modules. They make huge investments in computer networks to access and report data. In spite of these massive expenditures, many organizations still believe they are data rich and information poor. There are still too many surprises and feelings of helplessness in dealing with problems. Organizations remain too reactionary. So while we have more numbers than ever before, we need these numbers to give clearer signals than those provided by our current performance measurement systems.

This chapter will show you how to:

- Deploy performance targets to processes
- Use control charts to eliminate the need for a multitude of performance measures
- Establish an effective strategic plan by measuring processes performance.

ROLE OF PERFORMANCE MEASURES IN DETECTING PATTERNS

The goal of performance measurement is to develop a rigorous, repeatable, and verifiable method of understanding performance results. Performance measures should provide a statement of the organization's aims and dreams and form the basis of a manifesto of intent. A powerful performance measurement system provides the manager with a clear understanding of why operational performance is good or bad. The measurement process must bring to light the various effects of process decisions. It enables the management team to identify specific factors that contribute to or detract from the successful attainment of performance goals. This knowledge will enable the manager to make well-informed decisions. A good diagnosis will lead to the right prescription.

Two major factors determine whether a performance measure is useful. First, the measure must detect a meaningful pattern. The reality is that if a business has a history of repeated patterns recording separate, yet hauntingly similar events, it may have common underlying causes for these events. Bold obvious patterns scream for recognition. The process data reflects a seemingly endless string of events that depend on other events—a string that needs interpretation. Such patterns demand an explanation. These patterns can be understood by observing the processes.

A second factor is the utility of the performance measure itself. We often seem to measure for measurement sake. If performance data is known, what actions will result? One does not really need the performance measure where the system detects signals that cry for resolution but management takes no action. The data is generally irrelevant to a user who does not act.

The challenge of creating a performance measurement system is enormous. An enterprise's results depend on the performance of hundreds of thousands of micro processes. Therefore, management can never deal with truth, in the sense of a precise correspondence between the measures and the described business events. This imprecision immediately gives rise to an important question. If an enterprise is extremely complex and everything is connected to everything else, how can we ever hope to understand anything? Because all processes are ultimately interconnected, to explain any one link we need to understand all the others, which is obviously impossible.

What makes it possible to build an effective performance measurement system is that, even though the exact behavior of the individual micro processes can not be precisely determined, there are definite definable patterns that can be detected. Performance understanding progresses by finding tentative answers to a series of increasingly subtle questions that reaches increasingly deeper into the essence of how the process works. Patterns give rise to observed regularities that can be statistically measured. *Therefore, performance measurement systems must use statistical and probability methods to detect a pattern and signal.*

The first role of a performance measurement system is to detect patterns that shed light on how the processes operate and why they deliver observed results. Patterns, intervals, and repetitions govern a business. Patterns set up expectations. Patterns tell us where we are. To perceive a pattern means that we have already formed an idea of what's next. The punch line of a joke tells us that a set of events we thought belonged to one pattern was really, all along, part of a different pattern.

Performance measures monitor process performance data to confirm meaningful patterns, the traces of activity that are constantly played out by these processes. These elements, juxtaposed with the pattern of history, are the ingredients of a much richer view of the business world. Patterns provide the reason why cycles of historical business events reoccur. These cycles, whether over days or years, share a poignant similarity. To search for patterns is to recognize that a business is not a lengthy series of isolated events, but rather the result of a set of regular, repeated processes that react in predictable ways with external events.

Patterns are coded messages; once the key is discovered, the pattern can be read like a story. The recognition of rudimentary process patterns can have a profound consequence to an organization. We wrestle with the pattern and sometimes we end up seeing performance results differently than we did when we began. Along the way, we see how process performance can be inferred from patterns. The recognition of patterns—the real data of management—leads to a generalized and coherent management system for running an organization.

A pattern exists because there are regularly occurring sets of conditions that influence a process—dampening it at times and triggering expansion at other times. Were business performance to result from isolated events rather than patterns, chaos would rule. Everything would be unique and one-off. But this is not the case. Patterns triumph and random events are the exception.

At the heart of performance measurement is the search for recognition and pursuit of patterns in numbers. The evidence becomes persuasive when the patterns begin to make connections among events. Patterns pose a question about why certain performance results are observed. And, perhaps counterintuitively, it is also patterns that suggest the answers to those questions (see the sidebar "The Levi Strauss Experience").

The patterns associated with processes are derived from very few factors. Economic and physical forces prevail. Processes make patterns because they cannot do otherwise. As a simple example, if you introduce titanium products into a machine shop configured to process soft aluminum, bottlenecks, quality problems, high machine maintenance, and late deliveries will follow. The patterns that emerge are inevitable. Constraints govern processes and constraints lead inevitably to patterns.

Even though patterns have a story to tell, the story is not always easy to discover. Too often we look for patterns that merely reinforce our predetermined ideas. In other words, our conclusions are tainted by the way we look at something. For example, a performance measure used in the health care industry monitored the cost of medical procedures by doctor. It detected a significant cost disparity by individual doctor. The analyst suggested the hospital fund a training program for the doctors to lower the cost of the medical procedures. Looking at the same data by medical procedure rather than by doctor revealed that most of the variation resulted from a single procedure. A better solution than training the doctors would have been to understand why the variation was so large for this procedure. It is such a two-way street—the search for more apt measures to explain business events and the search for new ways of seeing the causes of events that result in understanding to "pop out."

The more patterns can be repeated, the more a process can be documented and the more confident managers can be of the anticipated results of a process—whether or not they appear to agree with the prediction arising from the model. One event is tantalizing, but it is the repetition of the results that builds confidence in the reality of a pattern. Once confronted with essentially similar results, managers can either congratulate themselves that the model was confirmed or return to the chalkboard to try to puzzle out the unexpected that is sure to happen in the future.

A second important role of performance measures is to understand relationships among processes. Consider that an enterprise is a set of processes

The Levi Strauss Experience

Levi Strauss implemented an activity-based management (ABM) system. After defining the activities of each sewing cell, they identified the root causes of problems affecting its performance. Every cell identified thick or thin material, fabric color and nonstandard color thread as a factor causing poor performance. The pattern that emerged was that each of these factors was a feature of the product that did not match well with the process capabilities of the sewing cells.

nesting within other processes that are driven by events. Performance measures must be set up for each separate process (activity) and for each significant nest of processes—in other words, at all levels within an organization.

The performance of any process is never isolated; processes all follow from the interaction of the other parts, and the overall stability of their interrelations determines the performance of the entire enterprise. For example, when we see a network of relationships among leaves, twigs, branches, and a trunk, we call it a tree. When we draw a picture of a tree, most of us will not draw the roots. Yet the roots of a tree are often as extensive as the parts we see. In short, what we call a tree depends on our perceptions. It depends on our methods of observation and measurement. The method of questioning becomes an integral part of the chosen performance measures.

The properties of the nested processes must be understood within the context of the larger whole. The performance of an enterprise is more than the sum of the performance of every individual process. Enterprise measures arise from the relationships, synergy, and disharmony of the parts. Enterprise measures are obscured when they are only broken down into isolated process performance measures. What we call a process is merely an element within an inseparable web of relationships. Therefore, we need to measure both the parts and the whole.

If the enterprise performance is derived from the behavior of the individual processes plus synergy, we cannot ignore the individual processes. The process of developing performance measures must include a complete description of the individual process.

A third role of performance measures is to detect key events that will disrupt a process's equilibrium. Often patterns come to a breaking point that might result in stupendous changes, literally forcing a new look at present-day events. The September 11, 2001 attack on the World Trade Center is but one example. The results are wholly unpredictable from a simple extrapolation of the past process pattern. Performance analysts try to detect an upcoming break from an expected pattern, for which the analyst must then find a new pattern that will emerge after the key event.

As an analogy, were we to monitor the flow of a waterfall, we might detect a significant increase in the waterfall's rate of flow. This increase could not be predicted from the measurements taken at the waterfall itself. However, were we to monitor rainfall in upstream mountains, we could predict the future increase in the waterfall flow rate when we detect an unusually large rainstorm. The unusually large rainstorm in the mountains is an example of a key event that affects a downstream (no pun intended) process.

Patterns disrupted by key events will cause significant tension within an organization. The anxiety that arises from a crisis will cause the organization to take action. The adaptability of a process to adjust to the new set of conditions is central to survival. Organizational crisis manifests itself as a breakdown of the existing systematic balance and at the same time requires the organization to transition to a new state of balance.

Performance measures are an integral part of a process-based accounting system. Performance measures identify how well a process is performed. It measures the process efficiency and effectiveness. A process that is efficient and effective will deliver predictable results. Inefficient and ineffective processes deliver unpredictable results.

LEADING AND LAGGING INDICATORS IN A PERFORMANCE MEASUREMENT SYSTEM

To minimize reliance on historical information, the concept of leading and lagging indicators was introduced into performance measurement lexicon. A lagging indicator tells us what happened in the past. An example of a lagging indicator is on-time shipments. On-time shipment is calculated by taking the ratio of the number of orders that were shipped on or before the contractual shipment date to the total number of orders. This is a lagging indicator because it is calculated for a past period of time. A leading indicator, on the other hand, measures factors that cause subsequent results. A leading indicator of on-time shipments might be the number of schedule changes. A significant increase in the number of schedule changes might foretell a decrease the on-time shipment ratio.

The main problem with leading indicators is that no single performance measure can ever provide a complete and definitive understanding of a business. This is because all processes are connected in multiple ways to their environment. No matter how many connections we take into account in our performance measurement system, we will always be forced to leave others out. By focusing on the selected measures, we are often blindsided by other factors we choose not to measure.

The core of this problem is that organizations must make decisions on limited information. It is neither practical nor feasible to consider all relevant information. Some of the information is unavailable or too costly to collect. The practical consequence is that managers must make decisions based on limited information. It is still better to make decisions on limited objective information than it is to make purely subjective decisions. Take a custom home builder as an example. Some of the key factors that affect the builders' success would include the level of interest rates, an effective acquisition program, well-designed and constructed homes, an excellent brand image, and strong construction controls. There are assuredly other important factors that could and should be included. However, in the end we must limit the number of factors that we measure. The dilemma of what measures to include and which to exclude seems impossible to resolve; however, predictive accounting offers a new perspective on this problem.

THE NEED FOR A PROCESS-BASED PERFORMANCE MEASUREMENT SYSTEM

Much has been written about how performance measures should be process based. Some believe that processes are but one of several performance dimensions that are needed to support a robust performance measurement system. This chapter contends that processes should be the foundation of a performance management system. The resulting framework would incorporate a balanced scorecard and strategic performance measurement principles. Even more important, a process-based framework can integrate a wide range of other management tools, such as activity-based costing (ABC), activity-based management (ABM), six sigma, and total quality management.

Processes perform the work of an enterprise. Performance measures assess progress toward a predetermined set of goals or objectives. These relationships can be restated: A performance measure assesses progress relative to how well an organization's processes achieve its predetermined goals and objectives. In other words, performance achievement is an attribute of a process.

Patterns hold clues to how the process works, both at the macro and micro level. We must follow the evidence that internal and external forces continually act in predictable ways to shape process performance. Actual performance results provide testimony to the dynamic forces that we might plausibly evoke to explain such results. The present is a key to both the past and the future. Indeed, using knowledge of processes to confirm past performance while simultaneously interpreting the future is at the core of predictive accounting. It falls on the performance analyst to focus on the processes that produce the history and the future results.

A powerful performance measurement system by itself is insufficient to guarantee good results. A management team must use those measurements—that is, an enterprise must be flexible enough to adapt rapidly and successfully to the signals provided by the performance measurement system. An excellent performance measurement system is no better than how effectively management uses the results. Management must take action on the signals and must be prepared to take the difficult actions necessary to adapt to a changing environment gradually or, if necessary, on occasion, rapidly.

A PROCESS-BASED PERFORMANCE MEASUREMENT FRAMEWORK

A process affects performance results in two ways. First, the totality of the interconnections of all processes creates an enterprise-wide performance result. Second, each individual process has its own unique performance outcome. A performance measurement system must measure both aspects of a process.

There are some extremely interesting implications when one accepts that processes should be the foundation of a performance measurement system. These implications can be stated in terms of a set of performance measurement principles. The process-based performance principles follow.

1. *An in-control process delivers consistent and predictable results.* The implications to performance measurement are enormous. *A performance measurement system should never measure the results of a process.* Performance results depend

on the process capabilities and the degree of variation inherent in the process. It is a waste of time to measure the number of errors, late outputs, or cost overruns. These results are inevitable in a process that is out of control. All such measures should be stripped from a performance measurement system. They should be replaced with process control measures. Once established, these measures must be constantly monitored and action taken only when there is a significant change to the process.

2. *Performance targets are what the customer or executive team wants performance to be.* Again, the implications to performance measurement are enormous. *A process can deliver performance only within certain limits depending on its capabilities.* There is no guarantee that process capabilities will deliver the results expected by customer or executive team performance targets. It is an exercise in futility to develop a top-down set of performance targets and then expect your current processes to achieve the targets. Each process must be evaluated to determine whether it is capable of delivering its expected results. Directed process improvements are the only means through which performance targets can be achieved.
3. *Performance measures should assess whether the desired outcome of a process is being achieved.* Every process should have a clearly articulated outcome. *A performance measure assesses progress relative to predetermined goals or objectives.* An outcome must be translated into quantifiable performance targets against which actual results can be measured.

Applying the process-based performance principles to a performance measurement system implies that it should consist of two elements—a process control element and an outcome-based performance measurement element. These two elements will be discussed in greater detail in the following sections.

Process Control Elements

Process logic tells us that an in-control process delivers good performance. Conversely, processes that are out of control or have negative relationships with other processes deliver spotty or poor performance. *The secret is to focus on measuring the process rather than performance results.*

To illustrate the difference, consider a traditional performance measurement system's attempt to assess the performance of the new product introduction process. One potential measure is the number of new products introduced versus planned. This measures the effectiveness of the new product introduction process to meet budgeted output. A value close to budget indicates the output is on plan. But there are other aspects of performance that should be measured. Shouldn't we measure the number of new products that were introduced on time? Or maybe we should measure the number of products that were introduced that met cost targets? Or, should we measure the number of new products that achieved sales targets? For any process, there are multiple dimensions to results that could and should be measured. This would necessitate the need for an exhaustive list of performance measures.

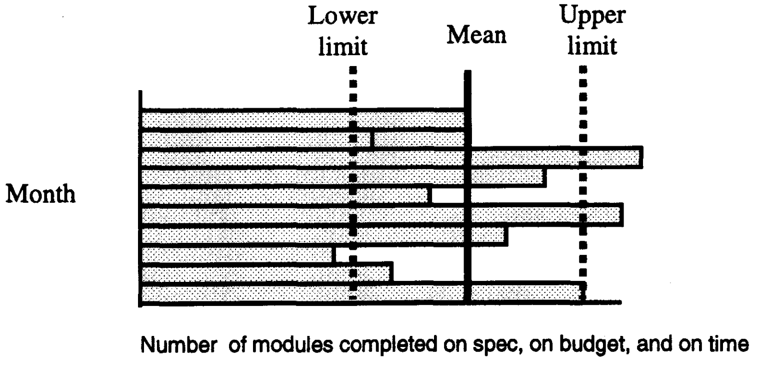
Measuring the process rather than the results dramatically reduces the daunting task of measuring performance. The process control approach measures whether the activities of the new product introduction process are in control. This involves setting up a control chart for the product introduction process and each of its major activities. The goal of the control chart is to ensure each activity and the overall process are in control and operating properly. If these conditions are met, we know that the targeted number of new products is being achieved and that the products are on cost and on schedule. Thus we do not need to measure the results directly. If the process is out of control, the goal of introducing new products will not be achieved, and we do not have to measure the results to determine this consequence.

Performance measures that evaluate performance results are "feel good" measures that do have a place in the total performance measurement process. They give the management team confidence that satisfactory results are being achieved. The problem with these measures is that they are far removed from the factors that cause poor performance—they identify problems, not solutions. Process measures, on the other hand, instantaneously detect problems and point to their root causes, enabling immediate corrective action to ensure superior performance.

To illustrate the control chart approach to performance measurement, assume the new product design process was broken down into design milestones. Each design milestone represents a step in the process. An output, budget, and schedule would be determined for each milestone. The number of milestones, converted to equivalent units, that were completed on spec, on time, and on budget would be tallied. A control chart for the process would be established.

The control chart tells us several interesting facts. It might, for example, show that the new product introduction process is out of control (see Figure 9.1). It is unreliable and thus unpredictable. It is not capable of consistently meeting performance targets. The organization does not need additional performance measures. It does not need its management to "brow beat" the people, nor does it need to revise the performance targets. What must be done

Figure 9.1 Out-of-Control Process



is to improve the process. Failure to improve the process will result in poor financial performance and, ultimately, downsizing.

Now let us look at the same new product introduction process, but this time it has different results (see Figure 9.2).

This control chart tells us that the new product introduction process is in control. It is reliable and thus predictable. It is capable of consistently meeting performance targets. The organization does not need additional performance measures, but it does need management to reward the people and potentially to use this process as a competitive weapon to grab a larger market share. What must be done is to continue to improve the process by continual process variation reduction (six sigma).

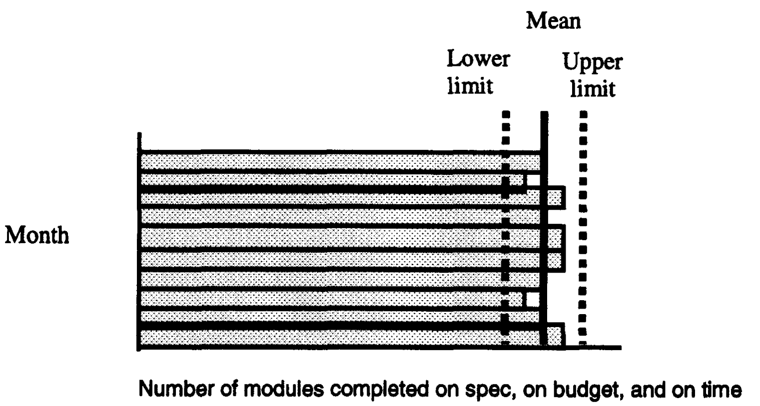
It follows that a world-class performance measurement system must directly measure process variation and be tied to an improvement program that constantly reduces process variation. When the process is in control, good performance results will be achieved. When a process is out of control, poor performance will follow.

Outcome-Based Performance Measures

All processes have a planned outcome. A process outcome should satisfy the user's requirements. Outcomes are intertwined with output specifications. Process outcomes are the voice of the customer. Few people would argue against the importance of listening to the process users and measuring how well the process meets customer objectives.

There are three primary approaches to measuring process outcomes. The first approach involves identifying a single performance measure. The advantage of this approach is its simplicity. The disadvantage is that no solitary performance measure can ever provide a complete and definitive understanding of process results. Whatever measure is chosen will exclude monitoring all other potential factors. It will also focus management's sole attention on a

Figure 9.2 In-Control Process



single factor leading to the inevitability of future exposure to problems caused by other factors.

A second method involves identifying multiple performance measures. The advantage is that management will focus on multiple measures, lessening the potential for a surprise. This approach minimizes the adverse effects of leaving important factors out. The problem with this approach is that it is very complex, due to the sheer number of measures. Too many measures merely confuse managers. Another problem is that some measures will show favorable results, while others will show less-favorable results. The user must then formally or informally weigh the importance of individual results relative to others to determine an overall effectiveness measure. Depending on arbitrary weighting methods makes the tool less useful. The comparative importance of each measure is a critical element in setting priorities.

The third, and suggested, approach is a hybrid of the first two approaches. This approach requires the process manager to specify process output specifications with the process users. For example, consider the activity of applying cash receipts to customer invoices. The process outcome specifications may include the following:

- To apply the cash to the customer invoice within four hours after receipt.
- To have no more than one pricing discrepancy for every 100 customer invoices.
- To resolve any pricing discrepancy within one working day.

An outcome ratio can be computed by dividing the number of cash receipts that meet the above criteria by the total number of cash receipts. The advantage of this approach is that it enables multiple requirements to be assessed within a single performance measure. It has a further advantage that it forces each process manager to specify and agree on performance outcomes with the users.

An outcome performance measure assesses how effectively a process meets customer needs. Outcome process measures reflect the voice of the customer but not the voice of the process. Therefore, while the outcome performance measures will tell you where you are, they will not tell you how you got there or how to fix under-performing processes. These measures do not provide any insight into how a process works, and thus these measures must be augmented with measures of process efficiency and effectiveness.

The balanced scorecard can be a useful tool in establishing a performance measurement system. The power of the balanced scorecard lies in its structure. The balanced scorecard solidifies an organization's focus on future success by setting objectives and measuring performance from four distinct perspectives.

1. *Financial perspective.* How do we look to our shareholders?
2. *Internal perspective.* How well do we perform at key internal business processes?
3. *Customer perspective.* How well do we satisfy our customers' needs? How do we measure up against the competition?

4. *Learning and growth perspective.* Are we able to sustain innovation, change, and continuous improvement through the organization's people and infrastructure?

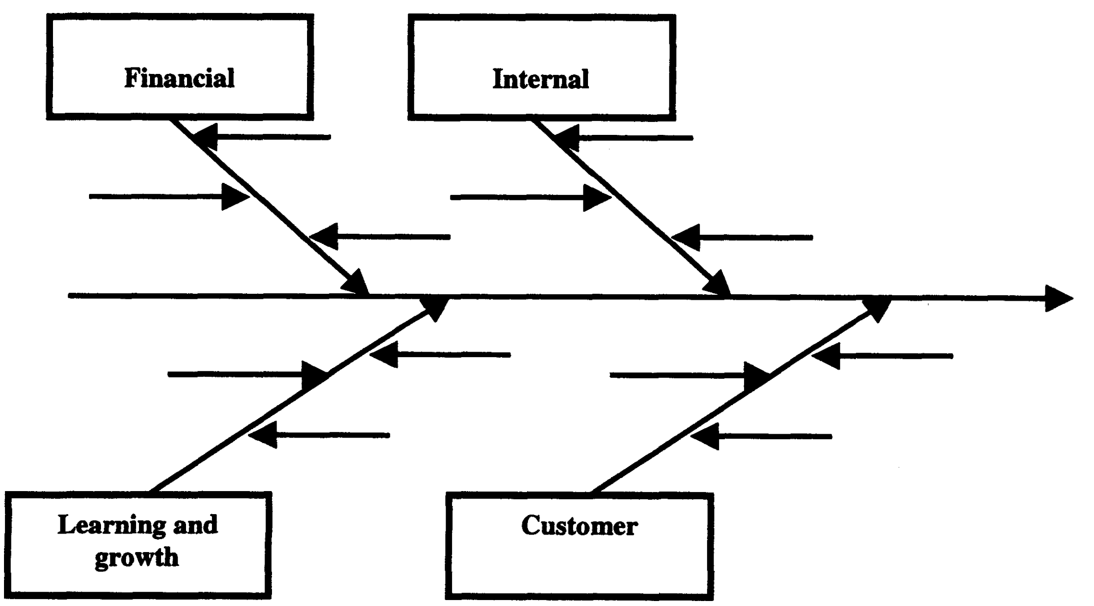
The balanced scorecard can best be thought of as performance measurement's equivalent to the Ishikawa fishbone diagram. The fishbone diagram shows that that are four factors to be considered when attempting to analyze a problem: manpower, methods, machines, and materials. A rigor is introduced into the analysis by forcing the problem to be viewed from all four dimensions. It is easy for an analyst who isn't using a fishbone diagram to overlook a critical source of a problem.

A similar structure is needed when setting outcome-based performance measures. It is easy to overemphasize certain measures depending on the experience and functional training of a manager. A richer set of outcome targets is possible by forcing a manager to consider all four performance perspectives (the fishbone diagram) as well as the balanced scorecard (see Figure 9.3).

IMPROVING PREDICTABILITY WITH CONTROL CHARTS

The principles of process management are very simple. Performance results are directly related to the stability of a process. Process stability is directly related to the amount and distribution of process variation. Control charts should be used to detect changes to process equilibrium. The factors that cause process variation must be identified and constantly minimized. Once a process

Figure 9.3 Combination Balance Scorecard and Fishbone Diagram



is in control, it must be brought to higher levels of performance. And finally, key events that will significantly disrupt process performance must be detected and proactive action must be taken to minimize their impact.

Once we accept that a process forms the foundation of the management system, statistical analysis provides a tool to measure process performance. The key elements of a process-based performance measurement system include the following:

- Measure the amount and distribution of process variation.
- Detect signals rather than random noise by using control charts.
- Identify and eliminate the causes of process variation.
- Continuously improve stable, in-control processes.
- Identify key events that might disrupt a process.

The Amount and Distribution of Process Variation Must Be Measured

To measure process variation involves a two-step procedure. The first step is to determine the key performance factors to be measured.

Step 1. Identify the Key Performance Factor

A key performance factor is one that is directly related to process performance. Typical performance measures include time, resource, cost, and outcome achievement.

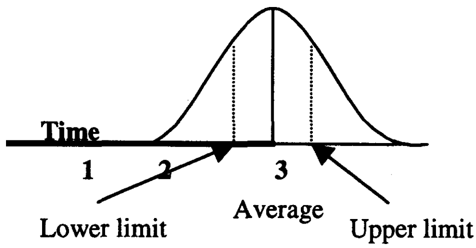
Time. Time is an excellent measure of process variation. All business events have a time component. The time depends on the process structure, its relationship with other processes, and the compatibility of the work with the process' capabilities. To illustrate this concept, consider the activities involved in producing a bicycle handlebar (see Figure 9.4).

Process theory states that all processes vary. Each execution of the process will result in a slightly different time. Assume the "produce component" activity takes an average of three minutes per handlebar to complete. This average includes both good and bad performance. Statistically, we would expect the actual times to vary between two and four minutes. The actual average time per handlebar is plotted on a time series graph (see Figure 9.5). The behavior of a process over stretches of time provides managers with an opportunity to

Figure 9.4 Time Measurement of Process Variation

Prepare for production	Produce component	Move to pick up area
30 minutes per batch	3 minutes per handlebar; 90 minutes per batch	5 minutes per batch

Figure 9.5 Actual Average Time per Handlebar



grapple with patterns of performance. Such patterns of historical events are encountered repeatedly in the data provided by accountants. The goal is to document the process's performance patterns.

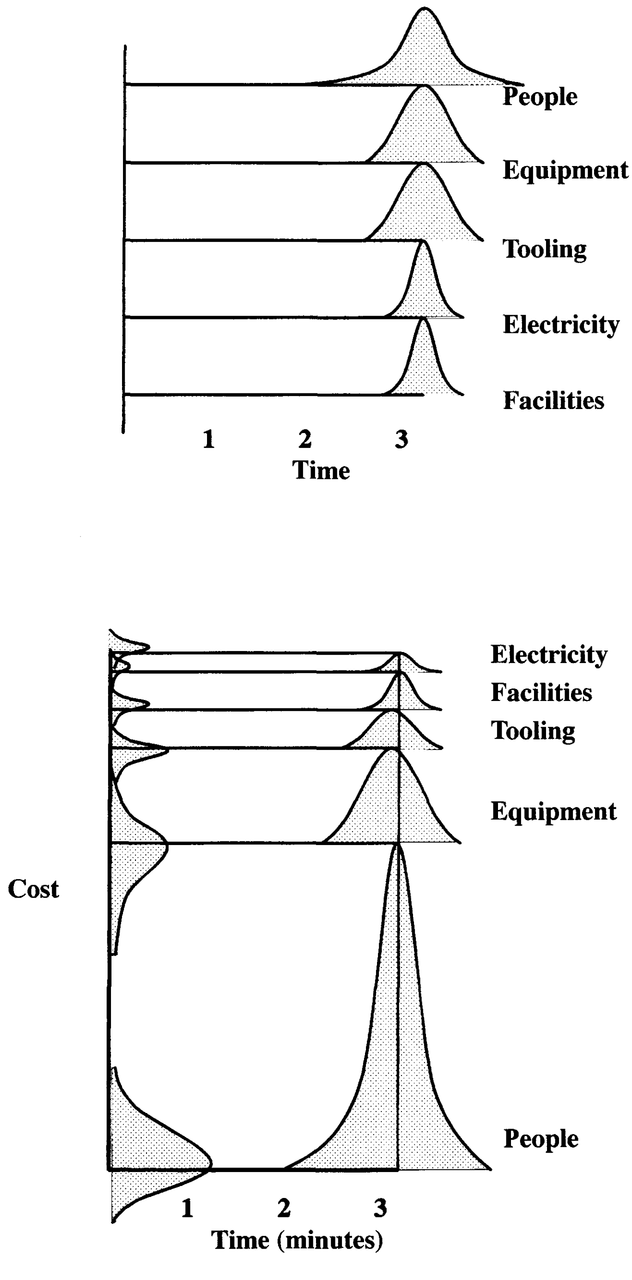
Resource Type. Another important factor that causes process variation is the type of resource—people, equipment, tooling, electricity, and facilities—that is required by the "produce component" activity (see Figure 9.6). Each type of resource will cause the process to vary to a greater or lesser degree. People are typically the greatest cause of variability—people get tired and loose mental concentration. Other factors that affect people's variability include motivation, training, experience, physical capabilities, and process complexity.

Equipment is less variable than people. Machine and tooling will wear out if not properly maintained or pushed beyond its capabilities. Power outages will cause a process to take longer, but the occurrence is infrequent (unless you work in California with their frequent brownouts). Facilities with improper layout or that are improperly cleaned or maintained will cause wasted time.

Cost. Cost is another common performance factor that can be used for process control. Cost is often employed because it is of paramount interest to management. Profit (revenue less cost) is the force that enables a business to survive. Financial performance is the ultimate measure of success for a business. Senior management's compensation and, ultimately, survival are based on providing a market-driven return on investment. Without an understanding of the financial impact of operational measures, management must ultimately revert to historical financial results, thus bypassing the performance measurement system. Stakeholders permit senior management only a minimal period of time to deliver results. It is difficult to stay the course when the performance measurements require senior management to rely on faith that measures will provide long-term financial results. As a consequence, profitability remains the guiding force behind most decisions.

Yet in spite of the importance of cost, it is not a good measure of process variation in its pure form. Process cost changes with differences in what is paid for resources, as well as changes due to process variation. Therefore, a cost variation may be due to changes in resource cost rather than process variation.

Figure 9.6 Variation Due to Resource



The solution, if cost is the performance variable, is to hold cost constant by using a standard resource cost.

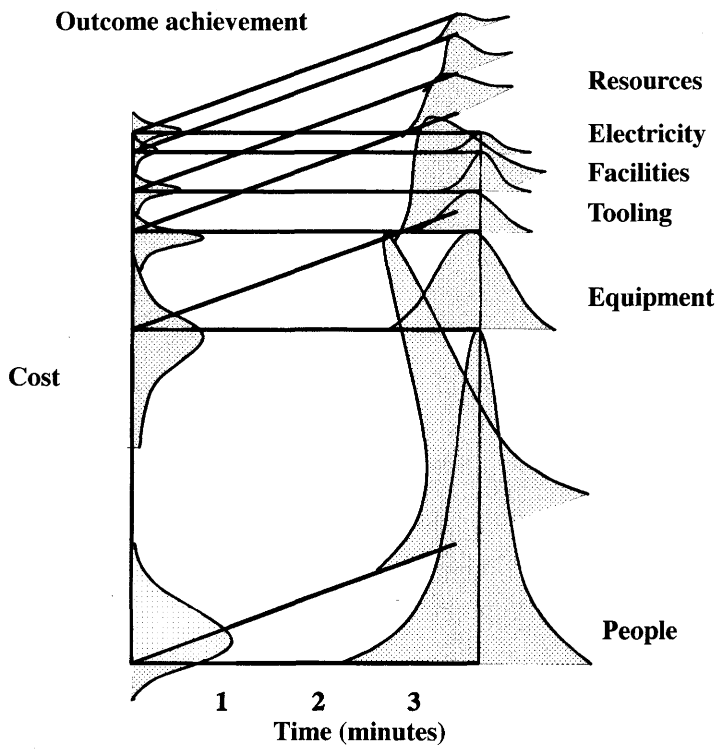
Outcome. A third process dimension is the outcome dimension. All processes have outcome targets. The stakeholders, customers, and the management team set the outcome target for each process. In the case of a production process, the outcome targets would include meeting tolerance specifications and scheduled time targets while meeting cost targets. A control chart would monitor the number of outputs that meet the outcome targets (see Figure 9.7).

Step 2. Decide How to Measure

The second step is to determine whether to measure process variation directly or indirectly. A direct measure can be used where you can gather the actual values of a performance measure with a high degree of precision. In our "produce handlebars" activity example, a direct measure is used where you are able to accurately determine the actual time spent on each handlebar. Direct measurement is easiest where resources are totally dedicated to a single process. For example, if one full-time person is assigned to producing a handlebar, we would expect that worker to produce an average of 140 handlebars per day (60 minutes per hour / 3 minutes per handlebar × 7 hours per day). We could set up a control chart to monitor the actual number of handlebars produced every day. Statistical analysis would suggest that the actual number of handlebars processed would rarely equal exactly 140, but rather that a range of expected values could be determined.

An essential prerequisite for direct measures is to separate used from unused capacity. Excess capacity will give false performance signals. In our

Figure 9.7 Outputs That Meet Targets



example, if the operator produced only 120 handlebars because of limited workload, the performance measurement system would give a false signal that the process was out of control.

Indirect performance measures are used where a precise determination of performance is impossible. A common rationale for using indirect measures is where a resource is employed in multiple activities. It is very difficult to accurately determine the time spent on each activity. A natural response on the part of most managers is to install a time-reporting system. Time reporting would appear to be accurate but, in reality, would be imprecise. The reason is the numbers cannot be any more accurate than the level of effort put forth on the part of the people who record the information. Many people consider time reporting to be an administrative burden and place more emphasis on completing the forms rather than being accurate. These people wait until the time reports are due and record how they think they spent their time. Worse still, some will record how they think their boss expects them to spend their time. (See Chapter 10, "How to Use Earned Value Reporting as a Feedback System," for a further discussion of time reporting.)

An effective indirect process measure is one that looks at the total bundle of processes assigned to a resource group. This approach accumulates the total workload accomplished during an analysis period for each resource group and determines how much time should have been spent to accomplish the work. The "should" amount of time is equivalent to a process standard and will be referred to as earned value time. We know the actual available time for the resource. We then subtract the earned value time from actual available time to compute an earned value variation. The earned value variation is plotted on a control chart to assess the stability of the bundle of processes. (See Chapter 10 for a discussion of earned value variation.)

The advantages of the earned value approach to performance measures are its objectivity and simplicity. It is accurate and objective because the actual number of outputs can be extracted from computer records and do not depend on a separate data-recording effort. It is simple because all the pertinent data is automatically extracted from existing business systems. The disadvantage is that it monitors variation for the entire bundle of processes rather than for each individual process. As a consequence, this approach does not identify the specific process within the bundle that is out of control. The next step in the performance measurement process will address this issue.

Control Charts Help Detect Signals From Random Noise

The control chart approach to the performance measures is more effective than comparing the individual values with a target. It is also fundamentally different. The control chart approach concentrates on the behavior of the underlying process instead of attempting to attach a meaning to each specific value of the time series. The control chart is essential to predictive accounting because it gives the user confidence that it is safe to extrapolate into the near future. Moreover, whenever it is reasonable to make this extrapolation, the control chart also defines the range of values that one is likely to anticipate in the near future.

Control charts help differentiate between expected and abnormal process variation. A process is in statistical control when the performance variable is within its expected range of possible values. Knowing when a process is in control helps to direct action to find and remove abnormal problems; it also tells you when to leave the process alone. When you take action to remove problems that do not exist—called tampering with the process—you may end up increasing the variation of the process and hurt performance. This is an example of a good intention gone wrong.

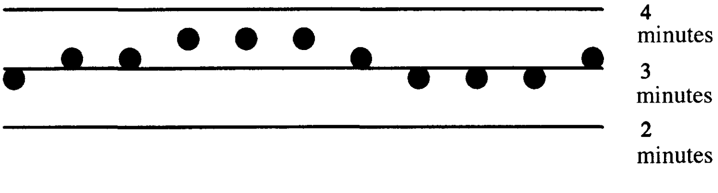
A control chart is simply a time series plot of individual measurements of a performance variable to which a center line and two horizontal lines called control limits have been added (see Figure 9.8). The center line represents the mean of the process when the process is in a state of statistical control. The upper control limit and the lower control limit are positioned so when the process is in control, the probability of an individual value of the output variable falling outside the control limits is very small. A common practice is to set the control limits where the probability of an individual measurement falling outside the control limit is less than three chances in 1,000.

Control charts are useful for evaluating the past performance of a process and for monitoring its current performance. We can use them to determine whether a process was in control during the past hour, day, week, the past month, or quarter. Our goal is to detect whether process data can be relied on to project future performance. Keep in mind that a primary prerequisite of predictive accounting is to have minimal variance.

Variation is the random and miscellaneous behavior of a process that undermines the ability to predict future results. Random, yet expected, variation is called process "noise." If not understood for what it is, noise will confuse and cloud all comparisons between single performance values. Until one can understand and exclude noise in a time series, one cannot fully understand the implication of a single performance value. A signal is where the data indicates a fundamental change has occurred to the process. While every data set contains noise, some data sets may contain signals. Therefore, before you can detect a signal within any given data set, you must first filter out the noise.

This is why performance measurement systems that do not use control charts to analyze data will always be at a disadvantage compared to those that do. Unless, and until, you make the distinction between signals and noise, you will remain unable to properly analyze and interpret data.

Figure 9.8 Time Series Plot



The Causes of Process Variation Must Be Identified and Constantly Eliminated

Process variation is due to external and internal factors that influence a process in a chain of cause and effects. These factors must be constantly identified and, where possible, minimized or eliminated. Many of these environmental factors are controllable.

A performance measurement system is effective only where there is action. A process must be improved when a control chart identifies a signal. The cause of the abnormal data must be researched and corrective action initiated. Similarly, where a control chart identifies a process with a wide range between the upper and lower limits, that process must be improved. Predictive accounting is of minimal value for those processes.

Action begins with an understanding of root causes. Throughout the enterprise we find processes nesting within other processes. All processes are interrelated with other processes. This web of relationships links processes together in a universal chain of cause and effect that determines how well a business performs. No event can occur without having a definite cause behind it. Good or bad performance is but the effect of some known or unknown cause.

For instance, if there is a machine breakdown, the operator will be idle or reassigned to another task while the machine is repaired. In either case the department's performance will be adversely affected. The machine breakdown is an event. The first level of performance analysis is to understand visible events. Accounting is based on event understanding. It records the operator time to the process where the machine broke down. The operator's cost will appear as an unfavorable variance to manufacturing. Did the machine breakdown result in productivity loss on the part of manufacturing? The answer, of course, is yes. Thus, according to event-incurred logic, performance is attributable to specific business events where they appear.

However, the knowledge provided by accounting for visible events is limited. We do not arrive at an understanding of why these events occur—we simply record that they did occur. We get the incorrect idea that events are separated and thus see our processes as distinct from each other. But when we go below the surface and seek the cause that produced the variation, tracing it back to its original source, we inevitably arrive at the knowledge that enables action.

If we analyze why the machine broke down, we might find, among other reasons, that preventive maintenance was not performed. The machine would not have broken down if proper preventive maintenance had been performed. More important, the machine will break down again sometime in the future if a preventive maintenance program is not implemented. A process-based accounting system cannot predict the exact time the machine will break down next, but it will unequivocally provide statistical probabilities of the likelihood for the next breakdown. No performance measurement system can be effective unless root causes are constantly identified and eliminated.

To understand performance, we must know all the key conditions that affect our processes. A key condition is any factor that is external to a process that affects its performance. A change in conditions results from a key event or any other factor that causes process variation. Root cause analysis enables an organization to move from the first to the second level of understanding performance. It enables us to augment our limited knowledge that an event occurred and where it occurred, to the higher knowledge of the conditions that caused the event. To understand performance, employees must trace the causes of events and become familiar with the conditions under which an effect is produced.

To detect problems without an integrated set of problem-solving tools would be a waste of an organization's resources. Root cause analysis is a powerful tool for reducing process variation. The approach begins by identifying the optimal performance level. It then identifies all the significant factors (root causes) that explain why current performance is different from the optimal performance. Root cause analysis begins with an understanding of variation. It requires the factors that cause process variation to be identified and traced to the root event, or missing event, that caused the problem. The magnitude of the problem is assessed and an improvement team put together to fix the problem.

In the chain of cause and effect, it can be shown that each effect is latent in the cause and each cause is latent in the effect. With the help of this understanding, we can easily explain why one individual process behaves in a certain way, or why performance is excellent or terrible. One event is both a cause and an effect at the same time. A process that is affected by a previous process will, in turn, affect other downstream processes. Thus an event can affect the whole enterprise, producing various kinds of effects.

Today's performance is a consequence of past events as much as future performance is a consequence of today's performance. From this endless chain of cause and effect, we can neither separate one single link, nor call it useless or unnecessary. In the same manner, it can be shown that the law of causation produces different effects that govern every action, however minute, trivial, or invisible, that affects the whole enterprise. No action can escape the law that every cause must be followed by an effect.

(See Chapter 7, "Process Valuation and Cause-and-Effect Analysis," for a discussion of combining process characteristics.)

Stable, In-Control Processes Must Be Continuously Improved

The performance results of processes that are in control are predictable. However, these results may not be sufficient to meet corporate objectives. The results must be compared to a target. To be effective, the target must be set by strategy and customer requirements. Arbitrary targets can negatively motivate employees. The most common forms of setting targets include strategy deployment, target cost, benchmarks, and state-of-the-art comparisons.

Key Events That Might Disrupt a Process Must Be Continuously Monitored

A process is characterized by events that repeat themselves in time. The events are predictable within a range of outcomes of differing likelihood. The performance is predictable until there is a significant event that disrupts the process balance. Such factors are called key events. Key events will cause a process to become unstable and thus vary beyond its expected performance levels. For instance, a change in interest rates has a dramatic impact on a credit-lending institution. Higher interest rates might preclude an extension of the credit activities.

The are several categories of key events. These categories include major changes in the following factors:

- Workload. A major workload shift will cause shifts in used and unused capacity. With larger workload, bottlenecks will result with their cascading effects on enterprise performance. With smaller workload, unused capacity is created, which increases the enterprise's cost.
- Product features. Processes are established based on a certain mix of product features. Major changes in product features can cause a mismatch between the required work and the process capabilities.
- Economic and environmental factors. These include changes in interest rates, foreign exchange rates, government regulations, and other factors.
- Prices for key resources.
- Technology.
- Customer requirements.
- Competitor products, services, practices.

Several facets of crises result from key events. The first factor is the duration of the event.

1. The first type of crisis is a "temporary" disruption to a process that over time will revert to the original state of equilibrium. These types of crises should evoke a short-term resolution that does not fundamentally change the process. A worker strike will cause a major short-term disruption to a business. However, when the strike is resolved, it is often back to "business as usual."
2. A second type of crisis is an "isolated" disruption. The changes triggered by the key event remain confined to a limited set of processes while the enterprise performance is typically unchanged, except for the isolated problem. An example might be a major technology breakthrough that affects an individual function.
3. The third type of crisis is a "catastrophe." A catastrophic event results in a permanent structural change to the enterprise. Most cataclysmic key events result in a new level of performance and thus a new recurrent pattern of behavior.

The second factor is the scale of the event.

- Some key events affect only one or a limited number of processes. When a person enters a forest with an ax, we can anticipate an upcoming key event for a selected tree(s) but not for the forest.
- Other key events trigger a series of events that cause significant disruption to the entire enterprise. A spark of fire in a forest that has undergone a prolonged dry spell may be a key event to the forest.

The impact of key events on the entire organization must be understood and their processes must be constantly adjusted to minimize the impact of these events. Success depends on the effectiveness and speed with which an organization adapts its internal processes to changes in the external environment (for example, customers' needs, competitors' actions, and economic forces). The negative impact of key events will be minimized where there are highly adaptable processes. A few key events, however, will cause larger cascades of change. Processes will therefore typically adapt to a changing environment gradually, but if necessary, they can on occasion change rapidly.

Through an understanding of key events, the rate and direction of change can be anticipated and built into the organization strategy. What will we do if a change in government results in lower entry barriers to potential foreign competitors? What if our major competitors merge? What if customers demand pattern changes? What technology breakthroughs could have a significant effect on meeting our strategic objectives? Key events should be measured and plans and process standards updated as appropriate.

SUMMARY

Performance evaluation provides valuable feedback on how effectively a work group's activities create value—how well a department has used its allocated resources to deliver a targeted level of service. Performance evaluation should be a constructive process. The evaluation must be sufficiently specific to inform the manager and employee about what has happened, guide them through it, and give them the basic tools to do something about it. Performance deficiencies should be easily identified and documented, improvement plans generated and implemented, and performance reevaluated.

Processes enable a paradigm shift in performance measurement. Today we search for an optimal set of performance measures that evaluate how well the organization has performed. The conflict between creating a limited yet comprehensive set of measures often freezes an organization into a state of inaction. Many organizations take years to derive their measures and often are never satisfied. Again processes offer a paradigm shift in thinking—control the process and good results will follow. The corollary is that measuring the performance without controlling the process is an effort in futility. Instead of searching for an optimal set of performance measures, we should institute process controls at the work level with only a couple of strategic performance measures being reported at the enterprise level.

For evaluation to have a real impact on decision making, managers and employees must have a sincere and enthusiastic belief that evaluations are needed. Experience has shown that to improve performance, it will not suffice merely to have a system of objective performance evaluation. It is also necessary to reward good performance through a performance incentive system. This is important to stimulate the management and workers to do even better on a consistent basis.

10

How to Use Earned Value Reporting as a Feedback System

Predictive accounting measures a process's value creation potential. This requires process (work) data to be added to the accounting system. With the added data comes the responsibility of keeping the process data current. The need for ongoing maintenance has been the weak link in earlier process initiatives, such as ABC. An often-used initial solution is to add time reporting to work groups. This approach follows the pattern of the traditional top-down vertical accounting system. However, this solution is impractical. The added administrative work requires additional time and resources. Even worse, the accuracy of the method is questionable.

Earned value offers an alternative approach. Earned value uses the actual number of work outputs and multiplies them by the standard resource-consumption rate to determine the standard hours worked. The actual work outputs form the basis for measuring and comparing with the organization's actual work capacity (actual cost). This approach uses work (actual versus capacity) as a feedback mechanism. Where the two values are close, an organization has confidence that the predicted costs were correct. The power of this approach is the ease in keeping process data current.

This chapter will show you how to:

- Identify earned value concepts
- Compare earned value with traditional accounting feedback techniques
- Implement proactive process control principles

An essential part of any accounting system is to provide the management team with timely feedback of the actual financial results. Such events as closing the books monthly, taking a physical inventory, and performing company audits fulfill this need in a conventional management system. The monthly accounting ritual of closing the books sets in motion the preparation of the cost reports that compare actual results with a budget that is presented for management action. The activities of physically counting inventory and auditing the organization provide financial statement users with the confidence that the statements are accurate.

A long-standing accounting dilemma is the extensive amount of time that elapses between when transactions actually occur and when they are reported in the accounting reports. This delay is caused both by procedural and mechanical deficiencies. Accounting reports are derived from a large amount of data that must be entered, examined, verified, and processed. The accounting process takes a significant amount of time and effort. Delays occur as a consequence of gathering the data, ensuring its accuracy, coding it, and then entering it into the accounting system.

In large part, reporting lags are a direct result of many financial transactions occurring outside the accounting department. For example, the purchasing department orders merchandise that is received by an inventory department. Accounting gets the paperwork from both departments and must further process it (1) to pay for the merchandise ordered and (2) to update the accounting records. In organizations that do not have fully integrated computer systems, the occurrence of a transaction, the transmittal of paperwork relating to that transaction and the updating of accounting records do not occur simultaneously. Before the monthly closings, accounting records must be brought up to date. This requires accounting clerks to go hunting for the documentation elsewhere in the organization, process it, and then enter it so accounting records are ready for the monthly closing. Sources of the accounting department logjams are often external to the department.

The response of most organizations to the reporting time lag is to streamline the closing process to compress the elapsed time. Compressed closing schedules help make the accounting feedback more timely. What compressed closings fail to do is to lead to meaningful action by increasing the relevance of accounting data. The biggest disappointment is that the monthly data does not have predictive value. Predictive accounting was developed to overcome this limitation.

The role of month-end closing changes dramatically in a process-based accounting system. The two primary functions of the month-end close become:

1. To present the upcoming months' predicted results.
2. To validate that the processes are in control and provide management with a measure of reliability of the future projections. To be reliable, process data must be verifiable, valid, and objective.

Earned value reporting is a tool that verifies the predictive ability of the process data. The need for earned value reporting arises primarily from the need for reliability.

Many view relevance and reliability to be mutually exclusive—that is, there is a trade-off. An accounting report may not be timely, for example, if every number must be verified. The traditional thinking was that accounting must strike a delicate balance between providing managers with relevant information and the need for reliability. Traditional accounting stresses the need for reliability over the need for relevance (see the sidebar ''Data Integrity'').

Process management offers a variety of feedback points:

- *Activity execution.* The process model requires that measurement points be established to detect potential sources of process variation as close in time to the occurrence of the variation as feasible. Ideally the measurement point should be part of the activity (see Chapter 7, ''Process Variation and Cause-and-Effect Analysis'').
- *Process variation detection.* The measurement point must distinguish between a fundamental change to a process and expected random variation (see Chapter 5, ''Determining Value Creation'').

The feedback loop must allow employees to correct the root cause of errors that are triggering the variation. However, employees too often rely on ''gut feelings'' to solve problems. At times, the intuitive style works, but more often it fails the organization. It is essential to have an objective understanding of the problems before you try to solve them. Thus, measurement is absolutely essential to progress. The process feedback system should provide management with the information needed to prevent the variation from occurring in the first place. Too often in white-collar processes, few measurement points exist, and where they do exist, there is little or no feedback.

One implication of a process-based accounting system is that we must question the arbitrary time frames we use to report financial data. Why report monthly? Operational processes need a much shorter feedback loop—perhaps daily, hourly, or even by the minute. Processes affected by macroeconomic factors need much longer time frames—perhaps quarterly or semiannually. Monthly reporting reacts too slowly or too quickly to many changing conditions.

Why then do companies report monthly? The answer is management uncertainty. Management needs to know the current state of an enterprise. Is the enterprise on track to achieve its committed financial results? Is it time to praise or raise the devil? Predictive accounting has emerged to answer this question by focusing on the future rather than the past.

Data Integrity

An essential part of any measurement system is an internal audit system that helps ensure data integrity. It is not logical to blindly accept data that is generated without proper checks and balances. The reason lies in human nature. People have a strong desire to please management by telling them what they want to hear. They will present only data that shows them in a favorable light. Negative data is not presented. Thus the primary purpose of an internal audit is not to catch people trying to falsify data—most people won't—but rather to ensure data inclusiveness.

WHY ACTUAL RESULTS ARE OF MINIMAL VALUE

An organization must continually assess whether it is meeting its cost, quality, and time performance targets. Answers to these questions lay in a multitude of systems. The financial system evaluates cost performance. Operational systems or performance measurement systems appraise quality and time performance. Predictive accounting enables the diverse performance metrics to be bundled into a single management system.

The underlying concepts of predictive accounting are straightforward. Set strategic targets based on stakeholders' needs. Identify an organization's revenue drivers and set product and service performance targets. Drive strategic targets to the activity level. Establish process controls to minimize process variation. Monitor the revenue drivers and other strategic factors to ensure that they meet targeted performance levels. Constantly improve the process to minimize future process variation and to move performance to a higher level.

The predictive accounting feedback loop is composed of two elements: a real-time process control system and a workload achievement control system. The real-time process control system monitors an organization's processes to ensure they are in control. There is no need for activity-level performance measures beyond the real-time process controls—excellent performance follows from processes that are in control. The people who perform the process will monitor the process control chart.

However, there is no guarantee that strategic mission will be met even if every process is in control and achieving its performance targets. Thus, the performance monitoring system must provide feedback on the effectiveness of the strategic plan. The performance monitoring system uses planning control charts (see Chapter 5, "Determining Value Creation"). A planning control chart determines the sensitivity of the planning assumption to the strategic plan. Actual results of the key factors are plotted over time to assess whether they are within the upper and lower planning limits. Management must initiate an updated plan when a signal is detected that the original planning assumption is no longer valid. In this environment, key events, rather than set planning horizons, drive planning.

The essence of predictive accounting is to anticipate future performance and to be proactive. In this environment, actual results are of little relevance. An analogy is the stock market. There is minimal impact on stock prices when the actual quarterly results are released because those results were already discounted and factored into the stock price. The only time actual earnings will have an impact on stock prices is when there is a surprise—the organization missed its forecasted earnings, for example. Wall Street does not like surprises.

A management team deserves no less than Wall Street. Predictive accounting can supply a meaningful glimpse into future performance. Management must be able to rely on this data to take the needed action. Actual results must shift from being of critical interest to being of minimal interest. This shift is possible when management has confidence in the predictive information.

Actual results can then be relegated to a role where they validate the predictions. Earned value reporting performs this task.

HOW EARNED VALUE REPORTING IS USED

Earned value is the amount of resources that should have been consumed based on the actual number of outputs completed during the analysis period. The simplest way to think of earned value is to equate it with physical accomplishment. It is a measure of the value of the work completed during a particular period of time weighed against the actual costs to accomplish that work. As such, it is an achievement-oriented performance system. As the name implies, it is something that is gained through some effort. It answers the question, What did I get for the money we spent? Earned value calculations can provide the management team with an early-warning signal of impending unreliability of process data in time for managers to respond effectively.

Earned value is particularly valuable to work groups that do a variety of activities in differing amounts during different time periods. Take an information technology (IT) group as an example. Assume that their key activities include:

- Developing the conceptual design.
- Developing the program specification.
- Coding the computer program.
- Documenting the computer program.
- Developing and producing the user manual.
- Debugging the computer program.

Further, assume that the IT group spent most of its time during a period being analyzed developing conceptual design and program specifications. It did a limited amount of coding and debugging and did not do any manual production or documentation. So how effective and efficient was the group? We simply do not know. How much value does each activity create? Does writing one line of program specification equal one line of code, and does that, in turn, equal one line of documentation? How can we equate the various activities?

Now suppose we determine that the conceptual designs the group worked on should have taken 200 work hours; the program specification writing, 300 hours; coding, 600 hours; and debugging, 400 hours. The group should have spent 1,500 (200 + 300 + 600 + 400) hours during this past period. Let us further assume that there were 10 systems analysts in the work group. We can determine that the group's productivity was excellent (10 people × (160 hours available during the month – 10 hours per month administrative time) = 1,500 available hours). This group's productivity would be poor if instead there were 15 systems analysts or if the work should have taken only 1,300 hours.

The labor (activity) standards are used as a weighting factor in establishing the value of the various activities. That is exactly what earned value does.

Earned value has enabled us to combine the productivity of vastly different work efforts. Earned value lets us combine programming lines of code with machine maintenance, number of new hires, number of customer visits, number of products packaged for shipment, number of suppliers certified, and so on. Earned value can be employed whenever work involves defined processes.

Take the process of renewing a driver's license at the department of motor vehicles. Assume that there is a receptionist and eight police officers. Further assume that the total salary and wage cost for the group is $1,500 per day and that it takes an average of 10 minutes to complete the renewal process. The department has the capacity to process 336 (7 hours × (60 minutes/hour / 10 minutes per renewal) × 8 police officers) renewals each day. This means it costs an average of $4.46 ($1,500/336 renewals in salary and wages) for every renewal. If on a particular day, the department processed 320 renewals, it would have an earned value of $1,427 ($4.46 × 320). The earned value is slightly less than the actual cost of $1,500, meaning that the actual cost of that particular day was slightly more than $4.46.

This example illustrates how earned value provides a yardstick that managers can use to objectively measure and determine the value of the work accomplished. It reduces subjectivity and allows for consistency in evaluating performance. Earned value provides context to the actual results.

Earned value adds context to actual cost in three ways:

1. It is a uniform unit of measure that combines financial and nonfinancial data.
2. It is a consistent method for analysis of process performance of any type of process—from highly automated to highly knowledge intensive.
3. It is the basis for validating the predictive consistency of a process.

A Uniform Unit of Measure That Combines Financial and Nonfinancial Data

The earned value calculation is stated in terms of a cost per output. The cost per output metric includes both measurable outputs—number of payroll checks or oil changes, for example—and monetary terms. The cost per unit is a measure of productivity.

A Consistent Method for Analysis of Process Performance

Earned value is a tool that helps managers objectively assess their cost performance. If you want to know the likely cost of your work before it is completed, you need to know how the current process consumes resources and also the cost of the resources.

If the earned value cost is considerably higher than actual cost, this appears to be good news. However, unless you understand the reason for the favorable cost of the completed work, you don't really know if this is good news or not.

How much slack time is there in the process? Did the people not perform all the work steps as thoroughly as required—and thus can we anticipate upcoming quality problems? What can I learn about the reasons for the increased productivity? This is exactly the missing information that earned value provides.

If the earned value cost is significantly less than actual cost, the manager may ask questions such as: Which of my processes are out of control? How can I improve my process performance? Are my process standards correct? What can I expect for future performance until my processes are improved? Earned value provides managers with the information needed to answer these important questions.

A Basis for Validating the Predictive Ability of Processes

Earned value enables an organization to assess whether it can rely on the process data to predict future financial results. Where earned value results closely approximate the actual cost, management has a high degree of certainty that the predicted cost is reasonable. On the other hand, where a significant difference exists between earned value and actual results, management will have little confidence in the predictive power of the process data.

Management can take action when necessary to put process performance back on track with the information provided by earned value reporting. Process improvements achieve the dual benefit of improving performance while simultaneously improving the accounting system's predictive power. Earned value does not eliminate the need for supplementary performance reporting, but rather provides a synergy by evaluating the effectiveness of the process-based accounting system.

At the heart of earned value reporting is risk reduction. Earned value helps managers evaluate and control risk by allowing them to measure actual work accomplished. The performance can be compared to a baseline spending based on process consumption of resources and the actual cost incurred.

To employ earned value, an organization must have a thorough understanding of a group's work, performance targets, measurements taken against one's own targets, and a continuous statistical understanding of expected results based on predictive accounting principles (covered in Chapters 1 through 7). This may sound complicated, but it is not. Earned value uses existing data that most information systems currently provide. What earned value changes is the way we look at the same data.

Benefits of earned value include the following:

- A single management control (feedback) system that provides reliable data. Managing with one system while reporting from another is neither efficient nor effective.
- For an organization that manages itself primarily by functional areas (for example, bank deposit, procurement, or accounting), the process orientation helps coordinate the contributions of each area to creating value. An organization must ensure that its work is properly integrated.

- Earned value metrics can help the manager assess the reasonableness of critical financial goals, such as completing its work within a targeted cost.
- By directing management attention to only the most critical problems, information overload can be reduced.

HOW TO CALCULATE EARNED VALUE

Earned value is computed by multiplying the actual number of outputs completed during the analysis period by the standard activity (resource usage) rate. The standard activity rate links the outputs to the resources needed to produce the output. The resources are in turn linked to general ledger (GL) accounts in which the cost of each resource is collected. The standard activity rate can be adjusted for the degree of difficulty (feature variation factors).

Planned workload coupled with the standard activity rate provides a basis for a GL budget. GL costs are "earned" when an event occurs that triggers an activity. The standard activity use rate should include all significant and traceable resources for the activity. The activity standard must separately identify each resource element (people, equipment, information systems, material, and other traceable resources). Activity standards should include materials that are consumed by the activity. Product-related material is not traced directly to the activity but can be assigned to products. The bill of material (BOM) is normally the basis for establishing material costs to products.

To illustrate this process, consider the activity "process accounts payable." The activity requires the following resources:

Accounts payable clerk	4.32 minutes
PC	4.32 minutes
Accounts payable computer system	4.32 minutes
Telephone (unit + long distance)	0.0432 minutes

The planned activity volume is 24,000 accounts payable invoices per year, or 2,000 invoices per month.

The current workload requires one AP clerk. Under normal conditions, we would expect the available work time to be:

2,000 invoices/month @ 4.32 minutes =
8,640 minutes, or 144 hours per month

This equates to one person working 90 percent (144 hours on AP/160 hours worked per month) of his or her time processing AP invoices and 10 percent of his or her time doing miscellaneous activities. Also assume that the AP clerk is paid $10 per hour, which equates to $1,600 a month for 160 hours.

Now let us assume that there were actually 2,400 invoices processed during the month. Earned value would be computed as follows:

2,400 invoices @ 4.32 minutes	= 10,368 minutes, or 172.8 hours per month
172.8 hours × $10	= $1,728 earned value cost for salary and wages
172.8 – 160 hours	= 12.8 overtime hours
12.8 × $5 overtime premium	= $64 overtime

Therefore, the earned value was $1,792 ($1,728 + $64) and the actual value was $1,825, creating an earned value variance of $–33 ($1,792 – $1,825).

The resulting earned value costs are compared to the actual salary, wages, and overtime costs reported in the GL and an earned value variance is computed. In this example, there is an anticipated variance between budget and actual costs due to the increased invoice workload. Analysis of earned value should focus on significant variances. This may include resource usage incurred above or below the activity standard amount as well as variances in the expected price of the material.

TRADITIONAL ACCOUNTING CONTRASTED WITH EARNED VALUE REPORTING METHODOLOGY

Traditional accounting evaluates performance by comparing actual cost to budget for each category of reported cost. Significant variances must be investigated and explained. Variance analysis is completely inadequate as a performance indicator because it fails to consider the value a department creates. It fails to answer the question, What value has the enterprise received for its expenditure of cost? The variance simply represents the difference between the actual capacity paid for during a period of time and the planned capacity. Is a small or favorable variance good if the workload has gone down? Obviously not! Yet this signal of problems would be missed with traditional variance analysis. Is an unfavorable variance bad if the workload has gone up? Again, obviously not! Yet a false signal of a problem would be sent with traditional variance analysis. Unfortunately, variance analysis can contribute to performance problems by drawing management attention away from its more urgent problems.

Traditional accounting systems track actual cost over time (see Figure 10.1).

Meaningful variance analysis needs workload information to answer such questions as, What work was accomplished with the capacity? and How effectively was the work performed? These questions go unanswered by traditional accounting (see Figure 10.2).

Earned Value Reporting Expands Flexible Budgeting

Earned value is a technique that achieves meaningful comparisons between planned and completed work. It has many similarities to a "flexible budget," where the original budget for work is adjusted for the actual level of output. Under the concept of flexible budgeting, a cost variance results when the actual cost of the work and its flexed budget differ.

Figure 10.1 Planned Accomplishment

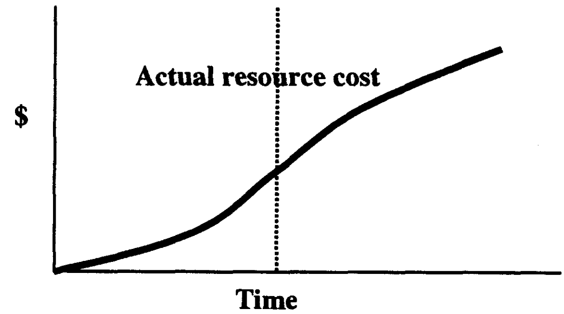
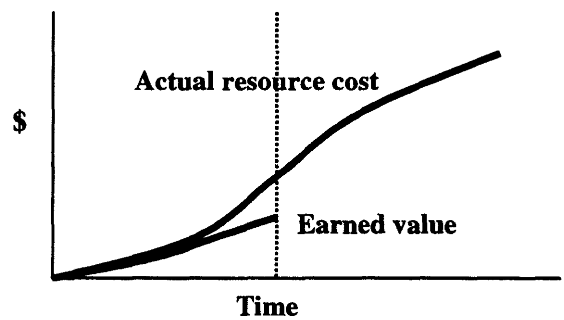


Figure 10.2 Planned Versus Actual Accomplishment



The power of flexible budgeting is that it adjusts the budget, and thus the variance, for workload changes. However, there remains stark differences between flexible budgeting and earned value reporting. One major difference is the focus on the process associated with earned value. Flexible budgeting remains focused on resource consumption by type of cost—salary and wages, travel, consumable supplies, and the like. Earned value focuses on the processes and their corresponding workload. Flexible budgeting is often implemented at a level too high to make it useful for managerial decision making.

A second difference is that flexible budgeting factors out workload changes but does not provide any other help understanding what caused the variance. Earned value's emphasis on the process acts seamlessly with root cause analysis and its emphasis on process variation reduction. The focus of earned value on the process lends itself to proactively eliminating variance rather than developing more sophisticated reports.

A third difference is that cost variance is often reported by traditional accounting systems but then is promptly ignored. In fact, the variance slate is wiped clean at the end of each year. In earned value, the variance is used to update a process standard. The variance becomes part of a time series of data used to track the process behavior. The update procedures are explained in the section "Step-by-Step Earned Value Reporting Methodology," later in this chapter.

A final difference is that earned value can be used to assess the conformance to a process's target execution time. A flexible budget does not provide any information about time variances. A macro process divides its work elements into activities that are assigned a target cost and process time. Because each increment of work in a process is time-phased, a time variance occurs if work is not completed (earned) when it was supposed to be completed. Because the work has a standard process cost, the time variance can be reported as either a time variance or as a monetary amount. Like the cost variances, significant schedule variances are analyzed and corrected when possible.

How Earned Value Reporting Expands on Project Management Accounting

An alternative traditional accounting approach is to set up a subsidiary project management system in the cost accounting system. A project can be used to track the actual results of processes that lend themselves to project management. Examples include new product introduction, information system development, process improvement, and others. These types of projects tend to be characterized as one-off initiatives that have a definite start and end date. Repetitive processes do not lend themselves to project management accounting.

First let us consider the advantages of project management accounting. The first benefit is that a project is most often constructed by identifying its significant activities. A well-constructed project plan will look very much like a process map. A second benefit is that the total cost of the project will be treated as a discrete amount rather than as a hidden part of each functional area. Management will be able to see project cost in a way not possible with the traditional accounting system.

Project management accounting, like flexible budgeting, has several drawbacks. First, traditional cost analysis concentrates on the actual cost of work completed. To assign the actual cost of salary and wages to a project requires the employees to collect and record how they spent their time. Time reporting is riddled with inconsistencies, such as:

- When employees are recording time, they are not accomplishing their work or improving their processes. Time is one of the most precious assets in the downsized organization. We should not waste it on nonessential administrative duties.
- Time reporting is not necessarily reliable or accurate.
- Time reporting must be verified. Time reporting is highly subjective because accuracy depends on people and their motives. As a consequence, the data must be verified, and verification comes at a very high cost. Failure to verify can negate the insight the information provides if it is wrong.

Earned value does not require time reporting. Time is earned based on the actual work accomplished and the standard process time it takes to complete the work. Earned value automatically creates a time report rather than asking the employee to complete one. What earned value brings to the management process is a measure of the amount completed work by work group. It provides a unit of measure that is consistent and comparable in cost terms. In other words, it allows us to compare "apples and apples" by using the same unit of measure for physical progress as that used for cost. Management can meaningfully assess whether the actual costs spent to date are higher or lower than planned.

Earned value incorporates learning into the process while project management accounting treats each project as a one-off accounting exercise. Process learning occurs because process variation analysis seeks to understand the root cause of problems. Earned value is directly affected by process variation. Large process variation is seen by the earned value system. Management will gain insight on which processes are in control and which processes need to be brought into control.

Earned value permits activities to be simultaneously shown by functional organization and by process. In contrast, product and project accounting charges cost out of a functional group and into the product/project. This calls for the management team to make an all-or-nothing decision. Where do they want to see the data? Do they want to see the cost as a function or as a project? No such distinctions are necessary for earned value.

Earned value requires minimal external verification. Actual workload data is downloaded from operational systems and thus is less subject to potential manipulation. Predictive accounting has a myriad of checks and balances that are a by-product of the system. Earned value is one of those checks and balances. Under predictive accounting, a control chart is constructed for each activity. The work team is responsible for bring its activities into control and keeping them there.

Earned value validates the expected performance of the process. Earned value variance will be high when processes are out of control and low when they are in control. Earned value acts as a check and balance of the expected performance relative to the actual performance.

The advantages of the earned value approach to performance measures are its objectivity and simplicity. It is accurate and objective because the actual number of outputs can be extracted from operational systems and do not depend on a separate data-recording effort. It is simple because all the data is extracted from existing business systems. It monitors variation for an entire bundle of processes rather than for each individual one.

STEP-BY-STEP EARNED VALUE REPORTING METHODOLOGY

On a periodic basis (monthly is recommended), download your actual costs from the GL and actual outputs for the chosen analysis period. This section discusses in greater detail the steps of earned value reporting (see Chapter 2, "The Process-Based and Predictive Accounting Framework"). At this point we have come to the practical part of actually seeing how earned value is applied. Earned value is a component in a process-based accounting system. It presumes that an organization has completed the following analysis:

- Defined its activities and macro processes.
- Created the activity standards.
- Performed root cause analysis.
- Created control charts and is monitoring all activities to determine which ones are in control and which are out of control.
- In progress of bringing the out-of-control processes into control.
- Identified its strategic value drivers.
- Created planning control charts for its strategic value drivers and is monitoring them.
- Constructed a key-event-detection system.

Earned value reporting requires an organization to complete each of the above steps before using the earned value information to manage its business. The remainder of the earned value analysis will use the information in conjunction with the earned value information.

Step 1. Track Actual Workload

The first step in the earned value process is to track the actual workload completed during the analysis period (see Table 10.1). The actual work accomplished forms the basis of earned value reporting. It is important that the practitioner should avoid subjectivity in collecting output data. The optimal solution is for the actual outputs to be downloaded from operational systems. The automatic download improves data integrity while reducing redundant data entry into the process-based accounting system.

It is critical that an organization measures all the significant actual work done during an analysis. The timing of work can potentially distort an earned value analysis. The problem is most severe for work started in one analysis period and completed in another where the following conditions exist:

- The cost of the work is very large.
- The work has a long duration to complete.

Table 10.1 Actual Workload

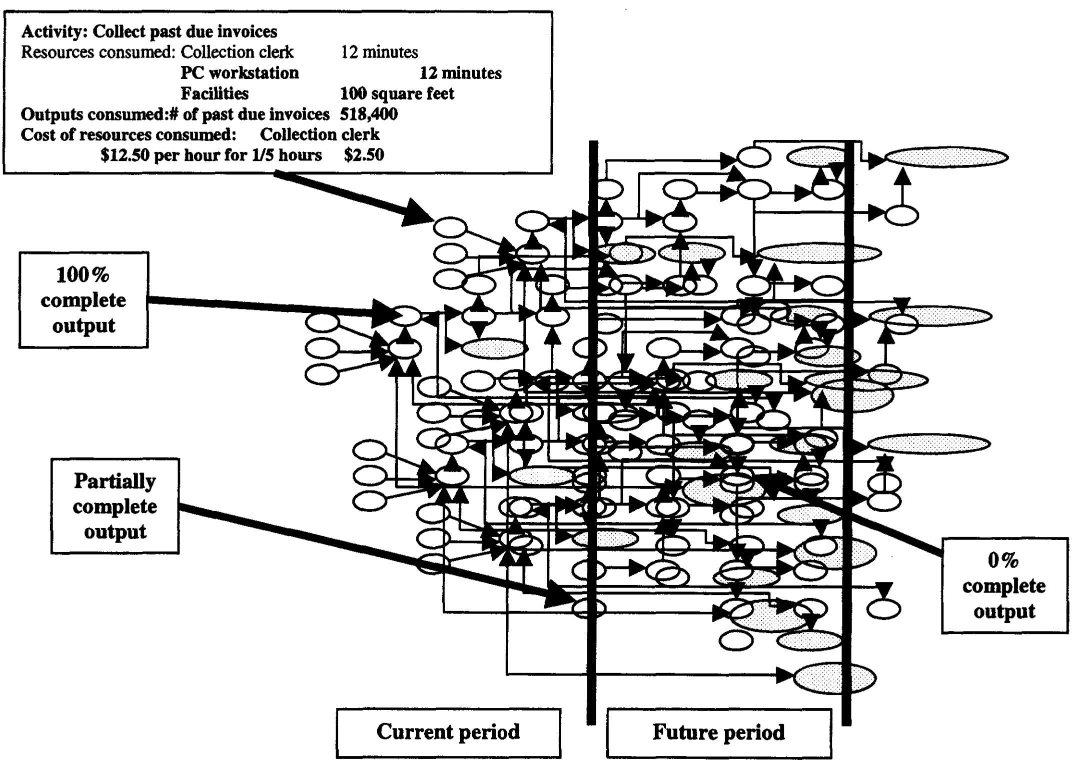
Level	*Output*	*Period 1*	*Period 2*	*Period 3*	*Period 4*
1	Sales	$ 95K	$ 140K	$ 105K	$ 90K
2	Sales orders	960	1420	1200	980
3	Cash applications	170	965	1430	1235

A group's workload must be evaluated to determine whether either of these conditions exists. Where these conditions are detected, the organization must assess its materiality to the earned value analysis (see Figure 10.3).

Incomplete work exists where work overlaps an analysis period. The impact of incomplete work is that some of the actual cost will occur in one analysis period while the earned value will be reported in another analysis period. The first step is to determine the significance of the issue. Many outputs are large in number and are completed in a relatively short time period. These outputs are not materially affected by the output timing issue.

Outputs that take a significant amount of time to complete and involve overlapping time periods need to be restructured. These outputs must be broken down into the individual tasks that are of a shorter time duration. The decomposing of a process into tasks allows the user to determine a percentage completion for the larger process. One common procedure is to report percent complete according to completed tasks within the activity.

Figure 10.3 Assessing Materiality to Earned Value Analysis



Key earned value questions:	**What has been accomplished? What did it cost?**
Earned value approach:	**Determine the outputs completed during the current period.**
	Determine activity standard.
	Multiply the outputs by the activity standard

For example, if an activity is to create a design drawing, progress might be reported as follows:

- Five percent when the preliminary specifications are prepared.
- Thirty-five percent when the first draft of the drawing draft is completed.
- Forty-five percent when the first draft is reviewed.
- Sixty percent when the revised draft is completed.
- Eighty percent when the marketing approval is received.
- Ninety-five percent when the final draft is completed.
- One hundred percent when the drawing is issued to manufacturing.

The key in defining earned value using the percent-complete approach are (1) each task must be discrete, and (2) it is easy to determine that the task is completed. A completed task is best recognized by physical evidence, such as a computer transaction, a document, or a physical transformation of the product or service. The disadvantage of this approach is that it involves more data collection.

Step 2. Capture Actual Cost

Capture the actual cost incurred by the work group during the analysis period (see Table 10.2). The actual cost comes from the GL system. It is the same data that is reported to management on a monthly or quarterly basis. Accounting must be sensitive to timing issues because cost is earned when the outputs are completed.

It is most appropriate to use dollars (francs, pounds, pesos, or their equivalent) as the unit of measure for earned value. Since each labor hour, machine hour, and facilities space has a price, dollars can be used to control process cost. However, when using dollars, additional factors enter into the performance evaluation. This includes salary rate differences, escalation, and purchase price variances. Consider the effect of an activity that calls for a certain job grade to do the work. What is the impact if a different job class with different salary rates performs the work? The monetary measures will include the effect of the higher salaries. For financial control, this is good information. However, for

Table 10.2 Actual Cost

Cost Account Description	*Amount*
Salary and wages	$2,000.00
Depreciation	83.33
Software cost	85.00
Facilities cost	112.50
Total	$2,280.83

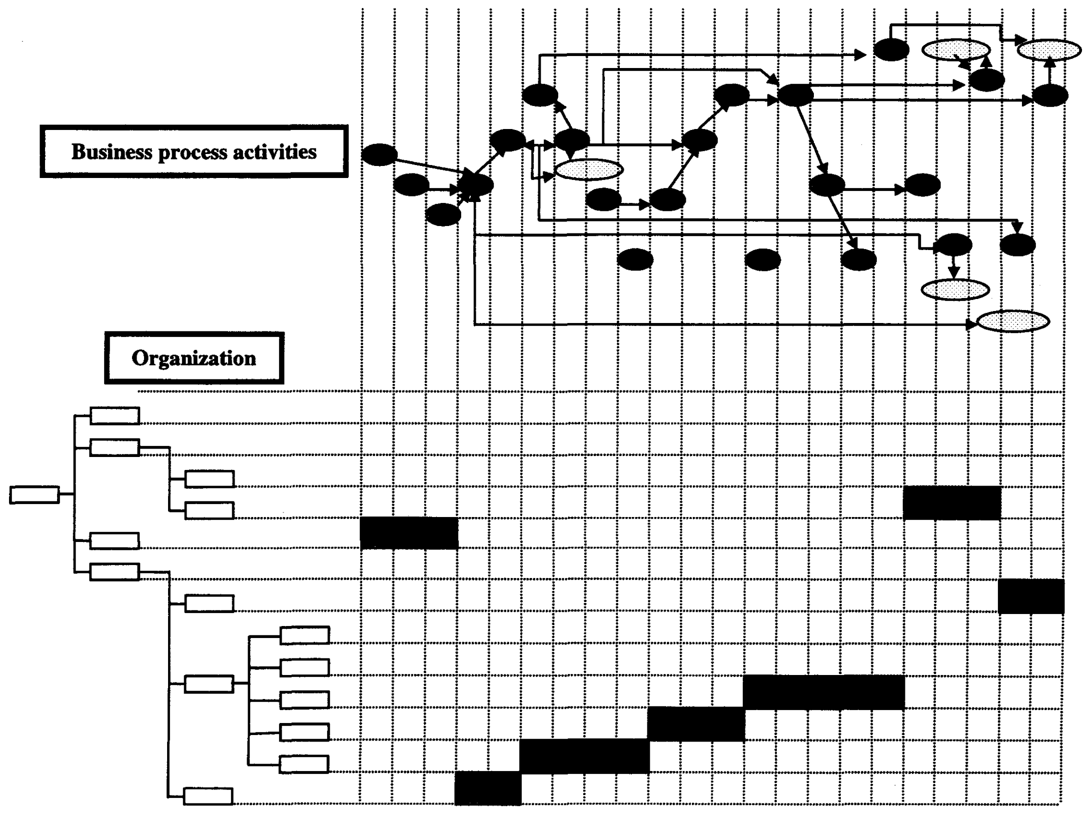
performance control, this information muddies up the waters. Standard resource rates are used to minimize the impact of such decisions.

The Achilles heel of earned value is the difficulty in tracking actual cost to the individual processes. Tracking actual cost is relatively easy where resources are totally dedicated to a single process. The actual cost can come directly from the payroll system and accounts payable invoices. There still remains the problem of tracing shared service costs—often referred to as allocating indirect cost (see Chapter 4, "Steps for Operating the Process-Based Accounting System").

The most difficult problem arises where a resource is employed in multiple activities. It is very difficult to accurately determine the time people spend on each individual activity. A natural response on the part of most managers is to install a time reporting system. Time reporting systems are to be discouraged, as was discussed earlier in this chapter.

An alternative approach is to look at the total bundle of processes assigned to a resource group. This approach accumulates the total workload accomplished during an analysis period for each work group (see Figure 10.4). Process standards are used to determine how much time should have been spent to accomplish the actual collection of work. As mentioned in chapter 9, "the

Figure 10.4 Departmental Activity Responsibility Matrix



'should' amount of time is referred to as earned value time. We know the actual total available time for the resource. We then subtract the earned value time from actual available time to compute an earned value variance. The earned value variation is plotted on a control chart to assess the stability of the bundle of activities.''

Step 3. Compute Earned Value for Each Activity

Earned value is computed for each activity. Earned value is the economic value of a standard amount of resources consumed by a unit of completed output. For all primary activities, the earned value is computed by multiplying the actual work accomplished by the process standard. A primary activity has a discernible output that is provided to a customer. A process standard consists of all an activity's directly traceable resources needed to complete a unit of work. The standard resource consumption per output provides a baseline against which actual resource consumption can be compared. Resources are assigned to a group in accordance with its planned workload. The outcome baseline is to complete the workload on spec within the resource constraints.

For all secondary activities, earned value is computed as a standard allowance of cost. A secondary activity is an administrative or process improvement activity. Examples are training, completing a timesheet, or managing the work team. Secondary activities usually comprise many small tasks. If a work team spends 3 percent of its time attending to its administrative activities and another 3 percent being trained, each month it would earn 6 percent of its time and the associated cost for these secondary activities.

Each resource, in turn, is associated with a GL chart of accounts. These connections enable the actual workload to directly compute earned value cost by GL account (see Table 10.3).

Step 4. Compare the Earned Value With the Actual Cost

The next step is to compare the earned value with the actual cost. The comparison is performed at the cost account level—the same level of detail reported in the GL. One would expect minimal variances where the processes are in control and capacity is well matched to actual workload.

A variance is computed for each cost element. For example, if a sales team planned to make 20 customer visits and yet made only 10, their time should be accounted for by other activities of the sales team. However, we should also expect less travel cost because ''visit customer'' is the primary activity that triggers the need to travel.

Step 5. Assign the Variance to the Individual Activities

The next step is to reverse the analysis and assign the variance to the individual activities (see Table 10.4). The preferred method is for the work team to assign

Table 10.3 Earned Value Cost

Process	*Resource*	*Process Rate*	*No. of Outputs*	*Cost*	*Salary and Wages*	*Depreciation*	*Software*	*Facilities*
Apply cash	Clerk	6 minutes	965	$1.25	$1,206.25			
	PC workstation	6 minutes	965	$0.05		$48.25		
	Software	6 minutes	965	$0.05			$48.25	
	Facilities	6 minutes	965	$0.07				$ 67.55
Research error	Clerk	20 minutes	100	$4.17	$ 417.00			
	PC workstation	20 minutes	100	$0.20		$20.00		
	Facilities	20 minutes	100	$0.35				$ 35.00
Total earned value					$1,623.25	$68.25	$48.25	$102.55

Table 10.4 Earned Value Variance Calculation

Cost account description	*Actual $*	*Earned Value $*	*Variance*
Salary and wages	$2,000.00	$1,623.25	$376.75
Depreciation	83.33	$ 68.25	$ 15.08
Software cost	62.50	$ 48.25	$ 14.25
Facilities cost	112.50	$ 102.55	$ 9.95
Total	$2,258.33	$1,842.30	$416.03

the variance based on its knowledge with the actual events that occurred during the analysis period. The work team will be aware of any extraordinary events that would have caused the variance.

An alternative approach is to allocate the variance back to the activities based on the relative magnitude of the activity cost. Significance can be assessed on the proportion of time spent on each activity or the total activity cost. Pareto's law increases the relevance of the variance allocation method. Pareto's law uses the observation that workload is rarely evenly balanced. During any period of time, a limited set of activities will consume the bulk of a group's time. During another period, a different set of activities will take over the department's time.

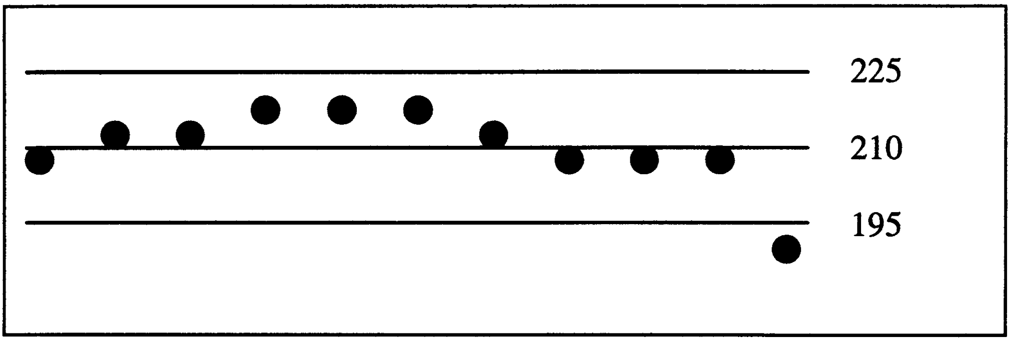
The reason Pareto's law is important is that during a particular time period, a small number of activities will dominate a group's time. If these activities were in control, we would expect a minimal earned value variance. When this variance was allocated to the actual mix of activities performed during the analysis period, the dominant activity—that is, one in control—would get a minimal variance allocation. Conversely, where an activity is out of control, we would expect a large earned value variance. Using the same logic, the dominant activity—that is, one out of control—would get a large variance allocation. Thus Pareto's law causes variance to be generally correct.

Step 6. Plot the Variance

The next step is to plot the allocated variance to each activity on a control chart (see Figure 10.5). The control chart helps to determine whether the earned value is within control limits. The control chart provides management with confidence in the predictive costs where processes are in control.

For example, if one full-time person is assigned to applying cash, we would expect that person to apply cash to an average of 210 invoices per day (60 minutes per hour / 2 minutes per invoice × 7 hours per day). We could set up a control chart to monitor the actual number of cash receipts applied every day. Statistical analysis would suggest that the actual number of invoices processed would rarely equal exactly 210, but rather that a range of expected values could be determined.

Figure 10.5 Earned Value Control Chart



An out-of-control process should cause the team to launch a root cause analysis to determine the source of the problem and product management to resolve the problem.

Step 7. Interpret Results

The final step is to interpret the results. Typical comparisons include the following:

- Compare the budgeted cost with the cost of budget earned for work accomplished. This comparison indicates the reason for the cost variance.
- Compare the planned amount of time by resource with the actual available resource time for the same work. This comparison provides a measure of capacity variance.

Comparing the value of work completed to the value of work scheduled during a given time period provides a valuable indication of dollar value of work accomplished. This variance may not, however, clearly indicate whether scheduled milestones are being met because some work may have been performed out of sequence or ahead of schedule. Time variance does not indicate whether a completed activity is a critical event or whether delays in an activity's completion will affect the group's performance. A formal time-phased scheduling system, therefore, must provide the means of determining the status of specific activities, milestones, and critical events.

Comparisons of the cost of completed work with the value planned for that work provides a cost variance. Earned value variance must lead to an understanding of the factors contributing to the variances. Examples include poor initial activity analysis, technical difficulties that required additional resources, the costs of labor or other resources different than planned, differences between planned and actual workloads, and process efficiency different than planned due to features and other factors. You must analyze significant earned value variances to determine one of several courses of action:

- The variance appears to be an aberration or the trend is not stable enough to draw any conclusions about the performance. *Action:* Continue to monitor future performance.
- The variation indicated corrective action is necessary to correct a problem. Examples include scrap, test rejections, unanticipated test quantities, and the like. *Action:* Initiate improvement project.
- The activity standard appears to be incorrect. *Action:* Update the activity standard.

Identify, at least monthly, the significant differences between both planned and actual performance and provide the reasons for the variances in the detail needed by senior management. Include a summary of the improvement projects underway to improve performance and other managerial actions taken as the result of earned value information.

Identify the impact of changes in the operational departments that affect the support departments. The support departments should be continuously adjusting their activities in response to permanent changes in demand derived from operations. Changes to the service level are needed by management for effective control of support departments, along with the reasons for any significant variances.

Summarize the impact of workload changes and their associated variances on the business process performance and the performance measures.

The greater the process variation, the more uncertain the expected use of the process's resources. Effective financial performance is possible only where there is minimum process variation. Thus it is critical to monitor earned value on a timely basis. Too frequent monitoring results in wasted effort responding to normal "noise" caused by random variations. Too infrequent monitoring results in the "trail" going cold when investigating the root cause of problems. Thus it is important to have a good activity standard and to keep track of performance against it. The identification of excess usage that is expected to continue for future units is key in validating activity quantities and performance. Based on this analysis, appropriate action should be taken to ensure activity variation is reduced and financial performance is more predictable.

SUMMARY

Earned value helps us to objectively see whether the processes are in control and to make any corrections needed to keep our performance on track. The reason that neither flexible budgeting nor product/project accounting solves the variance analysis problem is that both techniques were developed as patches to the traditional accounting worldview. Only by adopting a new process enterprise view are such breakthrough tools as predictive accounting and earned value reporting possible.

Appendix 1
Process Classification Framework

This Appendix contains the American Productivity and Quality Center (APQC) International Benchmarking Clearinghouse's activity dictionary. The dictionary is intended for use by both manufacturing or service companies.

One useful method of ensuring a consistent definition of activities is to use an activity dictionary. An activity dictionary provides a list of typical activities in a department. It provides a consistent starting point for activities by listing generic activities according to functions performed in a "typical" company within an industry. It provides a base line for defining an initial list of activities. Each activity is presented in the form of a short statement of what is done (not how or why).

The activities in the dictionary must be tailored to your specific organization. Whether the generic activity is appropriate to your organization is based on its frequency of execution, magnitude of cost and amount of time spent performing the activity. Additional company-specific activities that are necessary and are not part of the generic dictionary must be added.

An important element in establishing an activity dictionary is to specify the function of the activity. A function is an aggregation of activities that are related by a common purpose, such as material procurement, security and quality. Although most companies are organized functionally, the total spectrum of activities related to the function is much broader than the organizational unit that has primary responsibility for the function. For example, the responsibility for certain quality activities is assigned to the quality department. Yet many activities, such as quality planning for product design, in-process inspection and rework occur in other departments. There is no requisite interdependency among the activities in a function other than relating to a common purpose.

1.0 Understand markets and customers

- 1.1 Determine customer needs and wants
  - 1.1.1 Conduct qualitative assessments

1.1.1.1 Conduct customer interviews
1.1.1.2 Conduct focus groups
1.1.2 Conduct quantitative assessments
1.1.2.1 Develop and implement surveys
1.1.3 Predict customer purchasing behavior
1.2 Measure customer satisfaction
1.2.1 Monitor satisfaction with products and services
1.2.2 Monitor satisfaction with complaint resolution
1.2.3 Monitor satisfaction with communication
1.3 Monitor changes in market or customer expectations
1.3.1 Determine weaknesses of product/service offerings
1.3.2 Identify new innovations that are meeting customers needs
1.3.3 Determine customer reactions to competitive offerings

2.0 Develop vision and strategy
2.1 Monitor the external environment
2.1.1 Analyze and understand competition
2.1.2 Identify economic trends
2.1.3 Identify political and regulatory issues
2.1.4 Assess new technology innovations
2.1.5 Understand demographics
2.1.6 Identify social and cultural changes
2.1.7 Understand ecological concerns
2.2 Define the business concept and organizational strategy
2.2.1 Select relevant markets
2.2.2 Develop long-term vision
2.2.3 Formulate business unit strategy
2.2.4 Develop overall mission statement
2.3 Design the organizational structure and relationships between organizational units
2.4 Develop and set organizational goals

3.0 Design products and services
3.1 Develop new product/service concept and plans
3.1.1 Translate customer wants and needs into product and/or service requirements
3.1.2 Plan and deploy quality targets
3.1.3 Plan and deploy cost targets
3.1.4 Develop product life cycle and development timing targets
3.1.5 Develop and integrate leading technology into product/service concept
3.2 Design, build, and evaluate prototype products and services
3.2.1 Develop product/service specifications
3.2.2 Conduct concurrent engineering
3.2.3 Implement value engineering
3.2.4 Document design specifications

- 3.2.5 Develop prototypes
- 3.2.6 Apply for patents
- 3.3 Refine existing products/services
  - 3.3.1 Develop product/service enhancements
  - 3.3.2 Eliminate quality/reliability problems
  - 3.3.3 Eliminate outdated products/services
- 3.4 Test effectiveness of new or revised products or services
- 3.5 Prepare for production
  - 3.5.1 Develop and test prototype production process
  - 3.5.2 Develop and obtain necessary materials and equipment
  - 3.5.3 Install and verify process or methodology
- 3.6 Manage the product/service development process

4.0 Market and Sell

- 4.1 Market products or services to relevant customer segments
  - 4.1.1 Develop pricing strategy
  - 4.1.2 Develop advertising strategy
  - 4.1.3 Develop marketing messages to communicate benefits
  - 4.1.4 Estimate advertising resource and capital requirements
  - 4.1.5 Identify specific target customers and their needs
  - 4.1.6 Develop sales forecast
  - 4.1.7 Sell products and services
  - 4.1.8 Negotiate terms
- 4.2 Process customer orders
  - 4.2.1 Accept orders from customers
  - 4.2.2 Enter orders int0 production and delivery process

5.0 Produce and deliver for manufacturing

- 5.1 Plan for and acquire necessary resources
  - 5.1.1 Select and certify suppliers
  - 5.1.2 Purchase capital goods
  - 5.1.3 Purchase materials and supplies
  - 5.1.4 Acquire appropriate technology
- 5.2 Convert resources or inputs into products
  - 5.2.1 Develop and adjust production delivery process (for existing process)
  - 5.2.2 Schedule production
  - 5.2.3 Move materials and resources
  - 5.2.4 Make product
  - 5.2.5 Package product
  - 5.2.6 Warehouse or store product
  - 5.2.7 Stage products for delivery
- 5.3 Deliver products
  - 5.3.1 Arrange product shipment
  - 5.3.2 Deliver products to customers
  - 5.3.3 Install product

- 5.3.4 Confirm specific service requirements for individual customers
- 5.3.5 Identify and schedule resources to meet service requirements
- 5.3.6 Provide the service to specific customers

5.4 Manage production and delivery process
- 5.4.1 Document and monitor order status
- 5.4.2 Manage inventories
- 5.4.3 Assure product quality
- 5.4.4 Schedule and perform maintenance
- 5.4.5 Monitor environmental constraints

6.0 Produce and deliver for service oriented organizations

6.1 Plan for and acquire necessary resources
- 6.1.1 Select and certify suppliers
- 6.1.2 Purchase materials and supplies
- 6.1.3 Acquire appropriate technology

6.2 Develop human resource skills
- 6.2.1 Define skill requirements
- 6.2.2 Identify and implement training
- 6.2.3 Monitor and manage skill development

6.3 Deliver service to the customer
- 6.3.1 Confirm specific service requirements for individual customer
- 6.3.2 Identify and schedule resources to meet service requirements
- 6.3.3 Provide the service to specific customers

6.4 Ensure quality of service

7.0 Invoice and service customers

7.1 Bill the customer
- 7.1.1 Develop, deliver, and maintain customer billing
- 7.1.2 Invoice the customer
- 7.1.3 Respond to billing inquiries

7.2 Provide after-sales service
- 7.2.1 Provide post-sales service
- 7.2.2 Handle warranties and claims

7.3 Respond to customer inquiries
- 7.3.1 Respond to information requests
- 7.3.2 Manage customer complaints

8.0 Develop and manage human resources

8.1 Create and manage human resource strategies
- 8.1.1 Identify organizational strategic demands
- 8.1.2 Determine human resource costs
- 8.1.3 Define human resource requirements
- 8.1.4 Define human resource's organizational role

- 8.2 Cascade strategy to work level
  - 8.2.1 Analyze, design, or redesign work
  - 8.2.2 Define and align work outputs and metrics
  - 8.2.3 Define work competencies
- 8.3 Manage deployment of personnel
  - 8.3.1 Plan and forecast workforce requirements
  - 8.3.2 Develop succession and career plans
  - 8.3.3 Recruit, select and hire employees
  - 8.3.4 Create and deploy teams
  - 8.3.5 Relocate employees
  - 8.3.6 Restructure and rightsize workforce
  - 8.3.7 Manage employee retirement
  - 8.3.8 Provide outplacement support
- 8.4 Develop and train employees
  - 8.4.1 Align employee and organization development needs
  - 8.4.2 Develop and manage training programs
  - 8.4.3 Develop and manage employee orientation programs
  - 8.4.4 Develop functional/process competencies
  - 8.4.5 Develop management/leadership competencies
  - 8.4.6 Develop team competencies
- 8.5 Manage employee performance, reward and recognition
  - 8.5.1 Define performance measures
  - 8.5.2 Develop performance management approaches and feedback
  - 8.5.3 Manage team performance
  - 8.5.4 Evaluate work for market value and internal equity
  - 8.5.5 Develop and manage base and variable compensation
  - 8.5.6 Manage reward and recognition programs
- 8.6 Ensure employee well-being and satisfaction
  - 8.6.1 Manage employee satisfaction
  - 8.6.2 Develop work and family support systems
  - 8.6.3 Manage and administer employee benefits
  - 8.6.4 Manage workplace health and safety
  - 8.6.5 Manage internal communications
  - 8.6.6 Manage and support workforce diversity
- 8.7 Ensure employee involvement
- 8.8 Manage labor-management relationships
  - 8.8.1 Manage collective bargaining process
  - 8.8.2 Manage labor-management partnerships
- 8.9 Develop Human Resource Information Systems (HRIS)

9.0 Manage information resources

- 9.1 Plan for information resource management
  - 9.1.1 Derive requirements from business strategies
  - 9.1.2 Define enterprise system architectures
  - 9.1.3 Plan and forecast information technologies & methodologies

9.1.4 Establish enterprise data standards
9.1.5 Establish quality standards and controls
9.2 Develop and deploy enterprise support systems
9.2.1 Conduct specific needs assessments
9.2.2 Select information technologies
9.2.3 Define data life cycles
9.2.4 Develop enterprise support systems
9.2.5 Test, evaluate, and deploy enterprise support systems
9.3 Implement systems security and controls
9.3.1 Establish systems security strategies and levels
9.3.2 Test, evaluate, and deploy systems security and controls
9.4 Manage information storage & retrieval
9.4.1 Establish information repositories (database)
9.4.2 Acquire & collect information
9.4.3 Store information
9.4.4 Modify and update information
9.4.5 Enable retrieval of information
9.4.6 Delete information
9.5 Manage facilities and network operations
9.5.1 Manage centralized facilities
9.5.2 Manage distributed facilities
9.5.3 Manage network operations
9.6 Manage information services
9.6.1 Manage libraries and information centers
9.6.2 Manage business records and documents
9.7 Facilitate information sharing and communication
9.7.1 Manage external communications systems
9.7.2 Manage internal communications systems
9.7.3 Prepare and distribute publications
9.8 Evaluate and audit information quality

10.0 Manage financial and physical resources
10.1 Manage financial resources
10.1.1 Develop budgets
10.1.2 Manage resource allocation
10.1.3 Design capital structure
10.1.4 Manage cash flow
10.1.5 Manage financial risk
10.2 Process finance and accounting transactions
10.2.1 Process accounts payable
10.2.2 Process payroll
10.2.3 Process accounts receivable, credit and collections
10.2.4 Close the books
10.2.5 Process benefits and retiree information
10.2.6 Manage travel and entertainment expenses

- 10.3 Report information
  - 10.3.1 Provide external financial information
  - 10.3.2 Provide internal financial information
- 10.4 Conduct internal audits
- 10.5 Manage the tax function
  - 10.5.1 Ensure tax compliance
  - 10.5.2 Plan tax strategy
  - 10.5.3 Employ effective technology
  - 10.5.4 Manage tax controversies
  - 10.5.5 Communicate tax issues to management
  - 10.5.6 Manage tax administration
- 10.6 Manage physical resources
  - 10.6.1 Manage capital planning
  - 10.6.2 Acquire and redeploy fixed assets
  - 10.6.3 Manage facilities
  - 10.6.4 Manage physical risk.

11.0 Execute environmental management program

- 11.1 Formulate environmental management strategy
- 11.2 Ensure compliance with regulations
- 11.3 Train and educate employees
- 11.4 Implement pollution prevention program
- 11.5 Manage remediation efforts
- 11.6 Implement emergency response programs
- 11.7 Manage government agency and public relations
- 11.8 Manage acquisition/divestiture environmental issues
- 11.9 Develop and manage environmental information system
- 11.10 Monitor environmental management

12.0 Manage external relationships

- 12.1 Communicate with shareholders
- 12.2 Manage government relationships
- 12.3 Build lender relationships
- 12.4 Develop public relations program
- 12.5 Interface with board of directors
- 12.6 Develop community relations
- 12.7 Manage legal and ethical issues

13.0 Manage improvement and change

- 13.1 Measure organizational performance
  - 13.1.1 Create measurement systems
  - 13.1.2 Measure product and service quality
  - 13.1.3 Measure cost of quality
  - 13.1.4 Measure costs
  - 13.1.5 Measure cycle time
  - 13.1.6 Measure productivity

13.2 Conduct quality assessments
  13.2.1 Conduct quality assessments based on external criteria
  13.2.2 Conduct quality assessments based on internal criteria
13.3 Benchmark performance
  13.3.1 Develop benchmarking capabilities
  13.3.2 Conduct process benchmarking
  13.3.3 Conduct competitive benchmarking
13.4 Improve processes and systems
  13.4.1 Create commitment for improvement
  13.4.2 Implement continuous process improvement
  13.4.3 Reengineer business processes and systems
  13.4.4 Manage transition to change
13.5 Implement TQM
  13.5.1 Create commitment for TQM
  13.5.2 Design and implement TQM systems
  13.5.3 Manage TQM life cycle

Appendix 2
Six Sigma Conversion Table

This Appendix enables the user to understand the six sigma column on the process performance statement. The second column—sigma column—lists the process standard deviation. The column to the right lists the errors per million. For example, a 6.0 sigma would result in 3.4 errors per million. Alternatively, a 2.0 sigma would have 308,000 errors per million.

Yield %	*Sigma*	*Defects Per Million Opportunities*
99.9997	6.00	3.4
99.9995	5.92	5
99.9992	5.81	8
99.9990	5.76	10
99.9980	5.61	20
99.9970	5.51	30
99.9960	5.44	40
99.9930	5.31	70
99.9900	5.22	100
99.9850	5.12	150
99.9770	5.00	230
99.9670	4.91	330
99.9520	4.80	480
99.9320	4.70	680
99.9040	4.60	960
99.8650	4.50	1350
99.8140	4.40	1860
99.7450	4.30	2550
99.6540	4.20	3460
99.5340	4.10	4660
99.3790	4.00	6210
99.1810	3.90	8190

(*continued*)

Yield %	Sigma	Defects Per Million Opportunities
98.9300	3.80	10700
98.6100	3.70	13900
98.2200	3.60	17800
97.7300	3.50	22700
97.1300	3.40	28700
96.4100	3.30	35900
95.5400	3.20	44600
94.5200	3.10	54800
93.3200	3.00	66800
91.9200	2.90	80800
90.3200	2.80	96800
88.5000	2.70	115000
86.5000	2.60	135000
84.2000	2.50	158000
81.6000	2.40	184000
78.8000	2.30	212000
75.8000	2.20	242000
72.6000	2.10	274000
69.2000	2.00	308000
65.6000	1.90	344000
61.8000	1.80	382000
58.0000	1.70	420000
54.0000	1.60	460000
50.0000	1.50	500000
46.0000	1.40	540000
43.0000	1.32	570000
39.0000	1.22	610000
35.0000	1.11	650000
31.0000	1.00	690000
28.0000	0.92	720000
25.0000	0.83	750000
22.0000	0.73	780000
19.0000	0.62	810000
16.0000	0.51	840000
14.0000	0.42	860000
12.0000	0.33	880000
10.0000	0.22	900000
8.0000	0.09	920000

Assumptions

- There is a standard sigma shift of 1.5, per Motorola recommendation.
- The data is normally distributed.
- The process is stable.
- The calculations are made with using one-tail values of the normal distribution.

Glossary

Activity. A structured set of work steps that consume resources and information to convert inputs into an output; typically performed within a single group; can be classified into control, process, move, decision, store/file, input, report, and get information types.

Activity-based costing (ABC). Determining the cost of products/services, customers, and channels with activities and business processes. Activities consume costs, and cost objectives consume activities and business processes.

Activity analysis. Quantifies your organization's work into activities; shows the work that is done daily.

Activity-based management (ABM). Structuring an organization's activities and business processes to meet customer and other stakeholder needs with the least resources to produce a consistent output; planning and control of an organization through its activities and business processes.

Allocating. Assigning costs based on mutual agreement because no cause-and-effect relationship exists or the effort to establish a cause-and-effect relationship is of insufficient value.

Attributes. Activity characteristics, including primary/secondary; strategic, discretionary, required; non-value-added; cycle time, quality, and capacity.

Benchmarking/best practices. Comparing activities and business processes internally or externally with other locations, other similar organizations, or the best in the world.

Bill of activities. A listing of activities, business processes, and direct costs related to a product/service, customer, or other cost object where the cause-and-effect relationship can be cost-effectively established.

Business process. A significant business output that requires work to be performed by several groups as a sequence of related and interdependent activities or is performed at multiple locations (for example, manufacture or create product/service, market and sell product/service, procure supplies, distribute product/service, provide customer service, provide technology, provide skilled employees, provide information, support infrastructure).

Business process reengineering (BPR). The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed; used to ensure continuous improvement.

Capacity. The maximum availability of a resource. Can include theoretical, practical, budgeted, normal, surge, idle, seasonal, and committed capacity.

Capacity management. Creating value by allocating resources to activities to ensure there is adequate but not excessive capacity to perform the activity.

Cascading strategy. Flowing strategy throughout the organization from the president to the janitor and receptionist so everyone in the organization understands how his or her activities relate to the strategy.

Cause-and-effect diagrams. Diagrams used to better understand what are the root causes of a specific result. Also known as fishbone diagrams.

Cash flow velocity. The time between a cost outflow and the corresponding cash inflow; eliminates the need to distinguish between accounting earnings and cash flow because the two values become synonymous. The best possible value is zero or even negative (where an organization is prepaid before they must incur the cost of providing the product or service).

Characteristics. An attribute of product/service or customer that causes a process to take more time or incur more cost.

Common causes of variation. The methods, materials, machines, personnel, and environment that make up a process and the inputs required by the process; attributable to the design of the process; affect all output of the process and may affect everyone who participates in the process.

Continuous improvement. An important part of any activity-based budget wherein every employee works to improve the cost, time, and quality of activities and business processes that the customer is willing to pay for or that regulators require.

Control chart. A time series graph that plots process results over time with three lines added-a center line (process mean) that provides a visual reference for detecting shifts or trends, and control lines (limits) placed equidistant on either side of the center line; monitors the process variation over time by plotting the process results.

Cost center. Responsibility center that is accountable for costs (for example, department).

Cost driver. Any condition or factor that results in the increase of activity workload or cost-the root cause of cost.

Direct costs. Actual costs incurred or committed to a department, activity, or cost object.

Discounted cash flow (DCF). A technique for projecting annual cash flow into the future and then discounting its value back to the present, taking into account the time value of money. Every idea will be reduced to cash flow streams: How much will come in and when? Companies should calculate the present value of future cash flows using a larger discount factor that shrinks the value of future cash flows in proportion to increased risk.

Earned value. Calculated by multiplying actual workload by a budgeted activity rate; the amount of cost that a product or business process has earned based on workload.

Economic value added (EVA). Asserts that shareholders must earn a return that compensates them for their risk. Equity capital has to earn at least the same return as similarly risky investments in the equity market. There is no real value created in the minds of investors and actually the company operates at a value loss when this is not the case. On the other hand, if EVA is zero, this should be treated as a sufficient achievement because the shareholders have earned a return that compensates for the risk. The EVA approach—using average risk-adjusted market return as a minimum requirement—is justified because that average stock market return is obtainable from a diversified long-term investment on the stock markets. Average long-term stock market return reflects the average return that public companies generate from their operations.

Employees. Hourly, salaried, and commissioned workers.

Equipment. Machinery and computers that improve the productivity of employees.

Facility. Total area occupied by the organization or department, including land, building, leasehold improvements, furniture, and fixtures.

Feature. Any aspect of a product/service, customer, or process that increases the number of tasks or requires different tasks.

Feature costing. A technique that seeks to identify process variation caused by unique aspects (features) of individual products/services or customers.

Function. A group of activities having a common objective using common processes and requiring similar skills and experience.

Gap analysis. The study of the difference between an organization's goals and its current activity and business process performance.

Income statement. A statement that lists sales, revenues, and appropriations, as well as expenses over a set period of time.

Indirect costs. (1) Costs common to a multiple set of cost objectives and not directly assignable to such objectives in a specific time period. Such costs are traditionally allocated, by systematic and consistent techniques, to products/services, processes, and customers. (2) Costs that are not directly assignable or traceable to a product/service, customer, or process, but are traceable to an activity. (3) Expenses that do not have a close causal relation with the items being produced (for example, accounting, human resource, and senior management departments).

Input. The event (for example, a physical or electronic document) that triggers an activity. An activity may have more than one input but only one output.

Intangible value. Value in the form of intellectual capital (for example, process knowledge and innovation capacity).

Internal accounting. Identification, measurement, accumulation, analysis, preparation, interpretation, and communication of information that assists in fulfilling organizational objectives. Also called **management accounting**.

Life-cycle activity. An activity (for example, design new service) that should be amortized over the life cycle (for example, product development to product discontinuance) of a product/service.

Life-cycle costing. Accumulation of costs for activities that occur over the entire life cycle of a product/service, from inception to abandonment.

Macro process. See **Business process.**

Management accounting. Identification, measurement, accumulation, analysis, preparation, interpretation, and communication of information that assists in fulfilling organizational objectives. Also called **internal accounting** rather than financial accounting.

Materials. All supplies and sundries consumed by the business process.

Noise (process). Expected variation that is random and miscellaneous. Confuses and clouds all comparisons between single values.

Non-value-added activity. Activities that do not contribute to meeting customer requirements and could be eliminated without degrading the product/service or ongoing stability of the organization (for example, consequence of not doing it right the first time, unsynchronized work flow, bottlenecks, waiting, storing, moving). Even though an activity is value added, some of the tasks may be non-value added.

Non-value-added cost. An activity cost other than the minimum amount of equipment, supplies, space, and workers' time that is absolutely essential to meet customer requirements or organization stability.

Non-traceable activities. Activities, business processes, and direct costs where a cause-and-effect relationship cannot be cost effectively established with the item being costed.

Organization structure. The arrangement of lines of responsibility in an organization.

Outcome. Fundamental purpose of an activity or business process. Should be quantifiable and clearly understood.

Output. What your customer gets from you. Types include repetitive–standard work; repetitive–non-standard work; cognitive work; time-based work; project work; diverse work.

Output measure. Quantifies workload or the amount of work completed; provides a useful indicator and measurement on the overall performance of the activity.

Ownership. Employees "own" a process when they feel they are an integral part of that budget and understand its workings.

Practical capacity. A measurement of capacity that takes into account normal preventative maintenance, upgrades, holidays, and so forth.

Performance driver. Prime factor influencing the performance of an activity.

Performance measures. Metrics and goals for cost, time, and quality of activities, business processes, and cost objects.

Performance reporting. System of reporting and planning based on data collected from performance drivers and performance measures.

Planning. Delineation of goals, predictions of potential results of various ways of achieving goals, and a decision of how to attain the desired results.

Primary activity. Produces an output that is consumed outside the group that performs the work (for example, pay vendor, issue license); contributes directly to the mission of the department or organization.

Process. A repeatable series of actions or operations that consume resources to transform material, energy, or information into outputs that are provided to customers. (1) Proceeding or moving toward, progressive course, tendency, progress, procedure. (2) A continuing development involving many changes. (3) A particular method of doing something, generally involving a number of steps or operations.

Process control limits. Two horizontal lines added to a control chart so when the process is in control, the probability of the individual value of the process result falling outside the limits is very small.

Process controls. Monitor the process as it executes to detect process variations. (1) Detail process steps. (2) Assess which steps are most likely to have variation. (3) Determine the factors that cause process variation. (4) Determine how to monitor high-variation steps. Review process controls when the process changes, there is significant change to input, and there is significant process variation remains in process. Stabilize and then monitor the process.

Process decay. The deterioration of the value-creation potential of processes that occurs over time. The deterioration is caused by changes in the factors that influence value, such as the economy, competitors, technology advances, changing product mix, process capability, and capacity, among others. All processes decay at different rates depending on the rate of change of external factors. Value-creation potential depends on the degree of process decay and how effectively an organization overcomes process decay by way of process improvements.

Process dictionary. A listing of organization processes, activities and attributes (input, output, output measure, customer, supplier, performance measures, cost drivers, function, business process, outcomes, features, characteristics, value/non-value, primary/secondary, strategic, discretionary, required; and life cycle).

Process goals. Desired effect achieved by the performance of the key activities within each process.

Process improvement tools. (1) Bureaucracy elimination. (2) Duplication elimination. (3) Value-added analysis. (4) Cost driver/root cause analysis. (5) Simplification.

Process management. Continuously improve (change) the processes and activities of an organization to effectively and efficiently meet or exceed changing customer requirements; ensure the process is in control and consistently produces good results. Achieved by progressively implementing many changes to ensure the process is made better than its previous performance. Activities and processes have process controls in place to monitor the process as it is being performed. Costs must be viewed in terms of used and unused capacity costs rather than the traditional fixed and variable distinction. Separating the used and unused component enables management to understand the root cause of the problem rather than burying the variance in the wrong place.

Process maps. Graphic or pictorial representation of the activities that make up a business process and how process steps are sequenced, and identifies the information that links processes.

Process mean (average). The sum of the values divided by the number of values.

Product concept. Characteristics that reflect customer's values.

Project activities. One-time activities that have a defined start and end date.

Quality. The extent to which a product or service satisfies the needs and performances of the user. Quality usually is measured by its conformance to specifications.

Reengineering. See **Business process reengineering.**

Resources. Factors of product/service creation and production consumed by an activity (for example, people, facilities, technology, travel, and supplies).

Resource usage. Determined by summing the total hours a resource is consumed within an activity.

Secondary activity. Makes the primary activities more effective or are administrative in nature (for example, manage employee, train employee).

Service or service levels. The quality and frequency of activities provided to internal or external customers.

Service costs. Costs of activities and business processes that are directly or indirectly involved in the production of services to internal or external customers.

Service/product development. All activities required to define, design, develop, test, and maintain a service/product.

Service lead-time. Time from the first stage of operations to when the service, activity, or business process is finished (that is, queue time).

Signal (process). A process result that exceeds the expected variation. Indicates that something has changed in the process that has resulted in the unexpected result. To detect a signal within a process, you must filter out the noise.

Special causes of variation. Events that are not part of the process design. Typically, they are transient, fleeting events that affect only local areas or operations within the process for a brief period of time. Occasionally, such events may have a persistent or recurrent effect on the process.

Standard cost. Normally, the budgeted or anticipated cost of an activity, business process, or specific service at a given level of volume and under an assumed set of circumstances.

Strategic deployment. Allocating resources and manpower to achieve goals, meet customer needs, and ensure quality.

Strategic planning. Long range in nature; concentrates on customers and markets to be served.

Strategy. Statement of organization's plan to achieve specific goals.

Statistical control. A process whose output distribution does not change over time is said to be in a state of statistical control, or simply in control. If the distribution does change, it is said to be out of statistical control, or simply out of control.

Statistical process control (SPC). Monitoring and eliminating variation to keep a process in a state of statistical control or to bring a process into statistical control.

Surge capacity. Excess capacity needed to meet unexpected seasonal/cyclical, product start-up demands, or management policies.

System. A collection or arrangement of interacting processes that has an ongoing purpose or mission. Receives inputs from its environment, transforms those inputs into outputs and delivers them to its environment. To survive, a system uses feedback (that is, information) from its environment to understand and adapt to changes in its environment.

Target cost. A cost that is market-based cost and equals what customers are willing to pay, minus a profit target set by management.

Task. Specific steps describing how an activity is done. Detailed steps in producing an output. Should sufficiently describe how the output is produced. Only include tasks of significant time/ importance. See **feature** and **characteristics**.

Technology cost. The purchase price, start-up cost, interest, current market value adjustment, operating costs, and risk premium of acquiring technology.

Throughput. Total time of product/service production through a facility (for example, work center, department, office).

Total quality management (TQM). A management strategy in which functions work together to create a quality product or service as defined by the customer.

Tracing or traceable activities. Assigning cost based on a cause-and-effect relationship.

Value-added activity. Activities that contribute to meeting customer requirements and could not be eliminated without degrading the service, or are essential to the ongoing stability of the organization.

Value-added cost. Cost of activities that contribute to customer requirements and could not be eliminated without degrading the service, or are essential to the ongoing stability of the organization.

Waste. Non-value-added activities and tasks.

Work group. Consists of either an organizational unit in the formal organizational structure or a process work team. A process work team is a group of people from multifunctional disciplines who have shared responsibility to produce a specific end product or provide a specific service. Each unit or work team functions in a relatively autonomous or self-directed manner.

Workload. The amount of input volume that a particular activity or business process must convert into output.

Work Center. A specific area of the organization consisting of one or more people or equipment that perform essentially the same function. A work center may consist of work cells or workstations.

Work In Progress. A product or service that is partially completed.

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The Handbook of Process-Based Accounting

JAMES A. BRIMSON

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