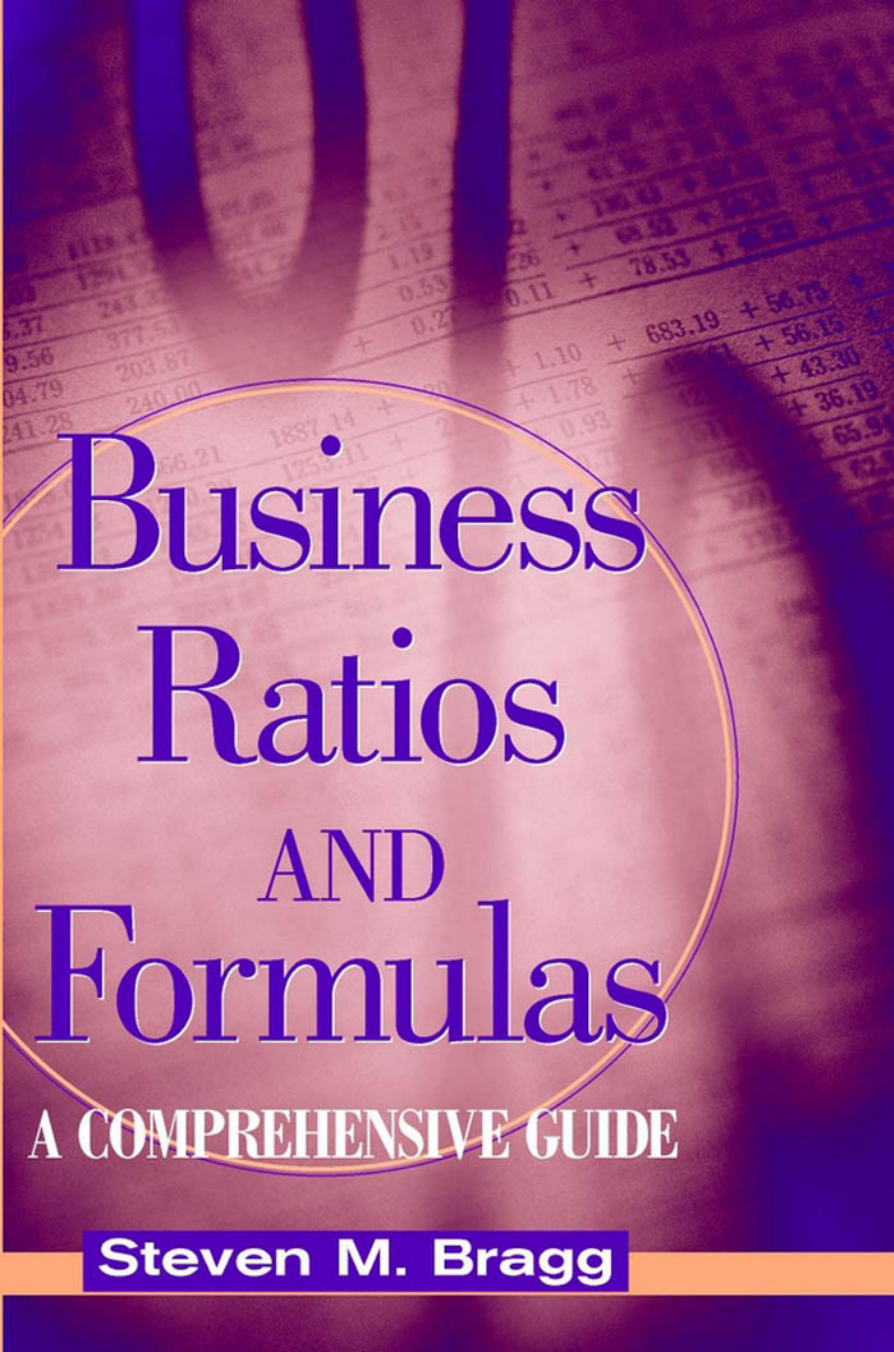
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Ratios
AND
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A COMPREHENSIVE GUIDE
Steven M. Bragg

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Dedication

To Andrea and Victoria: The value of watching you grow
has been beyond measurement.

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To Sheck Cho, the editor I have known longer than anyone else in the publishing business. Sheck, I value your experience and advice—you are the best.

Contents

About the Author xv
Preface xvii

1 Introduction 1

2 Asset Utilization Measurements 5
Sales to Working Capital Ratio 6
Sales to Fixed Assets Ratio 7
Sales to Administrative Expenses Ratio 9
Sales to Equity Ratio 10
Sales per Person 11
Sales Backlog Ratio 13
Sales Returns to Gross Sales Ratio 14
Repairs and Maintenance Expense to Fixed Assets Ratio 15
Accumulated Depreciation to Fixed Assets Ratio 17
Fringe Benefits to Wages and Salaries Expense 18
Sales Expenses to Sales Ratio 19
Discretionary Cost Ratio 20
Interest Expense to Debt Ratio 21
Foreign Exchange Ratios 22
Overhead Rate 24
Goodwill to Assets Ratio 26
Overhead to Cost of Sales Ratio 27
Investment Turnover 29
Break-Even Point 30

Margin of Safety 31
Tax Rate Percentage 32

3 Operating Performance Measurements 35
Operating Assets Ratio 35
Sales to Operating Income Ratio 37
Sales Margin 38
Gross Profit Percentage 39
Gross Profit Index 40
Investment Income Percentage 41
Operating Profit Percentage 42
Operating Leverage Ratio 43
Net Income Percentage 45
Profit per Person 46

4 Cash Flow Measurements 49
Cash Flow from Operations 49
Cash Flow Return on Sales 51
Fixed Charge Coverage 52
Expense Coverage Days 53
Cash Flow Coverage Ratio 55
Cash Receipts to Billed Sales and Progress Payments 56
Cash to Current Assets Ratio 57
Cash Flow to Fixed Asset Requirements 58
Cash Flow Return on Assets 59
Cash to Working Capital Ratio 61
Cash Reinvestment Ratio 62
Cash to Current Liabilities Ratio 63
Cash Flow to Debt Ratio 64
Stock Price to Cash Flow Ratio 66
Dividend Payout Ratio 67

5 Liquidity Measurements 69
Accounts Receivable Turnover 69
Average Receivable Collection Period 71
Days Delinquent Sales Outstanding 72
Days Sales in Receivables Index 73
Accounts Receivable Investment 74
Ending Receivable Balance 76

Inventory to Sales Ratio 77
Inventory Turnover 78
Inventory to Working Capital Ratio 81
Liquidity Index 82
Accounts Payable Days 83
Accounts Payable Turnover 84
Current Ratio 85
Quick Ratio 86
Cash Ratio 87
Sales to Current Assets Ratio 88
Working Capital Productivity 89
Defensive Interval Ratio 90
Current Liability Ratio 92
Required Current Liabilities to Total Current Liabilities Ratio 93
Working Capital to Debt Ratio 94
Risky Asset Conversion Ratio 95
Noncurrent Assets to Noncurrent Liabilities Ratio 96
Short-term Debt to Long-term Debt Ratio 98
Altman's Z-Score Bankruptcy Prediction Formula 99

6 Capital Structure and Solvency Measurements 103
Times Interest Earned 103
Debt Coverage Ratio 104
Asset Quality Index 106
Accruals to Assets Ratio 107
Times Preferred Dividend Earned 109
Debt to Equity Ratio 110
Funded Capital Ratio 112
Retained Earnings to Stockholders' Equity 113
Preferred Stock to Total Stockholders' Equity 114
Issued Shares to Authorized Shares 115

7 Return on Investment Measurements 119
Net Worth 119
Book Value Per Share 121
Tangible Book Value 122
Return on Assets Employed 123
Return on Operating Assets 125

Return on Equity Percentage 126
Return on Common Equity 127
Financial Leverage Index 129
Equity Growth Rate 130
Earnings per Share 131
Percentage Change in Earnings Per Share 132
Economic Value Added 133
Dividend Payout Ratio 136
Dividend Yield Ratio 137

8 Market Performance Measurements 139
Insider Stock Buy-Sell Ratio 139
Market Value Added 141
Stock Options to Common Shares Ratio 143
Cost of Capital 144
Sales to Stock Price Ratio 147
Price/Earnings Ratio 148
Capitalization Rate 149

9 Measurements for the Accounting/Finance Department 151
Purchase Discounts Taken to Total Discounts 152
Percentage of Payment Discounts Missed 154
Transactions Processed per Person 155
Transaction Error Rate 156
Average Time to Issue Invoices 157
Average Employee Expense Report Turnaround Time 158
Payroll Transaction Fees per Employee 160
Time to Produce Financial Statements 162
Percentage of Tax Filing Dates Missed 163
Proportion of Products Costed Prior to Release 164
Internal Audit Savings to Cost Percentage 165
Internal Audit Efficiency 167
Bad Debt Percentage 168
Percent of Receivables over XX Days Old 169
Percentage Collected of Dollar Volume Assigned 171
Percent of Cash Applied on Day of Receipt 172

Cost of Credit 173
Earnings Rate on Invested Funds 174
Brokerage Fee Percentage 175
Borrowing Base Usage Percentage 177

10 Measurements for the Engineering Department 179
Bill of Material Accuracy 179
Labor Routing Accuracy 181
Percentage of New Products Introduced 182
Percentage of Sales from New Products 183
Percentage of New Parts Used in New Products 184
Percentage of Existing Parts Reused in New Products 186
Average Number of Distinct Products per Design Platform 186
Percentage of Products Reaching Market before Competition 187
Ratio of Actual to Target Cost 188
Warranty Claims Percentage 190
Time from Design Inception to Production 191
Percentage of Floor Space Utilization 192

11 Measurements for the Logistics Department 195
Production Schedule Accuracy 196
Economic Order Quantity 197
Number of Orders to Place in a Period 198
Economic Production Run Size 199
Raw Material Inventory Turns 200
Raw Material Content 201
Finished Goods Inventory Turns 202
Obsolete Inventory Percentage 203
Percentage of Inventory > XX Days Old 204
Percentage of Returnable Inventory 205
Inventory Accuracy 206
Percentage of Certified Suppliers 208
Electronic Data Interchange Supplier Percentage 209
On-Time Parts Delivery Percentage 210
Purchased Component Defect Rate 212
Incoming Components Correct Quantity Percentage 213

Percentage of Actual Payments Varying from Purchase Order Price 214
Percentage of Purchase Orders Issued below Minimum Dollar Level 215
Proportion of Corporate Credit Card Usage 217
Percentage of Receipts Authorized by Purchase Orders 218
Freight Audit Recovery Ratio 219
Picking Accuracy for Assembled Products 220
Average Time to Ship 221
On-Time Delivery Percentage 223
Percentage of Products Damaged in Transit 224
Percentage of Sales through Distributors 225

12 Measurements for the Production Department 227
Constraint Productivity 228
Constraint Rework Percentage 229
Constraint Schedule Attainment 230
Constraint Utilization 231
Degree of Unbalance 232
Throughput Effectiveness 233
Break-Even Plant Capacity 234
Manufacturing Effectiveness 236
Productivity Index 237
Unit Output per Direct Labor Hour 239
Average Equipment Setup Time 240
Unscheduled Machine Downtime Percentage 241
Acceptable Product Completion Percentage 242
Work-in-Process Turnover 244
Scrap Percentage 245
Warranty Claims Percentage 247
Maintenance Expense to Fixed Assets Ratio 248
Indirect Expense Index 249
Reorder Point 250
On-Time Delivery Ratio 252

13 Measurements for the Sales and Marketing Department 255
Market Share 255

Customer Turnover 256
Browse to Buy Conversion Ratio 258
Recency 259
Direct Mail Effectiveness Ratio 260
Inbound Telemarketing Retention Ratio 262
Quote to Close Ratio 263
Sales per Salesperson 264
Sales Productivity 265
Sales Effectiveness 266
Sales Trend Percentage by Product Line 268
Product Demand Elasticity 269
Days of Backlog 270

14 Measurement Analysis with an Electronic Spreadsheet 273
Financial Statement Proportional Analysis 274
Financial Statement Ratio Analysis 275
Automated Ratio Result Analysis 278
Leverage Analysis 279
Trend Analysis 281
Forecasting 283
Cash Flow Analysis 286
Capital Asset Analysis 288
Compounding Analysis 290
Investment Analysis 292
Risk Analysis 295

Glossary 297
Appendix: Measurement Summary 303
Index 327

About the Author

Steven Bragg, CPA, CMA, CIA, CPM, CPIM, has been the chief financial officer or controller of four companies, as well as a consulting manager at Ernst & Young. He received a master's degree in finance from Bentley College, an MBA from Babson College, and a bachelor's degree in economics from the University of Maine. Mr. Bragg resides in Centennial, Colorado. He has also written the following books: *Accounting and Finance for Your Small Business* (Wiley), *Accounting Best Practices* (Wiley), *Accounting Reference Desktop* (Wiley), *Advanced Accounting Systems* (Institute of Internal Auditors), *Controllership* (Wiley), *Cost Accounting* (Wiley), *Financial Analysis* (Wiley), *Just-in-Time Accounting* (Wiley), *Managing Explosive Corporate Growth* (Wiley), *Outsourcing* (Wiley), *Sales and Operations for Your Small Business* (Wiley), and *The Controller's Function* (Wiley).

Preface

This book is designed for corporate managers who need to understand the performance levels of their departments. It contains performance measurements for the accounting, engineering, logistics, production, and sales departments. These measurements cover not only financial matters, but also efficiency, effectiveness, capacity, and market share. In addition, the book includes measurements related to asset utilization, operating performance, cash flows, liquidity, capital structure, return on investment, and market performance. These latter categories are of great interest not only to the accounting and finance departments, but also to a company's creditors and investors.

There are nearly 200 measurements in this book. Each one is accompanied by a complete description, an explanation of the calculation, an example, and cautions regarding its use. The cautions are of particular use since they describe the elements of a measurement that can be modified to deliver misleading results, different measurements that may work better in certain situations, use on a trend-line basis, and other measurements that should be used to reinforce indicated results.

The book also describes how to use an electronic spreadsheet to compile a standard set of measurements, using Microsoft Excel as the template. This is especially useful for investors and financial personnel, who need to compile information about a company's long-term performance.

Anyone who wishes to create a complete set of performance-tracking measurements for an entire company or for a specific function can use this book as a reference source. Managers can choose the correct blend of measurements to achieve an information set that can be used for feedback on strategy initiatives and specific efficiency projects, as well as for performance evaluations. This is the ideal tool for measuring corporate performance.

Centennial, Colorado
August 2002

1

Introduction

Every department in every business produces some kind of information that can be used by its manager to measure performance. This information may be related to operational considerations within the department, the financial condition of the entire company, or the performance of a company's suppliers and customers. Unfortunately, managers may not be aware of the multitude of measurements that can be used to track these different levels of performance or of the ways that these measurements can yield incorrect or misleading information.

This book is designed to help managers select the best possible set of measurements for a given situation. Chapters 2 through 13 itemize a series of performance measurements for different aspects of a company. Chapter 2 contains asset utilization measurements that can be used to determine a company's ability to sustain its sales, the level of asset and expense usage required to do so, and the sustainability of its current sales and expense levels. There are also specialized ratios that deal with such issues as sales returns, repairs and maintenance, fringe benefits, interest expense, and overhead rates.

Chapter 3 contains operating performance measurements, which describe an organization's operating performance in such areas as sales, gross margins, investment income, operating profit, and net profit.

Chapter 4 contains cash flow measurements, which are useful in determining the ability of a company's cash flows to keep it in business. These measurements should be used in conjunction with the liquidity measurements in Chapter 5, which focus on additional measurements related to cash flows, such as a company's ability to collect accounts receivable in an efficient manner, use its inventory within a short time frame, pay its accounts payable when due, and generally maintain a sufficient amount of liquid funds to pay off short-term liabilities. Chapter 6 contains capital structure and solvency measurements, which determine the relationship between a company's debt and equity, as well as the comparative proportions of different types of stock. It also addresses a company's ability to remain solvent and so can be used in conjunction with Chapters 4 and 5.

Chapter 7 contains return on investment measurements, which encompass net worth, several types of return on assets and equity, earnings per share, economic value added, and return on dividends. Chapter 8 addresses a company's financial

market performance by describing such measurements as the price/earnings ratio, several variations on the stock options to common shares ratio, market value added, and the cost of capital.

Chapters 9 through 13 cover measurements for individual departments. These chapters are devoted to performance measurements for the accounting, engineering, logistics, production, and sales departments. In contrast to Chapters 2 through 8, which are devoted to measurements that are primarily used by the accounting and finance functions, Chapters 9 through 12 are more concerned with such issues as work capacity levels, efficiency, and effectiveness, which in many cases require no financial information at all. For example, measurements in Chapter 11, which deals with logistics, cover such topics as production schedule accuracy, the on-time parts delivery percentage, and picking accuracy for assembled products.

Chapter 14 covers a variety of topics related to measurements using the Microsoft Excel electronic spreadsheet, including how to set up comprehensive sets of measurements that can be used for proportional, leverage, ratio, and trend analyses. It also covers a variety of spreadsheet formulas and report formats for forecasting, cash flow analysis, capital asset purchase analysis, interest compounding, investment analysis, and risk analysis.

The book concludes with an appendix and glossary. The Appendix lists the names and formulations of every measure in the book, sorted by chapter. This list should only be used with the precautions given for them in their respective chapters to ensure their proper use. The Glossary covers the definitions of the terms found in many of the measurements listed in this book, to clarify the exact types of information needed.

The chapters containing measurements (Chapters 2 through 13) have an identical structure. Each begins with a table that lists the measurements described in it, which one can use to quickly access a needed calculation. Thereafter, each chapter is broken down into the discussion of individual measurements. Within each measurement section there are a description, formula, example, and discussion of cautionary items. The description typically notes how the measurement is used and who uses it. The formula shows any variations on the calculation and what types of data to include or exclude from it. The example is generally a complete scenario that describes how the measurement is used in a simulated business situation. Finally, any cautionary items are noted; these can include the ways in which the measurement can be altered to yield incorrect results, or what other measurement should be used with it in order to yield a more comprehensive set of information.

The reader may use this book to search for a single calculation, which can be used for highly targeted needs. However, a better approach is to peruse the entire book, with the objective of developing a complete set of measurements that will yield a more comprehensive view of a company's entire operating and financial situation. For example, a CFO might be interested in a company's stock market performance and therefore watches only the price/earnings ratio. However, this single measurement focuses only on the perception of investors with regard to a company's future earnings potential. A more rounded set of measurements might

include the days of sales backlog (since it indicates future changes in sales volume), production capacity utilization (since it shows the ability of the company to produce its incoming sales), and the days of accounts receivable (since it shows the company's ability to convert sales into cash). The exact set of measurements will change in accordance with a company's industry, size, operational configuration, and degree of financial leverage, but one issue will remain the same: A single measurement is not enough to yield a clear view of a company's financial and operating condition.

Even if a company has developed a reasonable set of measurements, this does not mean that they should never be changed. On the contrary, measured items will generally gather a great deal of management attention and then improve to the point where they no longer change—thereby resulting in a stale set of measurements. For example, inventory accuracy can improve only to 100%. At this point, the measurement is needed on a monitoring basis to ensure that it does not degrade, while a new measurement can be created to be the focus of corporate attention. However, there will be a few measurements, usually involving sales levels and break-even points, that will always be the centerpiece of any measurement system, since they bring attention to bear on the most crucial revenue and cost elements of the business. Thus, a properly designed measurement system should include a few key items that will be constant for many years, accompanied by other measures that are used for internal improvement purposes and will change in concert with corporate objectives.

This book is filled with nearly 200 financial and operational measurements that have proven to be of considerable use to the author in tracking the performance of many companies in a variety of industries. If you would like to see other measurements in the next edition of this book, please send your request to the author at *brasto@aol.com*.

2

Asset Utilization Measurements

This chapter focuses on the ratios and formulas that can be derived primarily from the income statement. There are several that require additional information from the balance sheet, as well as internal information, such as employee headcount, that may not be readily discernible from published financial statements. The general intent of the analysis tools presented here is to show a company's ability to sustain its sales, the level of asset and expense usage required to do so, and the sustainability of its current sales and expense levels. There are also specialized ratios that deal with such issues as sales returns, repairs and maintenance, fringe benefits, interest expense, and overhead rates.

Each of the following sections describes the uses of a ratio or formula, explains the proper method of calculation, and gives an example. Each section also discusses how each ratio or formula can be misused, skewed, or incorrectly applied.

The ratios and formulas presented in this chapter are:

- Sales to Working Capital Ratio
- Sales to Fixed Assets Ratio
- Sales to Administrative Expenses Ratio
- Sales to Equity Ratio
- Sales per Person
- Sales Backlog Ratio
- Sales Returns to Gross Sales Ratio
- Repairs and Maintenance Expense to Fixed Assets Ratio
- Accumulated Depreciation to Fixed Assets Ratio
- Fringe Benefits to Wages and Salaries Expense
- Sales Expenses to Sales Ratio
- Discretionary Cost Ratio
- Interest Expense to Debt Ratio
- Foreign Exchange Ratios
- Overhead Rate
- Goodwill to Assets Ratio
- Overhead to Cost of Sales Ratio
- Investment Turnover
- Break-Even Point
- Margin of Safety
- Tax Rate Percentage

SALES TO WORKING CAPITAL RATIO

Description: It is exceedingly important to keep the amount of cash used by an organization at a minimum, so that its financing needs are reduced. One of the best ways to determine changes in the overall use of cash over time is the ratio of sales to working capital. This ratio shows the amount of cash required to maintain a certain level of sales. It is most effective when tracked on a trend line, so that management can see if there is a long-term change in the amount of cash required by the business in order to generate the same amount of sales. For instance, if a company has elected to increase its sales to less creditworthy customers, it is likely that they will pay more slowly than regular customers, thereby increasing the company's investment in accounts receivable. Similarly, if the management team decides to increase the speed of order fulfillment by increasing the amount of inventory for certain items, then the inventory investment will increase. In both cases, the ratio of working capital to sales will worsen because of specific management decisions. This ratio is also used for budgeting purposes, since budgeted working capital levels can be compared to the historical amount of this ratio to see if the budgeted working capital level is sufficient.

Formula: Annualized net sales are compared to working capital, which is accounts receivable, plus inventory, minus accounts payable. One should not use annualized *gross* sales in the calculation, since this would include in the sales figure the amount of any sales that have already been returned and are therefore already included in the inventory figure. The formula is:

$$\frac{\text{Annualized net sales}}{\text{(Accounts receivable + Inventory – Accounts payable)}}$$

Example: The Jolt Power Supply Company has elected to reduce the amount of inventory it carries for some of its least-ordered stock items, with the goal of increasing inventory turnover from twice a year to four times a year. It achieves its inventory goal rapidly by selling back some of its inventory to its suppliers in exchange for credits against future purchases. Portions of its operating results for the first four quarters after this decision was made are shown in Table 2.1.

Table 2.1

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Revenue	$320,000	$310,000	$290,000	$280,000
Accounts receivable	$107,000	$103,000	$97,000	$93,000
Inventory	$640,000	$320,000	$320,000	$320,000
Accounts payable	$53,000	$52,000	$48,000	$47,000
Total working capital	$694,000	$371,000	$369,000	$366,000
Sales to working capital ratio	1:0.54	1:0.30	1:0.32	1:0.33

The ratio calculation at the end of each quarter is for annualized sales, so we multiply each quarterly sales figure by 4 to arrive at estimated annual sales. The accounts receivable turn over at a rate of once every 30 days, which does not change through the term of the analysis. Inventory drops in the second quarter to arrive at the new inventory turnover goal, while the amount of accounts payable stays at one-half of the revenue level, reflecting a typical distributor's gross margin of 50% throughout all four periods. The resulting ratio shows that the company has indeed improved its ratio of working capital to sales, but at the price of some lost sales to customers who were apparently coming to the company because of its broad inventory selection.

Cautions: As stated in Table 2.1, using this ratio to manage a business can result in unforeseen results, such as a drop in sales because of reduced inventory levels or tighter customer credit controls. Also, arbitrarily lengthening the terms of accounts payable in order to reduce the working capital investment will likely lead to strained supplier relations, which may eventually result in increased supplier prices or the use of different and less reliable suppliers.

SALES TO FIXED ASSETS RATIO

Description: In some industries, a key barrier to entry is the large amount of assets required to produce revenues. For example, the oil-refining business requires the construction of a complete refining facility before any sales can be generated. By using the sales to fixed assets ratio, one can see if a company is investing a great deal of money in assets in order to generate sales. This is a particularly effective measure when compared to the same ratio for other companies in the same industry; that is, if another company has found a way to generate profitable sales with a smaller asset investment, then it will be rewarded with a higher valuation. This measure is also useful when tracked on a trend line, so that one can see if there are any sudden jumps in asset investments that the company has made to incrementally bring in more sales. For example, a printing facility may have achieved 100% utilization of its printing plant, and so cannot generate more sales without a multimillion dollar investment in new equipment. In such cases, the key question is whether there is a reasonable expectation of generating a sufficient incremental increase in revenues to justify the additional investment.

Formula: Divide net sales for a full year by the total amount of fixed assets. There are several variations on this formula. One is to calculate annualized net sales on a rolling basis, so that the last 12 months of revenue are always used. This can be a better approach than attempting to extrapolate revenues forward for several months, especially if future revenues are uncertain. The denominator in the calculation, which is the amount of total fixed assets, may be used net of depreciation or before depreciation; the most common usage is after depreciation, since this is more indicative of the actual value of the assets. However, if accelerated

depreciation is used, there may be little relationship between the amount of depreciation recognized and the value of the fixed assets, which may lead one to use total fixed assets prior to accumulated depreciation. Both variations on the formula are shown here:

$$\frac{\text{Annualized net sales}}{\text{Total fixed assets}}$$

$$\frac{\text{Annualized net sales}}{\text{Total fixed assets prior to accumulated depreciation}}$$

Example: The Turtle Tank Company creates tracked vehicles for a number of military organizations. It has recently received an order from the country of Montrachet for annual delivery of 20 tanks per year for the next eight years. The trouble with this order is that the company's existing capacity can only handle 10 more tanks per year. An entire additional production line must be created in order to manufacture the extra tanks, which will require an increase in fixed assets of $20 million. The price the company will receive for each tank is $850,000. Currently, it produces 70 tanks per year, and has fixed assets of $40 million. Based on these numbers, its net sales to fixed assets ratio will change as shown in Table 2.2.

The Turtle Tank Company is a publicly held company, so its management is concerned that the much lower ratio that would be caused by the new investment would not compare favorably to the same ratio for its competitors. This might cause investors to think that the company is poorly managed, resulting in a sell-off of its stock. An alternative solution for the situation is for the managers to ignore the short-term impact of the ratio and instead to focus on the key issue, which is whether there will be enough additional business in the future to justify the additional investment.

Cautions: The sales to fixed assets ratio should not be used at a consolidated level for companies that include many types of businesses, since it is quite possible that only a few businesses within the entity are asset-intensive. For this reason, it is better to calculate the measure for individual businesses or product lines. The ratio can also be misleading if a company does not have sufficient funds to purchase new assets, in which case it may appear to have a small asset base due to the large amount of offsetting depreciation expense that has accumulated over time.

Table 2.2

	If No Change	If Invest in New Line
Annual sales	$68,000,000	$76,500,000
Total fixed assets	$40,000,000	$60,000,000
Sales to fixed asset ratio	**1.7:1**	**1.3:1**

SALES TO ADMINISTRATIVE EXPENSES RATIO

Description: A key issue is how much overhead expense is needed to maintain a certain level of sales volume. For example, a company with a strategy of selling very small orders to its customers requires a large accounting department, not only to issue a vast quantity of invoices, but also to process a large number of payments. Similarly, if a company has a large proportion of employees to the amount of revenue generated (such as a restaurant chain), then the human resources staff will be correspondingly large. In these cases, it is important to ensure that the administrative expense is carefully controlled, so that it does not have an excessively large impact on profits.

Formula: Divide annualized net sales by the total of all general and administrative expenses. It is better to use the last twelve months of net sales for the annualized net sales figure, rather than an estimate of sales for future months, since the look-forward estimate may be substantially incorrect. Also, the expense figure in the denominator should include the cost of the sales department, especially if its cost is largely fixed (as is the case when the sales staff has a high proportion of salaries to commissions). The formula is:

$$\frac{\text{Annualized net sales}}{\text{Total general and administrative expenses}}$$

Example: The Windy Weather Gauge Company has experienced a sharp drop in sales volume. Its ratio of sales to general and administrative expenses has changed from 1:0.1 to 1:0.2, indicating that this cluster of expenses has doubled in proportion to overall sales. This relative expense increase will certainly have a major negative impact on profits. The controller needs to see if it is possible to drop these expenses back to their previous proportion to sales. Finding that the primary expense in this area is salaries, the controller quickly determines that there are so few personnel in each of the administrative areas that only outsourcing or the merging of departments will allow the company to achieve its previous sales to administrative expense ratio. Accordingly, the human resources work is taken on by the controller, computer systems development is curtailed, and the accounting department combines its accounts payable and receivable staff into a single group. Thus, quick action based on this ratio allows the company to shrink its administrative expenses down to a level that will ensure continuing profits.

Cautions: This ratio can be used as the justification for a reduction or freeze in the amount of general and administrative expenses, on the grounds that the proportion of expenses to sales in the past should be the same in the future. However, if there is a significant change in sales volume, this is a less clear relationship. For example, if sales volume doubles, it is quite possible that the general and administrative expense does not have to double as well, since much of the existing infrastructure may be able to handle the additional growth. Conversely, a significant drop in sales

volume may still require a company to leave much of its general and administrative expenses in place, due to long-term contracts that cannot be voided (such as building leases) or the presence of significant fixed assets (such as computer centers) that cannot be reduced to reflect the smaller sales volume. Consequently, changes to general and administrative expenses may be indicated by this ratio, but in-depth analysis must be done to determine if a change is really possible.

SALES TO EQUITY RATIO

Description: This ratio is used to determine the amount of equity that should be retained within a business as sales volumes fluctuate. For example, if sales growth increases rapidly, it is likely that a considerable additional amount of working capital will be required to sustain this higher level of sales growth. If so, the required cash can come from debt, internal cash generation, or equity. The ratio can also be used to determine if too much equity has accumulated in a business, so that some may be extracted through extra dividends, a stock buyback, or some other form of distribution.

Formula: Divide annual net sales by total equity. It is important to include retained earnings in the denominator; many companies that have high margins or have been generating profits for many years have accumulated a great deal of retained earnings, which may make up the largest component of equity. The formula is:

$$\frac{\text{Annual net sales}}{\text{Total equity}}$$

Example: An examiner for the Friendly Tax Collection Service calls on a company that has paid out no dividends for the past few years. An examination of the company's accounting records reveals the information in Table 2.3.

Table 2.3

	2000	2001	2002	2003
Sales	$12,500,000	$14,000,000	$15,500,000	$17,000,000
Retained earnings	$5,000,000	$6,250,000	$7,500,000	$8,750,000
Other equity	$350,000	$350,000	$350,000	$350,000
Total equity	$5,350,000	$6,600,000	$7,850,000	$9,100,000
Total fixed assets	$2,500,000	$2,600,000	$2,600,000	$2,700,000
Sales to equity ratio	2.3:1	2.1:1	2.0:1	1.9:1

This table reveals that the company is extremely profitable, with over a million dollars being added to retained earnings in every year. The company does not appear to be using these funds, since the amount of incremental investment in fixed assets is miniscule. The sales to equity ratio shows that the amount of equity in the business is continuing to rise in relation to sales. Consequently, the auditor can make a good case that the company should be distributing more of its equity as dividends; being taxable, these dividends will increase the taxes collected by the Friendly Tax Collection Service.

Cautions: If a company is already highly leveraged, the amount of equity is so small that the sales to equity ratio has no particular relevance. Also, a decision to shift away from debt to more equity, or vice versa, will have a significant impact on this ratio, even if there is no change in the sales level. Consequently, a company's financing decisions have a great deal of influence over this ratio.

SALES PER PERSON

Description: This is one of the most closely watched of all performance measures. It is based on the assumption that employees are at the core of a company's profitability, and so high degrees of efficiency in this area are bound to result in strong profitability. It is also a standard benchmark in many industries.

Formula: Divide revenue for a full year by the total number of full-time equivalents (FTEs) in the company. An FTE is the combination of staffing that equals a 40-hour week. For example, two half-time employees would be counted as one FTE. The formula is:

$$\frac{\text{Annualized revenue}}{\text{Total full-time equivalents}}$$

A variation on this ratio is to divide annual revenues by only those FTEs that can be categorized as direct labor. This measures the productivity of those personnel who are directly connected to the manufacture of a company's products or services. This measure should be used with care, since it is not always easy to determine which employees can be categorized as direct labor and which ones fall into the overhead category instead. The formula is:

$$\frac{\text{Annualized revenue}}{\text{Total direct labor full-time equivalents}}$$

Example: The operations manager of the Twirling Washing Machine Company wants to determine the sales per person for the company, both for all staff and just

the direct labor personnel. The company has annual revenues of $4.2 million. Its headcount is as follows:

Department	*Headcount*
Direct labor department	22
Direct labor part-time staff	6
Production supervisors	2
Materials-handling department	4
Sales, general and administrative	10
Administrative part-time staff	2
Engineering department	8

The company has 54 employees. However, if the part-time staff all work half-time, then the eight part-time positions can be reduced to four FTEs, which decreases the total headcount to 50 personnel. Another issue is what constitutes direct labor personnel—the company has a group of clearly defined direct labor personnel, as well as a materials-handling support staff and two production supervisors. The company can use any combination of these groups for its sales per direct labor measurement, as long as it consistently applies the measurement over time. However, the technically correct approach is to include in the measure any positions that are required for the proper completion of production efforts, which would require the inclusion of all three categories of labor. If this approach were not used, the person doing the measuring might be tempted to artificially inflate the measurement results by shifting direct labor personnel into other labor categories that fall just outside the definition.

The result of these measurements is overall sales per employee of $84,000 (which is $4,200,000 in revenues, divided by 50 employees) and sales per direct labor employee of $135,484 (which is $4,200,000 in revenues, divided by 31 employees). The employee figure of 31 was derived by adding 22 direct labor personnel to the three FTEs represented by the 6 part-time direct labor personnel, plus the production supervisors and materials-handling staff.

Cautions: This formula is subject to a high degree of variation, depending on how personnel are counted. For example, shifting away from employees to an outsourced solution or to the in-house use of temporary employees can artificially reduce the number of FTEs, as can the use of overtime by a smaller number of employees. Also, comparing the number of FTEs to revenue has less direct bearing on profitability than comparing revenues to the total of all salaries and wages expenses; for example, one company with a large headcount but low pay per person may be more profitable than a company having a lower headcount but a much higher salary per person. Also, some capital-intensive industries have so few employees in relation to the sales volume generated that this measure has much less significance than other measures, such as sales to fixed assets.

SALES BACKLOG RATIO

Description: The sales backlog ratio cannot be determined strictly from any standard financial statements, since the backlog is normally included only in internal management reports. Nonetheless, if the backlog information is available, this ratio should be used as an extremely useful tool for determining a company's ability to maintain its current level of production. If the ratio is dropping rapidly over several consecutive months, then it is likely that the company will soon experience a reduction in sales volume as well as over-capacity in its production and related overhead areas, resulting in imminent losses. Conversely, a rapid jump in the ratio indicates that a company cannot keep up with demand, and it may soon have customer relations problems from delayed orders and need additional capital expenditures and staff hirings to increase its productive capacity.

Formula: Divide the most current total backlog of sales orders by sales. It is generally best not to use annualized sales in the denominator, since sales may vary considerably over that period, due to the influence of seasonality. A better denominator is sales over just the preceding quarter. The formula is:

$$\frac{\text{Backlog of orders received}}{\text{Sales}}$$

A variation on this formula is to determine the number of days of sales contained within the backlog, which is achieved by comparing the backlog to the average daily sales volume that a company typically produces. This formula is:

$$\frac{\text{Total backlog}}{\text{Annual sales per 360 days}}$$

Example: The sales and backlog data for the Jabber Phone Company are shown in Table 2.4.

This table reveals that the company's sales are continuing to increase over time, while its backlog is decreasing. The change was caused by an increase in the company's productive capacity for additional cell phones. As a result, the company is gradually clearing out its backlog and converting it into sales. However,

Table 2.4

	January	February	March
Rolling 3-month sales	$4,500,000	$4,750,000	$4,800,000
Month-end backlog	$2,500,000	$2,000,000	$1,750,000
Sales backlog ratio	0.55:1	0.42:1	0.36:1

the management team must be aware that, if the present trend continues, the company will eventually clear out its entire backlog and find itself with a sudden reduction in sales, unless it greatly increases its sales and marketing efforts to build the backlog back up to a higher level.

Cautions: The sales backlog ratio is less useful for businesses that are oriented toward a just-in-time manufacturing model, since these organizations tend to operate with a reduced backlog. It is also of limited use for highly seasonal businesses, since their intention is to completely clear out their backlogs at the end of the selling season and then build up inventory for the next selling season, even in the absence of a backlog.

SALES RETURNS TO GROSS SALES RATIO

Description: This ratio reveals the extent returns on its sales. An excessive level of returns can be indicative of product flaws requiring replacement, or an overly generous returns policy, or the sudden appearance of a competing product on the market that distributors would rather keep in stock. No matter what the cause, this ratio is a good initial indicator of an underlying problem related to the product, prices, or the market.

Formula: Divide total sales returns by gross sales. This ratio can be unusually high or low from month to month, because sales returns are usually related to shipments made in previous months; consequently, a high sales month may have very low associated sales returns, which instead will appear in the ratio for the following month. To avoid this problem, the ratio should be aggregated on a rolling quarterly basis, so that returns will be more likely to be matched against related sales. The formula is:

$$\frac{\text{Total sales returns}}{\text{Gross sales}}$$

Example: The Matterhorn Pen Company sells the bulk of its pens during the Christmas selling season, with a sharp drop in sales immediately thereafter. Table 2.5 shows the sales and return figures for the six months nearest the Christmas season.

Table 2.5

	Oct	Nov	Dec	Jan	Feb	Mar
Gross sales	$35,500	$150,000	$650,000	$10,000	$18,000	$23,000
Returns	$2,800	$3,550	$15,000	$65,000	$1,000	$1,800
Returns ratio	8%	2%	2%	**650%**	6%	8%

Table 2.6

	Oct	Nov	Dec	Jan	Feb	Mar
3-Month rolling sales	$81,500	$208,500	$835,500	$810,000	$678,000	$51,000
3-Month rolling returns	$7,400	$8,650	$21,350	$83,550	$81,000	$67,800
Returns ratio	8%	4%	3%	10%	12%	**133%**

This table shows that there is a time lag of exactly one month on all sales returns, and that the return rate is always exactly 10% when compared to the gross sales from which the returns originated. However, due to the extreme seasonality of sales, the returns ratio varies enormously from period to period, with the worst case being in January, when the returns from the massive December sales month are offset against the puny January postseason sales. To fix this problem, the controller elects to measure the ratio on a rolling three-month basis, which smooths out the ratio somewhat, as shown in Table 2.6. However, the returns attributable to the December sales month occur in January, which therefore still appear in the March three-month rolling measurement when the corresponding sales have dropped out; to avoid this problem, reporting the measure could be delayed by one month on an ongoing basis, so that the most recent month's returns could be divided by the sales from the preceding month.

Cautions: The amount of sales returns can be masked, rendering this ratio less informative. For example, a company can offer free extra products or services to a customer who wishes to make a return rather than accepting the returned goods. Another ploy is to charge off to expense an unreasonably high or low return reserve or to roll returns into some other account. Also, unusual returns, such as products that are being called back to the factory to repair a serious flaw, may be recorded against a special loss reserve. Another variation is to shift returned goods back into finished goods inventory and then write up the value of this inventory without ever making a charge against sales. By any or all of these means, a company can hide the true amount of its sales returns.

REPAIRS AND MAINTENANCE EXPENSE TO FIXED ASSETS RATIO

Description: This ratio is useful for estimating the age of the collective group of fixed assets listed in the financial statements. If the ratio follows an increasing trend line, then the company is probably in need of some asset replacements. An increasing trend line may also be indicative of high asset-usage levels, which can prematurely require advanced levels of repair work. Of particular interest is an increasing ratio that suddenly drops with no corresponding increase in the amount of fixed assets, this indicates that a company is running out of cash and cannot afford to repair its existing assets or purchase new ones.

Formula: Divide the total amount of repairs and maintenance expense by the total amount of fixed assets. If the expense is broken down into subcategories, such as between production equipment and facilities, then the measure can be calculated for each category presented. It is better to calculate the ratio with the total amount of fixed assets in the denominator, rather than net of depreciation, since the type of accelerated depreciation method would otherwise impact the amount of net assets used in the calculation. The formula is:

$$\frac{\text{Total repairs and maintenance expense}}{\text{Total fixed assets before depreciation}}$$

Example: The Hot Cinnamon Candy Company is being examined by the due diligence team of another candy company, which may decide to make an acquisition offer. The due diligence team has collected information about the company as shown in Table 2.7.

This table shows the impending demise of the candy company—sales are dropping, which may be the cause of a continuing decline in available cash and an increase in the amount of debt. Of particular concern is the sudden drop in the amount of repairs expense in 2003, because there is no corresponding increase in the fixed assets account that would indicate that new assets have been purchased. The due diligence team should conclude that a purchase of this company would require a cash infusion to fix a backlog of equipment repairs.

Cautions: As noted earlier, the ratio can be manipulated by company management if it chooses to delay making expenditures on needed asset repairs. Also, a high ratio can yield misleading conclusions, because it can indicate that management is taking the best possible care of its equipment or that the equipment is so old that it is near the point of failure. Also, the amount of repairs and maintenance expense can be manipulated by shifting the salaries of the equipment repair staff to some other overhead category or outsourcing the work. Finally, this ratio may not change much from period to period in those situations where a company employs a repair team whose wages will be charged to the repairs account at all times, even if there are no repairs to be made.

Table 2.7

	2000	2001	2002	2003
Sales	$25,000,000	$24,500,000	$23,000,000	$21,500,000
Cash	$2,350,000	$1,780,000	$953,000	$229,000
Debt	$0	$250,000	$590,000	$1,020,000
Repairs expense	$450,000	$475,000	$500,000	$125,000
Fixed assets	$5,850,000	$5,875,000	$5,900,000	$5,900,000
Repairs to assets ratio	8%	8%	8%	2%

ACCUMULATED DEPRECIATION TO FIXED ASSETS RATIO

Description: Comparing the amount of accumulated depreciation to the gross amount of fixed assets recorded on a company's balance sheet can indicate the extent to which a company has continued to replace its existing assets with new ones on an ongoing basis. For example, if the proportion of accumulated depreciation to fixed assets is quite high, it is evidence that not too many assets have been added by a company in recent years, which may in turn lead one to suspect that there is little cash available for such investments.

Formula: Divide the total accumulated depreciation by the total amount of fixed assets. A variation on this approach is to run the same calculation for different classes of assets, in order to see if there are certain types of assets in which a company does not appear to be making a sufficient level of investment in new assets. The formula is:

$$\frac{\text{Accumulated depreciation}}{\text{Total fixed assets}}$$

Example: A potential acquirer is reviewing the financial statements of the Bavarian Clock Company. The financial information under review is limited and does not contain a sufficient degree of information regarding cash flows from year to year. Consequently, the acquirer is trying to get a general idea of the company's ability to generate cash by reviewing the expenditures it has made for fixed assets. The assumption is that an increase in the ratio of accumulated depreciation to fixed assets over time is an indicator of a shortage in cash. The financial information is compiled in Table 2.8.

The ratio at the bottom of the table indicates that the company appears to have experienced a sudden drop in its cash flow in the past two years, because the amount of accumulated depreciation has skyrocketed in comparison to the fixed asset base, indicating that the company has stopped purchasing fixed assets.

Cautions: This ratio can present an incorrectly unfavorable view of a company's reinvestment policy if the company has taken an aggressive approach to depreciation, using accelerated depreciation calculations and short estimated time periods

Table 2.8

	1999	2000	2001	2002
Accumulated depreciation	$428,000	$500,000	$1,205,000	$1,940,000
Fixed assets	$2,375,000	$2,500,000	$2,410,000	$2,425,000
Accumulated depreciation to fixed assets ratio	18%	20%	50%	80%

over which assets are depreciated. Under this treatment, depreciation levels will rise rapidly, leading one to believe that a company's asset base is older than it really is. Also, a company owning long-term assets that require minimal replacement will also show a high ratio of accumulated depreciation to fixed assets, even though there is no particular need to buy new equipment; in this case, one should look at the amount of repairs and maintenance expense to see if a proper level of expenditures is being made to keep the equipment operational. Finally, a company's accounting staff may not be making journal entries that would eliminate from the balance sheet the asset cost and accumulated depreciation associated with assets that are no longer on the premises. If so, the volume of accumulated depreciation listed in the balance sheet may appear to be quite high; this is evidence less of improper asset management and more of inadequate accounting for eliminated assets.

FRINGE BENEFITS TO WAGES AND SALARIES EXPENSE

Description: Apparently small changes in a company's benefit policies can have a profound impact on the total benefits expense for a company. The best way to see the total impact of these changes is to calculate a ratio of fringe benefit costs to total wages and salaries. This is also a useful measure when comparing the overall fringe benefit costs of two companies that are considering merging, so that the surviving entity can calculate the potential savings to be made by shifting the other company's benefit plan to that of the acquirer. This can also be a tool for comparing the benefit costs of union shops to non-union shops, since there can be significant differences in the benefits granted to union members.

Formula: Add together the cost of all discretionary benefit costs, minus the cost of any related deductions from employee pay, and divide this amount by the total of all wages, salaries, and payroll taxes. The formula is as follows:

$$\frac{\text{Life insurance} + \text{Medical insurance} + \text{Pension funding expense} + \text{Other benefits}}{\text{Wages} + \text{Salaries} + \text{Payroll taxes}}$$

Example: The Associated Grocers Corporation (AGC) is considering a hostile takeover of the Federated Grocers Corporation (FGC). It needs to find ways to cut expenses after the acquisition in order to prove to its shareholders that the transaction is cost-effective. One area under consideration is the fringe benefits of FGC. Since this is a hostile takeover attempt, FGC is not cooperating in providing detailed benefits information to AGC. Instead, AGC can obtain the fringe benefits and wages information of FGC from publicly available sources. The AGC acquisition team prepared Table 2.9.

The table reveals that, though the total dollars associated with fringe benefits for both companies are nearly the same, the proportion of fringe benefits to wages

Table 2.9

	AGC (Acquirer)	FGC (Acquiree)
Total fringe benefits	$1,490,000	$1,420,000
Total wages and salaries	$7,842,000	$5,917,000
Fringe benefits to wages ratio	19%	24%
Potential savings	—	**$296,000**

and salaries for the acquiree are 5% higher than for AGC. By reducing this percentage to 19% (the same one achieved by AGC), the acquirer can reasonably estimate that a savings of $296,000 can be achieved by using its benefits package at the acquiree.

Cautions: The ratio can be rendered incorrect if the denominator includes one-time costs associated with severance packages or hiring bonuses. Also, unusual one-time benefits, such as Christmas bonuses, can cause unusual spikes in the ratio in the months when these benefits are paid out; later this problem can be resolved by accruing for one-time benefits over all months, thereby smoothing out their impact.

SALES EXPENSES TO SALES RATIO

Description: The type of sales method used to bring in sales may be so expensive that the margin obtained from any sales does not even cover the cost of sales. This ratio is useful for determining the variable cost of sales, so that management can determine if the sales system must be altered to result in a less expensive approach.

Formula: Divide all sales-related costs by total sales. Since sales expenses incurred may not result in sales for several months, it is best to calculate this ratio on at least a quarterly basis. The formula can also be broken down into smaller pieces, so that, for example, sales compensation only is compared to sales. The basic formula is:

$$\frac{\text{Sales salaries} + \text{Commissions} + \text{Sales travel expenses} + \text{Other sales expenses}}{\text{Sales}}$$

Example: The Moving Cart Corporation (MCC) manufactures food carts for street vendors. Since rolling out a line of partially customized food carts, its profits have dropped. Further investigation reveals the information in Table 2.10.

Table 2.10

	Before Custom Carts	After Custom Carts
Sales	$4,500,000	$7,500,000
Gross margin	$1,800,000	$2,925,000
Gross margin percentage	40%	39%
Sales salaries	$240,000	$400,000
Sales travel costs	$15,000	$285,000
Other operating expenses	$1,395,000	$2,325,000
Net margin	+$150,000	–$85,000
Sales expense to sales	5.7%	9.1%

The table reveals that MCC has achieved approximately the same proportion of gross margin and operating expenses to sales through the transition to custom carts, but that its sales costs (especially its travel costs) have risen considerably. A change in the sales method, from traveling to customer locations to some less personalized approach, is clearly in order.

Cautions: There may be an exceedingly long time lag between the incurrence of sales expenses and any resulting sales, such as when sales cycles are long (e.g., government sales) or when products must be hand-built for customers over a long time (e.g., passenger ships). This may render the ratio difficult to use as a comparative tool.

DISCRETIONARY COST RATIO

Description: This ratio is extremely important when reviewing companies that are locked into tight cash flow situations, because an analyst can use it to determine what costs can be dispensed within the short term to bring a company back to a neutral or positive cash flow situation. A high ratio of discretionary costs to sales means that there are considerable opportunities for expense reductions.

Formula: Divide all discretionary costs by sales. Discretionary costs can include marketing, research and development, training, and repairs and maintenance costs, as well as any other costs that do not directly contribute to ongoing sales or production activities.

$$\frac{\text{Discretionary costs}}{\text{Sales}}$$

Example: The management team of the Tony Twinkle Donut Company wants to make its company private. To do so, they have obtained a great deal of debt financing, which must be paid off by cutting deeply into the company's discre-

Table 2.11

	Discretionary Costs
Repairs and maintenance	$185,000
Marketing	$486,000
Training	$72,000
New product development	$340,000
Total	$1,083,000

tionary costs. To see if this option will work, the Chief Financial Officer has constructed the list of discretionary costs shown in Table 2.11.

In addition to the $1,083,000 of discretionary costs, the company already generates $650,000 of cash flow, for a total available cash flow of $1,733,000 if all discretionary costs are not incurred.

The total amount of debt required to take the company private is $15,000,000 and carries an interest rate of 9.75%. The incremental tax rate is 34%. Based on this information, the company can pay the interest on the loan, which costs $965,250 after taxes ($15,000,000 × 9.75% × (1 – 34%), but will only have $767,750 of funds available to pay of the principal on the debt each year. The management team decides that it is too risky to withhold these discretionary costs for the many years required to pay off the debt, and withdraws its buyout offer from consideration by the board of directors.

Cautions: This ratio is only useful for short-term measures, since discretionary costs cannot be delayed forever. For example, the complete elimination of all marketing costs will eventually destroy a company's market share, while delayed repair costs will cut into the useful productive capacity of the manufacturing department and may take some equipment completely out of action. Consequently, this ratio should only be used for short-term corporate turnarounds where funds are expected to be available at a later date.

INTEREST EXPENSE TO DEBT RATIO

Description: This ratio is useful for determining the approximate interest rate that a company is paying on its debt. An analyst can use this information to see if a company is paying unusually high interest, which can be indicative of financial difficulties that are leading lenders to charge inordinately high rates of interest.

Formula: Divide the interest expense by the sum of all short- and long-term debt. The total amount of debt can also include all leases, if an interest expense can be calculated from them and is included in the interest expense account. The formula is:

Table 2.12

	2000	2001	2002
Interest expense	$1,450,000	$5,030,000	$4,990,000
Total debt	$18,125,000	$50,300,000	$33,267,000
Interest to debt ratio	8%	10%	15%

$$\frac{\text{Interest expense}}{(\text{Short-term debt}) + (\text{Long-term debt})}$$

Example: An investor suspects that the Paulson Printing Company, maker of fine engraved letterhead, is beginning to have difficulty obtaining debt to finance an acquisition binge. The investor obtains the information in Table 2.12 for the last three years of operations.

The ratio reveals that, although the total amount of interest paid in the most recent year has declined, this is based on a smaller amount of outstanding debt, resulting in a very high interest rate. The investor might also suspect that the total amount of debt has been reduced because lenders are calling in their loans, forcing the company to find smaller amounts of higher-cost debt.

Cautions: A company's accountants are supposed to create an account for any discount or premium that investors paid when acquiring its debt, and gradually amortize these amounts down to zero over the life of the debt; if this entry is not made, then the reported level of interest will always be the stated interest rate on the debt, which may not represent the actual interest rate. Also, the interest rate paid may not be indicative of a company's current ability to pay off its debt, since the debt may have been incurred years previously, when rates were lower. It is also possible that a company in a difficult financial position has obtained debt at normal market rates, but at the price of severely restrictive covenants that will not appear in the financial statements.

FOREIGN EXCHANGE RATIOS

Description: A company that engages in trade with business partners in other countries will expose itself to foreign exchange fluctuations, unless it can convince its partners to only transact business in U.S. dollars or engages in hedging operations. The two ratios shown in this section can be used to determine the proportion of foreign currency gains and losses that a company is incurring in relation to overall net income and sales. These ratios can be used to make a case for foreign exchange hedging operations, which will mitigate the risk of foreign exchange losses.

Formula: Divide both recognized and unrecognized foreign currency gains and losses by net income. The formula is:

$$\frac{\text{Foreign currency gains and losses}}{\text{Net income}}$$

A variation is to divide both recognized and unrecognized foreign currency gains and losses by total sales. This approach gives one a perspective on the size of such gains and losses in relation to total revenue generating activity. The formula is:

$$\frac{\text{Foreign currency gains and losses}}{\text{Total sales}}$$

Example: The Sosan Trading Company, which imports goods from Sri Lanka, is reporting a net loss for the first time in its history. Its controller wants to find out how much of the loss was caused by foreign currency losses. The company experienced a loss of $178,000 as opposed to a budgeted profit of $242,000 for the year. Foreign currency losses were $113,000. The controller chooses to use the budgeted profit figure as the denominator for the calculation, which is:

$$\frac{\text{Foreign currency gains and losses}}{\text{Budgeted net income}} =$$

$$\frac{\text{\$113,000 Foreign currency losses}}{\text{\$242,000 Budgeted net income}} =$$

47% Foreign currency loss ratio

Though the calculation shows that 47% of the budgeted profit was lost to foreign exchange losses, the actual reduction from the budgeted profit level was $420,000 (actual loss of $178,000 + budgeted profit of $242,000). Consequently, the controller will have to continue searching to find additional causes of the loss.

Cautions: The foreign exchange ratio that uses net income as the denominator is the recommended approach, since it gives one a clear idea of the impact of these activities on a company's profits. In particular, if a large proportion of company profits comprise exchange gains, an investor should inquire as to why the company is not making more money from its core operating activities. If such a high proportion of exchange gains continues for several periods, this can be a sign that the company is relying too heavily on its foreign currency trading expertise to generate profits.

OVERHEAD RATE

Description: The overhead rate is used to determine the amount of overhead cost that should be applied to a unit of production, which may be a completed product or some amount of services rendered to a customer.

Formula: Divide total overhead expenses by an activity measure. The following expenses should be included in overhead:

- Depreciation and cost depletion for production-related assets
- Factory administration expenses
- Indirect labor and production supervisory wages
- Indirect materials and supplies
- Maintenance
- Officers' salaries related to production services
- Production employees' benefits
- Quality control and inspection
- Rent
- Repair expenses
- Rework labor, scrap, and spoilage
- Taxes other than income taxes related to production assets
- Tools and equipment not capitalized
- Utilities

This list of overhead items should be further subdivided into only those portions of the expenses that relate to the production process. For example, only that portion of the rent expense that relates directly to production should be included in overhead.

The activity measure used in the denominator should be a measure that can be applied broadly to the production process. The most common one is direct labor, which can be either direct labor hours or direct labor dollars. An increasingly common denominator is total machine hours used. Both of these activity measures are noted in the following two ratios:

$$\frac{\text{Total overhead expense}}{\text{Direct labor}}$$

$$\frac{\text{Total overhead expense}}{\text{Total machine hours}}$$

Example: The Overhead Crane Company has a great deal of overhead related to its manufacturing process, including a large production facility that contains a

Table 2.13

Allocations	Small Overhead Crane	Automated Loader
Overhead rate per labor hour	$95	$95
Direct labor hours used	450	125
Overhead allocation	$42,750	$11,875

variety of stamping machines and lathes. It has used a traditional overhead allocation methodology for many years, whereby it allocates its overhead costs to products based on the amount of labor hours accumulated by each one. The cost accountant suspects that this results in the overallocation of costs to some products, and underallocation elsewhere. To prove the point, the accountant constructs Table 2.13, which shows the allocation of costs to two products based on a traditional allocation using direct labor hours.

A key item in the table is the overhead rate of $95 per direct labor hour. The company's actual labor cost per hour is only $24, so there is almost four times as much overhead cost charged than direct labor dollars. Since even a small change in the amount of direct labor hours charged to a product will result in a change in the overhead charge that is four times greater, it is evident that some other activity measure must be found that will not cause such large cost swings.

The cost accountant elects to switch to a double allocation method by forming two cost pools. One accumulates overhead costs related to machining operations, while the other pool accumulates costs related to direct labor. The cost accountant allocates the labor overhead cost pool using direct labor hours; because the cost pool is so much smaller than before, the allocation rate will drop to $15.92 per hour. The cost accountant allocates the other cost pool based on machine hours used; because there are thousands of machine hours in a typical month, this allocation rate will also be much smaller, at $28.05 per hour. Table 2.14 shows overhead allocation, using the same amount of direct labor hours as before to allocate the direct labor cost pool, while also assigning machining overhead costs in an extra column. The net result of this slightly more complex approach is that the amount of overhead cost charged to the small overhead crane drops significantly, whereas the overhead charged to the automated loader rises; the change results from the higher level of machine hours used by the automated loader. In total, the same amount of overhead costs have been allocated.

Cautions: The overhead rate is not generally used anymore for decision-making purposes, though it is still used to derive the overhead cost that is reported on the financial statements, per the requirements of Generally Accepted Accounting Principles (GAAP). One of its problems is that direct labor has historically been the most common activity measure used to derive it, even though direct labor composes an increasingly small proportion of the production process; consequently, the ratio of overhead costs to direct labor incurred is quite high, so a small change

Table 2.14

	Small Overhead Crane		Automated Loader	
Allocations	**Labor Costs**	**Machine Costs**	**Labor Costs**	**Machine Costs**
Overhead rate per unit	$15.92	$28.05	$15.92	$28.05
Direct labor hours used	450		125	
Machine hours used		500		1,120
Overhead allocation	$7,194	$14,025	$1,990	$31,416
Total allocation	$21,219		$33,406	

in the direct labor applied to a product will also result in a much larger change in the amount of overhead cost that is applied to it.

Another problem is that there may be little relationship between the overhead cost pool and any single activity measure—instead, machine hours are only related to machine repairs and utilities, while supervisory salaries are related to an entire production line, rent is related to the square footage used by a production line, and so on. A properly applied activity-based costing system will avoid this issue by using a variety of activity measures to determine the most accurate application of overhead costs.

Yet another problem is presented by throughput accounting; under this concept, the only issue that matters to a company is its ability to schedule its manufacturing process around one or more bottleneck operations within the facility. If overhead is incurred to reduce the load on the bottleneck, then profits may still increase despite the increase in expense. Under this concept, the application of overhead costs is irrelevant.

GOODWILL TO ASSETS RATIO

Description: The Financial Accounting Standards Board no longer requires companies to amortize the goodwill that is recorded on their balance sheets, preferring instead to have them write down goodwill only after determining that it has been impaired. This can cause problems for the investor, who may be faced with situations where large proportions of company assets are made up of this intangible, with no ongoing and consistent goodwill write-down that will gradually eliminate it. One can use the goodwill to assets ratio to see if there is an excessive proportion of goodwill on a company's balance sheet or if the ratio is increasing over time.

Formula: Divide unamortized goodwill by total assets. The formula is:

$$\frac{\text{Unamortized goodwill}}{\text{Total assets}}$$

Table 2.15

	1999	2000	2001	2002	2003
Goodwill	$0	$100,000	$350,000	$825,000	$1,285,000
Total assets	$500,000	$625,000	$1,025,000	$1,725,000	$2,450,000
Goodwill to assets ratio	0%	16%	34%	48%	52%

Example: The Genex Snowboard Company has purchased several of its competitors over the past few years, gradually increasing its share of the market for premium racing snowboards. However, it has made these acquisitions at a large premium over the fair market value of the underlying assets. Also, the combined entity has not seen a dramatic rise in sales or profits as a result of the acquisitions. The primary group of investors is becoming concerned that there might be a goodwill write-down in the near future. Before going to company management about the issue, they review the information in Table 2.15 about the goodwill to assets ratio for the past five years.

Though it is impossible to tell from the presented numbers if there is an incipient write-down in the future, the goodwill to assets ratio for the company has increased markedly over the past few years, and now stands at about one half of all assets. It appears to be time for the investors to make their concerns known to the company's board of directors.

Cautions: Though the goodwill to assets ratio is a good way to highlight the possible presence of an overabundance of goodwill, there is no way to tell how much of it is likely to result in a sudden write-down. A company with only a small proportion of goodwill to assets may be just as likely to write down goodwill as a company that has an overwhelmingly large proportion of it.

OVERHEAD TO COST OF SALES RATIO

Description: A long-term trend over the past century has been a gradual replacement of direct labor costs by overhead costs within the cost of goods sold. Overhead now composes the largest proportion of costs within this category for many companies. Given its increasing importance, an overhead to cost of sales ratio is needed so that managers can see if there are continuing increases in overhead costs that require action to reduce. Several variations on this formula are noted in the following section.

Formula: Divide total overhead expenses by the cost of goods sold. In order to get some idea of the changes in this ratio over time, it is important to incorporate the same costs in the overhead cost pool in every measurement period. The formula is:

$$\frac{\text{Total overhead expenses}}{\text{Cost of goods sold}}$$

A variation on the ratio is to divide total overhead expenses by the combination of direct material expenses and direct labor expenses. This approach removes overhead from the denominator. The formula is:

$$\frac{\text{Total overhead expenses}}{\text{Direct materials + Direct labor}}$$

Another variation is to divide total overhead expenses by just direct materials, thereby removing both direct labor and overhead costs from the denominator. This approach compares overhead to the only direct cost clearly associated with the manufacturing process (since direct labor is sometimes considered to be a fixed cost in the short term). The formula is:

$$\frac{\text{Total overhead expense}}{\text{Direct materials}}$$

Example: The Snoozer Mattress Factory has gradually altered its production process so that it now contains a large amount of automated materials handling and production equipment. This has resulted in a significant reduction in direct labor costs and an increase in overhead costs. The CFO wants to conduct a before-and-after comparison of the overhead to cost of sales ratio to see how these changes have altered the company's cost structure. She compiles the information in Table 2.16.

The CFO chooses to use the ratio formulation where both direct labor and direct materials are included in the denominator; the results show more than a doubling of overhead costs in proportion to direct costs. A further evaluation for the CFO at this point will determine how this change has altered the company's break-even point; with such a large increase in overhead costs, it is likely that the break-even point has also increased.

Cautions: Overhead costs tend to be fixed in the short term, while the mostly direct costs included in the denominator will vary with sales. This means that the

Table 2.16

	Before Changes	After Changes
Overhead expenses	$1,458,000	$2,045,000
Direct materials	$375,000	$410,000
Direct labor	$720,000	$302,000
Overhead to cost of sales ratio	133%	287%

ratio can vary substantially from period to period if sales fluctuate considerably. To avoid this problem, it may be necessary to use an average cost in the denominator that consists of a rolling average that covers multiple reporting periods. By doing so, there will be no sharp fluctuations in the denominator, thereby making the comparison to overhead costs more useful.

INVESTMENT TURNOVER

Description: The investment turnover measurement is used by investors to determine the ability of a company to convert its debt and equity into dollars of sales. A high ratio of sales to equity and debt indicates a high level of efficiency in creating sales. This measure should be tracked on a trend line to see if there are changes in the level of sales efficiency over time.

Formula: Divide total sales by the combination of stockholders' equity and long-term liabilities. In cases where debt is coming due in the short term, and therefore is categorized as a short-term liability, it is also acceptable to include it in the denominator. The formula is:

$$\frac{\text{Sales}}{\text{Stockholders' equity + Long-term liabilities}}$$

Example: The CFO of Saint Nick & Elves, purveyors of fine crystal figurines, has asked a select group of current investors to invest an additional $400,000 in the company. They want to see if the company has made efficient use of their money in the past and therefore create the investment turnover calculation for the past few years to see if there is a trend in the level of sales efficiency. The results are included in Table 2.17.

The turnover ratio is clearly improving over time, which might lead investors to invest the requested $400,000. However, they might also ask the CFO to acquire additional lower-cost debt instead of equity, since the table shows that the debt level has consistently dropped over the past few years.

Cautions: Just because a company has a high investment turnover ratio does not mean that it can generate a profit. It may be "buying" sales by offering products

Table 2.17

	1999	2000	2001
Sales	$13,000,000	$14,500,000	$17,250,000
Stockholders' equity	$4,250,000	$4,500,000	$4,750,000
Long-term liabilities	$950,000	$675,000	$640,000
Investment turnover	2.5	2.8	3.2

or services at extremely low prices, which would result in operating losses. Consequently, the measure should be combined with an ongoing review of gross margins and net profits.

BREAK-EVEN POINT

Description: This measure should be in the core group of performance measures that any accountant uses. It measures the sales level at which a company exactly breaks even. This figure is useful for a number of operating decisions, such as determining how much extra productive capacity is available after break-even sales have been manufactured, which tells the management team how much profit can theoretically be generated at maximum capacity levels. It is also good for determining changes in the break-even point resulting from decisions to add fixed costs (especially when replacing variable production costs with fixed automation costs) and figuring changes in profits when the sales staff is contemplating making changes in product prices.

Formula: Divide the average gross margin percentage into total operating costs. Be sure to include all operating costs outside of the cost of goods sold in this calculation—only extraordinary items that are in no way related to ongoing operations should be excluded from this formula, which is:

$$\frac{\text{Total operating expenses}}{\text{Average gross margin percentage}}$$

A variation on the formula is to remove all noncash expenses, such as depreciation, from the calculation. This approach is useful for companies that are more interested in determining the point at which they break even on a cash flow basis rather than on an accrual reporting basis. This formula is:

$$\frac{\text{Total operating expenses} - (\text{Depreciation} + \text{Amortization} + \text{Other noncash expenses})}{\text{Average gross margin percentage}}$$

Example: The Reef Shark Acquisition Company, which is a holding company that acquires all types of distressed businesses, is looking into the purchase of a sewing thread company. Its two key concerns are the break-even point of the acquiree and the presence of any overhead costs that it can eliminate by centralizing functions at its corporate headquarters. Its due diligence team constructs the information found in Table 2.18.

The table clearly shows that the acquiree currently has a break-even point so high that it is essentially incapable of ever turning a profit, since the break-even

Table 2.18

	Before Acquisition
Maximum sales capacity	$10,000,000
Current average sales	$9,500,000
Gross margin percentage	35%
Total operating expenses	$3,500,000
Break-even point	$10,000,000
Operating expense reductions	$750,000
Revised break-even level	$7,857,000
Maximum profits with revised break-even point	$750,050

level is the same as its maximum productive capacity. However, the removal of some key overhead costs reduces the break-even point to such an extent that the acquirer will be able to generate a significant return from the existing sales level. The revised break-even level is determined by subtracting the operating expense reductions of $750,000 from the existing operating expenses of $3,500,000, and then dividing the remaining $2,750,000 in operating expenses by the gross margin of 35% to arrive at a new break-even point of $7,857,000. The maximum potential profit figure of $750,050 is derived by subtracting the revised break-even point from the maximum possible sales capacity level of $10,000,000 and then multiplying the result by the gross profit percentage.

Cautions: This measurement should be tracked on a trend line, because it usually requires substantial changes by the management team to alter it, which may require a number of reporting periods to accomplish. To calculate it on a spot basis, it is useful to create a multiperiod measurement, so that an average gross margin percentage and operating cost can be used that smooths out expense irregularities over the short term.

MARGIN OF SAFETY

Description: This is the amount by which sales can drop before a company's break-even point is reached. It is particularly useful in situations where large portions of a company's sales are at risk, such as when they are tied up in a single customer contract that can be cancelled. The margin of safety indicates the probability that a company may find itself in difficult financial circumstances caused by sales fluctuations.

Formula: Subtract the break-even point from the current sales level, and then divide the result by the current sales level. To calculate the break-even point, divide the gross margin percentage into the total fixed costs. This formula can be broken

down into individual product lines for a better view of risk levels within business units. The formula is:

$$\frac{\text{Current sales level} - \text{Break-even point}}{\text{Current sales level}}$$

Example: The Fat Tire Publishing House, Inc., is contemplating the purchase of several delivery trucks to assist in the delivery of its *Fat Tire Weekly* mountain-biking magazine to a new sales region. The addition of these trucks will add $200,000 to the operating costs of the company. Key information related to this decision is noted in Table 2.19.

The table shows that the margin of safety is reduced from 21% to 19% as a result of the truck acquisition. However, profits are expected to increase by $20,000, so the management team must weigh the risk of adding expenses to the benefit of increased profitability.

Cautions: This calculation is not of much use in cases where strong seasonal swings in sales will send the margin soaring far above and plummeting well below the break-even point on a monthly basis.

TAX RATE PERCENTAGE

Description: This measure is used to determine whether a company's taxation staff could to complete tax-planning strategies that could delay or permanently reduce a company's tax liability.

Formula: Divide the income tax paid by the amount of before-tax income. There is a crucial difference between the amount *paid* and the amount of the tax liability *recorded*, as long as the taxation department has succeeded in delaying the amount of cash issued to taxation authorities, then the company can continue to invest the cash. The formula is:

Table 2.19

	Before Truck Purchase	After Truck Purchase
Sales	$2,300,000	$2,700,000
Gross Margin Percentage	55%	55%
Fixed Expenses	$1,000,000	$1,200,000
Break-Even point	$1,818,000	$2,182,000
Profits	$265,000	$285,000
Margin of safety	21%	19%

$$\frac{\text{Income tax paid}}{\text{Before-tax income}}$$

For those companies that are more interested in simply reporting a lower income tax expense, irrespective of the actual amount of cash paid out, the numerator in the formula should be changed to the income tax expense. The formula is:

$$\frac{\text{Income tax expense}}{\text{Before-tax income}}$$

Example: The International Outsourcing Group (IOG) conducts manufacturing operations on behalf of its clients in eleven countries. Its large and experienced tax-planning staff is in the process of formulating transfer prices between the various subsidiaries that focus on the recognition of income in those countries where income tax rates are the lowest. Its primary technique is to shift partially completed products from the United States to Brazil, where they are completed and income is recognized. Since that country has a tax rate 11% lower than that of the United States, the IOG can continue to permanently recognize a lower-than-average income tax rate on its income statement.

Cautions: None.

3

Operating Performance Measurements

This chapter addresses measurements that can be used to describe an organization's operating performance in such areas as sales, gross margins, investment income, operating profit, and net profit. It does not address the measures for operating performance of individual departments, which are covered in Chapters 9 through 13. The measurements covered in this chapter are:

- Operating Assets Ratio
- Sales to Operating Income Ratio
- Sales Margin
- Gross Profit Percentage
- Gross Profit Index
- Investment Income Percentage
- Operating Profit Percentage
- Operating Leverage Ratio
- Net Income Percentage
- Profit per Person

OPERATING ASSETS RATIO

Description: This measurement is the only one in this chapter that is based solely on information in the balance sheet. It is designed for use by managers to determine which assets can be safely eliminated from a company without impairing its operational capabilities. Its intent is to focus management attention on assets that are not generating a return on investment so that they can be eliminated.

Formula: Divide the dollar value of all assets used in the revenue creation process by the total amount of assets. Both of these numbers should be recorded at their gross values, prior to any depreciation deduction. The calculation can also include accounts receivable and inventory. The formula is:

$$\frac{\text{Assets used to create revenue}}{\text{Total assets}}$$

Example: The Matrix Motor Company has been in business since 1902 and has accumulated a large number of fixed and other assets during that time. The company has recently been acquired by a much younger company that wants to "clean up shop," partially by reviewing all assets and clearing out those that are no longer needed. As a first step in this process, its acquisition team elects to calculate the operating assets ratio and then use the results to target individual assets for further action. It accumulates the information found in Table 3.1.

The acquisition team elects to exclude overdue accounts receivable, obsolete inventory, and unused production equipment from the numerator in the equation, thereby focusing attention on those items as logical targets for reduction in order to make Matrix a more asset-efficient organization. The resulting calculation is:

$$\frac{\$428{,}000 \text{ Accounts receivable} + \$978{,}000 \text{ Inventory} + \$207{,}000 \text{ Fixtures} + \$4{,}832{,}000 \text{ Equipment}}{\$8{,}405{,}000 \text{ Total assets}} =$$

$$\frac{\$6{,}445{,}000 \text{ Assets used to create revenue}}{\$8{,}405{,}000 \text{ Total assets}} = 76.7\% \text{ Operating assets ratio}$$

The measurement reveals that about one quarter of Matrix's assets cannot be usefully employed for revenue generation and should be evaluated for elimination.

Cautions: The derivation of the asset list used for the numerator is highly subjective. Unless the measurement is backed up with a rigorous selection system to determine which assets are truly being used for productive activities, it is likely that some assets will be included in the numerator that should not be there. Also, the concept of asset usage to create revenue can create gray areas, for example, should any equipment used by the sales department be itemized as part of the revenue-creation process? The best way to deal with these issues is to create a detailed list of what asset classes should be included in the measurement, which may

Table 3.1

Asset Type	Gross Value
Current accounts receivable	$428,000
Overdue accounts receivable	$33,000
Current inventory	$978,000
Obsolete inventory	$524,000
Furniture and fixtures	$207,000
Production equipment	$4,832,000
Unused production equipment	$1,403,000
Total assets	$8,405,000

also require a written justification for the inclusion of specific assets in the numerator of the formula.

SALES TO OPERATING INCOME RATIO

Description: This ratio is useful for determining the results of operations before unrelated income or expense is added to or subtracted from a company's financial results. It is particularly noteworthy in cases where a company continually muddies the waters by adding a variety of items, such as asset sales and loss contingency reserves, that make it difficult to see how the underlying business is performing. The ratio is best used on a trend line, so that long-term changes in profitability can be readily seen and acted upon.

Formula: Divide operating income by net sales (reduced by investment income). Investment income, if listed as revenue, should be eliminated from the net sales figure, because it relates to a company's financial activities rather than its operations. The formula is:

$$\frac{\text{Operating income}}{\text{(Net sales)} - \text{(Investment income)}}$$

Example: The Misses Sportwear Company, which is publicly held, bothers the investment analysts who follow its stock because it tends to report consistent earnings for a number of consecutive quarters, followed by an occasional large loss. One analyst reviews the issue by calculating the sales to operating income ratio for the company for the last few years. The results are shown in Table 3.2.

It is evident from the table that the company is periodically creating a loss reserve, against which it will charge selected operating expense items for the next few years. Every time the reserve runs out, the company will charge off another large expense for a new reserve and then start the process again. Operational results, as shown by the sales to operating income ratio, are worsening over time, so the analyst should issue a sell recommendation on this stock.

Table 3.2

	2000	2001	2002	2003
Sales	$52,000,000	$55,000,000	$58,000,000	$61,000,000
Operating expenses	$58,000,000	$62,000,000	$64,000,000	$70,000,000
Operating income	-$6,000,000	–$7,000,000	–$8,000,000	–$9,000,000
Sales to operating income	–11.5%	–12.7%	–13.8%	–14.8%
Other expenses	$20,000,000	–$9,000,000	–$11,000,000	$20,000,000
Net income/loss	–$26,000,000	+$2,000,000	+$3,000,000	–$29,000,000

Cautions: This ratio can cause false signals that a company is having problems, if the company's sales are so seasonal that the ratio reveals a loss during nonseasonal selling periods. It can also be misleading if there are several operating units, because it may show that overall results are acceptable while not revealing that some product lines within the reporting group have less stellar results. This problem can be avoided by calculating the ratio for each individual product line or business unit within a company.

SALES MARGIN

Description: This ratio clusters sales and distribution expenses with the cost of goods sold, thereby isolating all profits from a company's revenue-generating activities. It can also be viewed as the contribution margin before administrative costs are considered. It is particularly useful when calculated for individual product lines, since the cost of sales and distribution can vary significantly by product line, and thus shows the actual margins generated in these areas. It should be tracked on a trend line to see if distribution and sales costs are proportionally changing in relation to sales volume.

Formula: Subtract sales expenses from the gross margin, and divide the result by gross sales. Sales costs should include the sales department's payroll, commissions, benefits, travel expenses, customer service, field maintenance, warranty, sales promotion, advertising, and distribution costs. The formula is:

$$\frac{\text{Gross margin} - \text{Sales expenses}}{\text{Gross sales}}$$

Example: The Turner Furniture Company has struggled to achieve profitability for many years. It has a gross margin of 40%, but its sales, general, and administrative costs are so large that the company has never earned more than 2% net profits. The controller decides to calculate the sales margin to see if some additional information can be gleaned. By breaking sales costs out from other administrative costs and combining them with the gross margin, the controller finds that the sales margin drops to only 15%, leaving little room to cover other administrative costs. Further investigation reveals that the salespeople make so many trips to customer sites to finalize deals that their travel cost alone is eliminating 7% of company profits. As a result, the company switches from personalized sales to a furniture catalog, which completely eliminates travel costs and greatly increases profits.

Cautions: None. This is a very useful measurement, particularly when used to determine the profitability of products or services that are customized to some degree. Customization tends to require much more sales effort than sales of standard products, which can drastically reduce net profits.

GROSS PROFIT PERCENTAGE

Description: This is one of the most important measurements derived from the income statement. It reveals the profit left over from operations after all variable costs have been subtracted from revenues. In essence, it reveals the efficiency of the production process in relation to the prices and unit volumes at which products are sold.

Formula: There are two ways to measure the gross margin. The most common approach is to add together the costs of overhead, direct materials, and direct labor; subtract the total from revenue; and then divide the result by revenue. This approach takes into account all costs that can be reasonably associated with the production process. The formula is:

$$\frac{\text{Revenue} - (\text{Overhead} + \text{Direct materials} + \text{Direct labor})}{\text{Revenue}}$$

The trouble with this approach is that many of the production costs are not truly variable. Under a much more strictly defined view of variable costs, only direct materials should be included in the formula, since this is the only cost that truly changes in proportion with changes in revenue. All other production costs are then shifted into other operational and administrative costs, which typically yields a high gross margin percentage. The formula is:

$$\frac{\text{Revenue} - \text{Direct materials}}{\text{Revenue}}$$

Example: The Spanish Tile Company bases its sales-quoting system on the gross margin assigned to its products; prices quoted must have a gross margin of at least 25% in order to cover administrative costs and create a modest profit. Recently, the Iberian Tile Company has been taking business away from the Spanish Tile Company through more aggressive pricing. Investigation of its competitor's quoting practices reveals that it uses an alternative gross margin model that relies only on direct material costs as a deduction from revenues. This means that its competitor is always in a position to offer lower prices, because it does not incorporate direct labor and overhead costs into its pricing model. The Iberian Tile Company is in danger of quoting excessively low prices if it continues to use its gross margin model, so it focuses on how prospective sales will impact its bottleneck operation, which is the tile kiln. If a prospective sale requires a great deal of kiln time, then it is charged a much higher price than other quotes that do not use as much of this valuable resource. As a result of this survey, the Spanish Tile Company realizes that its competitor has a more precise and

aggressive quoting model that will likely result in more lost sales for Spanish Tile in the future.

Cautions: As was hinted at in the example, a company can incorrectly assume that all of the costs used to calculate the gross margin are variable. This is not always true; direct materials are frequently the only completely variable costs. Consequently, changes in sales volume will generally result in a different gross margin percentage, since some of the costs vary with the sales volume and others (e.g., direct labor and overhead) are fixed.

GROSS PROFIT INDEX

Description: This ratio is used to detect significant changes in a company's gross profit percentage from period to period, which can be a sign of fraudulent financial reporting. If the ratio is substantially higher than one, then there is a high risk that fraudulent reporting was used to achieve an improvement in the gross profit percentage from period to period.

Formula: Divide the gross profit in period two by sales for the same period, and then divide this by the same calculation for period one. The formula is:

$$\frac{\dfrac{\text{Gross profit in period two}}{\text{Sales in period two}}}{\dfrac{\text{Gross profit in period one}}{\text{Sales in period one}}}$$

Example: The internal auditor of the Ultra-Kleen Carpet Company, makers of easy-to-clean throw rugs, has maintained a gross profit index calculation on a monthly basis for a number of years, so that potential accounting irregularities can be spotted shortly after they arise. The gross profit, sales, gross profit percentage, and gross profit index for the past six months are noted in Table 3.3.

Table 3.3

	Jan	Feb	Mar	Apr	May	Jun
Sales	$2,500,000	$2,400,000	$2,550,000	$2,650,000	$2,300,000	$2,450,000
Gross margin	$1,050,000	$984,000	$1,096,500	$1,298,500	$1,150,000	$1,200,500
Gross profit %	42%	41%	43%	49%	50%	49%
Gross profit index	—	98%	105%	114%	102%	98%

The gross profit index unaccountably increased to 114% in April, which reflects a jump in the gross profit percentage from 43% to 49% from March to April. The internal auditor is not aware of any accounting or business issues that would have resulted in such a large jump; however, a new management incentive plan was finalized at the beginning of April that rewarded managers for increasing gross profits. With this clue, the internal auditor digs deeper into the issue and eventually finds that sales have been improperly booked for many months beginning in April, resulting in inordinately large gross margins.

Cautions: This ratio is useful only if a company is in substantially the same line of business from period to period; otherwise, there can be valid, large differences in gross margins between reporting periods. For example, if a manufacturing company with 30% gross margins were to purchase a software company with 95% gross margins, the gross profit index would vary enormously, but would be entirely valid.

Also, be sure to use the same accounting methodologies in both periods being reviewed so that the results are not skewed. For example, a change in the allocation method for overhead costs between periods would alter the gross margin to such an extent that the periods would not be comparable.

INVESTMENT INCOME PERCENTAGE

Description: This measure is used to determine the effectiveness of a company's investment activities. However, review the Cautions section in regard to the how this measure can skew a company's investment objectives.

Formula: Add together all dividend income and interest income for the period, and divide it by the carrying value of all investments. The dividend and interest income should be recorded on the accrual basis, since there may be timing differences in the receipt of funds that would otherwise shift the income to some future period and skew the resulting measurement. The formula is:

$$\frac{\text{Dividend income + Interest income}}{\text{Carrying value of investments}}$$

It may also be possible to include in the calculation the change in value of investments in other companies under the equity method of accounting, whereby the investing entity records an increase in income based on its proportionate share of the income recorded by the investee. However, this entry does not necessarily correspond to an actual cash payment to the investor, either at the time of the entry or at any point in the future, and for that reason may be excluded from the calculation.

Example: The Curious Coin Company, purveyors of coins recovered from sunken ships, invests its excess funds in a variety of investments. The CFO would

Table 3.4

Type of Investment	Amount of Investment	Rate of Return
Money market	$1,300,000	2.5%
U.S. Treasury bills	$500,000	4.2%
Bonds	$2,700,000	7.5%
Common stock	$4,175,000	12.8%
Totals	$8,675,000	9.1%

like to determine the average investment income percentage from these investments. The relevant information shown in Table 3.4.

The CFO must retain a large proportion of the funds in short-term, liquid accounts, in case the company needs money to purchase recovered coins on short notice. All other funds are invested on a long-term basis with a balanced goal of modest risk and return. Based on company goals, the CFO decides that an average investment income percentage of 9.1% is reasonable.

Cautions: The primary problem with the investment income percentage is that it can drive investment officers to engage in highly risky investment activities in order to achieve the highest possible levels of return on investment. In reality, most companies reserve some portion of their available funds for extremely safe and liquid investments that yield low returns. Even in cases where funds can be invested for the long term, the types of investments should be restricted to those that carry modest to low levels of investment risk so that a company will not experience unexpected losses through its investment activities. To ensure that the use of this measurement does not result in improper investments, it should be coupled with an ongoing review of the risk ratings of the investments. Another possibility is to alter the measurement so that it is a comparison of the rate of return achieved and the average rate of return for the class of investments in which activities are allowed; any improvement over the average rate of return can then be considered a reasonable return on investment.

A separate issue is that companies may invest some excess funds in whole life insurance policies, which can have significant cash surrender values. If the cash surrender values can be readily ascertained, the return on these investments should also be calculated, net of the cost of term life insurance that is included in them.

OPERATING PROFIT PERCENTAGE

Description: The operating profit percentage reveals the return from standard operations, excluding the impact of extraordinary items and other comprehensive income. This percentage reveals the extent to which a company is earning a profit from standard operations, as opposed to resorting to asset sales or unique transactions to post a profit.

Formula: Subtract the cost of goods sold, as well as all sales, general, and administrative expenses, from sales. To obtain a percentage that is related strictly to operational results, be sure to exclude interest income and expense from the calculation, since these items are related to a company's financing decisions rather than its operational characteristics. Expense totals used in the ratio should exclude all extraordinary transactions, as well as asset dispositions, since they do not relate to continuing operations. The formula is:

$$\frac{\text{Sales} - (\text{Cost of goods sold} + \text{Sales, general, and administrative expenses})}{\text{Sales}}$$

Example: The Swiss Mountain Chocolate Company has a loan with the local bank whose covenants include the stipulation that the loan will be immediately callable if the company's operating profit percentage drops below zero. In the current month, it will incur an operating loss of $15,000, which will allow the bank to call in its loan. The calculation it is using to derive the operating loss is:

Revenue	$1,428,000
Cost of goods sold	–571,000
Gross margin	857,000
Operating costs	849,000
Interest expense	23,000
Operating profit/loss	–$15,000
Operating profit percentage	–1%

Since there is no specification in the loan agreement of the operating loss calculation, the controller defines it as excluding financing activities and removes the interest expense from the calculation, which then yields an operating profit of $8,000. To be ethically correct, the controller also specifies the exact contents of the calculation in the next report to the bank.

Cautions: An organization that is not experiencing acceptable operational results will seek to bolster revenues and artificially reduce expenses in order to make this ratio look better than it really is. Examples of possible methods for altering this ratio are incorrect capitalization of expenses, recording expenses in the wrong accounting periods, and inaccurately valuing inventories. Revenues may also be increased by a variety of techniques, such as pulling sales into an accounting period that should have been recognized in the following period, as well as recording unshipped products as sales. The number of methods for falsely enhancing this ratio is enormous.

OPERATING LEVERAGE RATIO

Description: This ratio reveals the extent to which fixed costs are required to create profits, by comparing the amount of fixed costs to operating income. It is

particularly useful when a company is considering the acquisition of more fixed assets to replace variable costs, such as manual labor in the production process, and wants to find out the extent to which this will add to its fixed cost structure. This ratio works well when combined with break-even analysis, which is heavily influenced by changes in fixed costs.

Formula: Subtract all variable expenses from sales and then divide this amount by operating income. Under the most strict definition of variable expenses, this will likely include only direct materials costs and commissions; all other expenses are fixed in the short run and can be included in the ratio as fixed costs. The formula is:

$$\frac{\text{Sales} - \text{Variable expenses}}{\text{Operating income}}$$

Example: The Wide Wallet Company, maker of fine wallets to be sold in countries issuing large banknotes, is considering the services of an outsourcing company to sew its wallets, thus dispensing with a number of personnel on its production line. The before and after cost structure of this decision is shown in Table 3.5.

The company staffs the direct labor positions each day in direct proportion to the amount of work available, so direct labor can be considered a valid variable cost. The outsourcing contract has a minimum fixed cost of $580,000, which can be increased if production levels exceed a contractually set minimum level. Upon investigation of the numbers in the table, the company's financial analyst realizes that the proposed deal will replace variable labor costs with a fixed cost that will only contribute $20,000 to the company's profit level and will worsen its ratio of fixed costs to operating profits from 10:1 to 12:1. Consequently, the proposed deal is dropped.

Cautions: Be careful to examine all costs used in the numerator of the ratio, and include them as fixed costs when in doubt as to their fixed or variable nature. Though all costs are variable in the long term, most are hard to change in the short term and so should be itemized as fixed costs. Even the wages paid to direct labor

Table 3.5

	Before Outsourcing	After Outsourcing
Sales	$3,750,000	$3,750,000
Fixed outsourcing fee	$0	$580,000
Direct labor cost	$1,450,000	$850,000
Direct materials	$800,000	$800,000
Operating income	$150,000	$170,000
Operating leverage ratio	10:1	12:1

personnel are usually not variable, since most companies do not vary their direct labor staffing levels unless there are marked changes in the level of production.

NET INCOME PERCENTAGE

Description: This percentage is used to determine the proportion of income derived from all operating, financing, and other activities that an entity has engaged in during an accounting period. This figure is the one most commonly used as a benchmark for determining a company's performance, even though it can be significantly misrepresented by the accounting department, as noted in the Cautions section below.

Formula: Divide net income by revenue. If this percentage is being tracked on a trend line, it may be useful to eliminate from the calculation any extraordinary income items, such as losses from disasters, since they do not yield comparable period-to-period information. The formula is:

$$\frac{\text{Net income}}{\text{Revenue}}$$

Example: The Quick Cuts Hair Salon is a franchise operation that pays for the initial fixed assets required by each franchisee. This involves an investment of about $200,000 per hair salon. The management team is determined to grow the operation as fast as possible while still reporting healthy profits. To do so, it sets the capitalization limit very low, at just $250, so that nearly everything it purchases is capitalized. Because it uses a 10-year depreciation period for all fixed assets, this results in the recognition of costs over many future periods that would normally be recognized at once if a higher capitalization limit were used. Its operating results for a typical store are shown in Table 3.6.

The key line item in the table is the assets costing less than $1,000; if the company had set a higher capitalization limit, these costs would have been recognized as expenses at once, which would have yielded a loss on operations of $27,000 per store. As a result, the company's accounting policy is creating false profits. When

Table 3.6

	Per-Store Results
Sales	$350,000
Wages	$260,000
Supplies	$75,000
Assets < $1,000	$42,000
Net income	$15,000
Net income percentage	4%

combined with the high initial setup cost of each store, it is apparent that this seemingly healthy franchise operation is actually burning through its cash reserves at a prodigious rate.

Cautions: The net income figure is frequently taken as representing a company's operational performance, even though it can be warped by the inclusion of interest income and expense (which are financing activities) plus the inclusion of gains and losses from nonoperating activities. It is also possible to reveal a positive net income figure when a company is experiencing a major cash drain, by means such as aggressive capitalization of costs incurred and the early recognition of revenue. Consequently, an initially favorable opinion of a company's performance from reviewing this percentage should be bolstered by the examination of other measures to ensure that it has indeed had favorable financial results.

PROFIT PER PERSON

Description: This measure is useful for those enterprises with a high proportion of personnel costs to other costs, such as consulting or other service businesses, where changes in the efficiency of the staff have a direct impact on the profitability of the overall corporation. It is least useful in highly automated entities where the proportion of labor costs to total costs is quite small. This is a more comprehensive measure than sales per person (which was described in Chapter 2), since it accounts for not only the ability of the staff to bring in sales but also their ability to wring a profit from those sales.

Formula: Divide net profit by the total number of full-time equivalents. This measure is more reliable when net profit from operations is used instead of total net profit, since this concentrates attention on actual operating results, rather than other actions that may impact profits. A full-time equivalent (FTE) is the combination of staffing that equals a 40-hour week. For example, two half-time employees would be counted as one FTE. The formula is:

$$\frac{\text{Net profit}}{\text{Total full-time equivalents}}$$

Example: The Durable Diskette Company's president is considering a new bonus plan for the management team that is based on the number of personnel in relation to profits. Because salaries and wages are such a large component of expenses, the president considers this to be a key performance measure. Some managers will attempt to incorrectly enhance their reported performance under this measure, so the president derives a formula that converts the cost of part-time staff, outsourced services, and services from temporary agencies into FTE. The components are:

- Each salaried person equals one FTE.
- The total of all hours recorded in the payroll system per month divided by 160 hours equals the number of FTEs on hourly pay.
- The total number of hours billed by temporary agencies per month divided by 160 hours equals the number of FTEs from outside agencies.
- The total billings from outsourcing services per month divided by the hourly cost of equivalent positions within the company or industry equals the total number of FTEs from outsourced functions.

This comprehensive formula, when used to plot profit per person on a trend line, allows the president to determine which managers are truly improving the efficiency of their departments and not just attempting to hide the number of personnel reporting to them.

Cautions: In a very-low-profit situation, this ratio is so small that it yields no relevant information. Also, managers can manipulate this number by shifting to outsourcing services or temporary labor services, thereby effectively moving headcount out of the company, although costs are still incurred from outsourcing billings.

4

Cash Flow Measurements

Though many of the other ratios in this book are useful for determining a company's performance level in a variety of areas, the core issue is whether there is enough cash flowing from ongoing operations to sustain the company. This chapter deals with a variety of measurements that involve a company's cash flow. If a performance measure in this chapter yields a poor result, then action must be taken at once to ensure that corporate survival is maintained. The measures here can also be combined with the liquidity measures noted in Chapter 5. The cash flow measures in this chapter are:

- Cash Flow from Operations
- Cash Flow Return on Sales
- Fixed Charge Coverage
- Expense Coverage Days
- Cash Flow Coverage Ratio
- Cash Receipts to Billed Sales and Progress Payments
- Cash to Current Assets Ratio
- Cash Flow to Fixed Asset Requirements
- Cash Flow Return on Assets
- Cash to Working Capital Ratio
- Cash Reinvestment Ratio
- Cash to Current Liabilities Ratio
- Cash Flow to Debt Ratio
- Stock Price to Cash Flow Ratio
- Dividend Payout Ratio

CASH FLOW FROM OPERATIONS

Description: Under generally accepted accounting principles, a company can easily report a large income figure, even while its cash reserves are draining away. The cash flow from operations ratio can be used to determine the extent to which cash flow differs from the reported level of either operating income or net income. Any difference in the ratio that varies significantly from one is indicative of substantial noncash expenses or sales in the reported income figures. Cash flow problems are likely if the ratio is substantially less than one.

Formula: The formula can be generated in two formats. One is to divide operational cash flow by income from operations, while the second format is to divide cash flow from all transactions (including extraordinary items) by net income. The first format yields a more accurate view of the proportion of cash being spun off from ongoing operations, whereas the second version shows the impact of any transactions that are unrelated to operations. The formulas are:

$$\frac{\text{Income from operations + Noncash expenses – Noncash sales}}{\text{Income from operations}}$$

$$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Net income}}$$

Example: The Bargain Basement Insurance Company (BBIC) is opening new stores at a rapid clip, trying to gain premium locations before its key competitor, Super Low Premiums, Inc., grabs the same spots. The company is reporting net income of 20% from its operations, which is considered reasonable in the insurance business. However, it cannot understand why its bank continues to refuse additional loans to fund ongoing operational needs. The bank is concerned about BBIC's cash flow from operations ratio. The company's relevant projections are shown in Table 4.1.

The table reveals the key problem for BBIC, which is that the company is recognizing insurance as revenue prior to the receipt of cash from policy holders in some cases. Consequently, its rapid growth is only resulting in modest positive cash flow, which translates into a poor cash flow from operations ratio of 20%. The bank correctly finds this ratio to be indicative of BBIC's future inability to pay back a loan and so refuses to extend one.

Cautions: This ratio does not reveal the reason for variations between reported income and cash flow. The variance can be caused by significant and prolonged cash flow problems, or perhaps only a short-term issue that will not reappear, and there is no way to know unless one peruses the statement of cash flows for more detail. In short, extra information is needed in order to interpret this ratio properly.

Table 4.1

	Current Year	Next Year	Following Year
Sales	$5,000,000	$10,000,000	$15,000,000
Net income	$1,000,000	$2,000,000	$3,000,000
Revenue recognition of future insurance payments	$800,000	$1,600,000	$2,400,000
Annual cash flow	$200,000	$400,000	$600,000
Cash flow from operations ratio	20%	20%	20%

CASH FLOW RETURN ON SALES

Description: This is a general measure for determining a company's ability to generate cash flow at various levels of sales volume. It will tend to fluctuate in accordance with a company's step costs. For example, if a company is operating at maximum production capacity, it has reached a point where its cash flow is likely to be maximized. If it were to increase its costs in order to add capacity, the resulting cash flow could very well drop until sales increase to the point where incremental cash inflows exceed the incremental cash outflows associated with added production capacity.

Formula: Divide total sales into cash flow. This ratio is more useful when it is subdivided into individual product lines, so managers can see which products are generating the most cash flow relative to sales volume. The formula is:

$$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total sales}}$$

Example: The Better Back Chair Company is experiencing a dismal cash flow from its sales. The CFO decides to split the company into its various product lines to determine where the cash flow problems are the worst and organizes the information for Table 4.2.

The table reveals that only the Norwegian product line is generating a positive cash flow return on sales. Furthermore, the table reveals considerable quantities of noncash sales on two of the three product lines; extra investigation reveals that the controller has been booking sales prior to shipment so that sales have been artificially inflated. The CFO fires the controller and sets up better controls over the recording of sales.

Cautions: This ratio will vary considerably by industry, as well as a company's break-even level, which in turn is based on its relative level of fixed costs. Also, it may not make sense to pour more resources into a product line that generates a high ratio of cash flow return on sales if that product line has already achieved its maximum market share potential. In addition, it may be unwise to allocate more resources to a product line with a high ratio result if there are other underperforming

Table 4.2

	Andalusian Line	Norwegian Line	Tasmanian Line
Sales	$4,025,000	$1,750,000	$850,000
Net income	$55,000	$128,000	$89,000
Noncash expenses	$123,000	$58,000	$32,000
Noncash sales	$383,000	$0	$248,000
Cash flow return on sales	–5%	+11%	–15%

product lines that could achieve greater cash flow returns if the proper investment were made in them now.

FIXED CHARGE COVERAGE

Description: A company may have such a high level of fixed costs that it cannot survive a sudden downturn in sales. The fixed charge coverage ratio can be used to see if this is the case. It summarizes a company's fixed commitments, such as principal payments, long-term rent payments, and lease payments, and divides them by the total cash flow from operations. A ratio close to one reveals that a company must use nearly all of its cash flows to cover fixed costs and is a strong indicator of future problems if sales drop to any extent. A company in this position can also be expected to drop prices in order to retain business, because it cannot afford to lose any sales.

Formula: Summarize all fixed expenses, leases, and principal payments for the year, and divide them by the cash flow from operations. It is generally not necessary to include dividend payments in this calculation, since this should not be considered fixed over the long term. The types of expenses and other payments that are fixed can be subject to some interpretation; for example, if a lease is close to expiring, there is no need to include it in the formula since it is a forward-looking measure, and there will be no lease payments in the future. Also, if a company is expecting to reduce its principal payments by extending a loan over a longer time period, this may also be grounds for reducing the amount of fixed payment listed in the ratio. The formula is:

$$\frac{\text{Fixed expenses + Fixed payments}}{\text{Cash flow from operations}}$$

Example: The owner of Dinky Dinosaur Toys is anticipating a slowdown in the sales of his high-end wooden toys in the upcoming year and wants to know what his company's exposure will be. The company's annual fixed expenses and cash flow from operations are:

Cash flow from operations	$850,000
Interest on line of credit	80,000
Interest on long-term debt	150,000
Office equipment leases	45,000
Leases expiring within current year	10,000
Expected lease on company car	20,000
Principal payments on long-term debt	200,000
Balloon payment on long-term debt	150,000

If all of the fixed expenses and payments in this list were to be added together, they would total $655,000, which would represent a potentially dangerous fixed

charge coverage ratio of $655,000 to $850,000, or 77%. However, there are some line items on the list that are open to interpretation. First, the upcoming balloon payment is a one-time payment; it is up to the owner's judgment if this is to be included in the ratio, since it is meant to be a long-term ratio composed of ongoing fixed expenses and payments. Second, the expected lease on the company car is not really a fixed cost since it has not yet been incurred and can be stopped at the owner's option. Also, the leases expiring within the current year can be ignored unless new leases on replacement equipment must be obtained. Another issue is the interest on the line of credit: most lines of credit require a complete payoff at least once a year, which means that this line can theoretically be zero. For the purposes of this calculation, the owner should estimate the average interest and principal payment on the line of credit and include it in the ratio. Consequently, there is considerable room for judgment regarding the inclusion or exclusion of items that are highly dependent upon the purposes of this ratio and deciding what constitutes a "fixed" charge.

Cautions: As just noted, the simple compilation of fixed charges is not sufficient when calculating the fixed charge coverage ratio; some charges may be included or excluded, depending on how the ratio will be used. Also, an increasing number of costs may be considered fixed in the short term, whereas nearly all costs can be considered variable if a sufficiently long time frame is used. For example, if fixed costs are considered to be any costs that cannot be eliminated by management within the next month, then they must also include any purchase orders that will not be completed during that period as well as any contract that will not expire during that period. However, if the period is extended to more than a year, it is possible that even some loan payments can be successfully accelerated and completed during the intervening period, thereby eliminating them from the fixed charge list. Consequently, the time period during which costs are to be considered fixed charges has a large bearing on the outcome of the ratio.

EXPENSE COVERAGE DAYS

Description: This calculation yields the number of days that a company can cover its ongoing expenditures with existing liquid assets. This is a most useful calculation in situations where the further inflow of liquid assets may be cut off, so the management team needs to know how long the company will last without an extra cash infusion. The calculation is also useful for seeing if there is an excessive amount of liquid assets on hand, which could lead to a decision to pay down debt or buy back stock, rather than keep the assets on hand.

Formula: Summarize all annual cash expenditures, and divide by 360. Then divide the result into the summary of all assets that can be easily converted into cash. The largest problem with the formulation of this ratio is the amount of the annual cash expenditures, for there are always unusual expenses, such as fees associated

with lawsuits, warranty claims, and severance payments, that may not be likely to occur again. However, if all of these additional expenses were to be stripped out of the calculation, the ratio would always be incorrect, for there will inevitably be some unusual expenditures. To correct for this problem, a company with steady long-term expenditure levels could average its expenditures over several years. Companies experiencing rapid changes in expenditure levels will not have this option, and so will have to make judgment calls regarding the most appropriate expenditures to include in the calculation. The formula is:

$$\frac{\text{Cash + Short-term marketable securities + Accounts receivable}}{\text{Annual cash expenditures / 360}}$$

Example: The Chemical Detection Consortium (CDC) obtains 100% of its business from the federal government, which pays it to conduct random chemical warfare tests of airports. The CDC president is concerned that the government has not yet approved the budget for the upcoming year and cannot release funds to CDC until the date of approval. Consequently, the president asks the controller to calculate expense coverage days to determine how long the company can last without the receipt of any more federal funds. The controller finds that total expenditures in the preceding 12-month period were $7,450,000. The funds currently on hand are shown in Table 4.3.
The calculation of expense coverage days is:

$$\frac{\text{Cash + Short-term marketable securities + Accounts receivable}}{\text{Annual cash expenditures / 360}} =$$

$$\frac{\$48{,}500 + \$425{,}000 + \$620{,}000}{\$7{,}450{,}000 / 360} =$$

$$\frac{\$1{,}093{,}500 \text{ Cash Available}}{\$20{,}694 \text{ Expenses per day}} =$$

52.8 Days of expense coverage

Cautions: This calculation only reveals the number of days over which expenses can be paid if no other operational decisions are made. For example, if accounts payable are paid later than the normal due dates, the extension will effectively

Table 4.3

Fund Type	Amount
Cash	$48,500
Short-term marketable securities	$425,000
Accounts receivable	$620,000
Total	$1,093,500

lengthen the ratio. However, if accounts payable terms have already been lengthened prior to the calculation of the ratio, then suppliers may force the company to use up cash faster than is indicated by the ratio in order to clear out its obligations. The ratio can also be misleading if the annual expenditure level used to determine the denominator does not reflect the expense level being incurred during the period covered by the ratio (typically the next few months). This is a particular problem for seasonal businesses, where expense levels can fluctuate dramatically depending on the time of year. Consequently, the results of this calculation must be viewed in the context of the current state of accounts payable and short-term expenditure levels.

CASH FLOW COVERAGE RATIO

Description: This measure is similar to the fixed charge coverage measure, which shows a company's ability to meet all of its fixed expense and payment obligations. This variation focuses attention on the ability of a company's cash flow to cover all nonexpense items, which include payments for the principal on debt, dividends, and capital expenditures. This is of particular importance to companies with heavy debt repayment burdens or companies that are rapidly expanding their fixed asset bases.

Formula: Summarize for the reporting period all principal payments (including the principal portion of capital lease payments) as well as dividend payments and capital expenditures. Then divide this by cash flow for the period. The formula is:

$$\frac{\text{Total debt payments + Dividend payments + Capital expenditures}}{\text{Net income + Noncash expenses – Noncash sales}}$$

Example: The CFO of the rapidly expanding Perpetual Motor Company wants to make sure that there is enough cash flow to cover the company's debt and capital expenditure payments for the upcoming year. The company's budget model estimates cash flow of $10,500,000, total principal payments of $4,025,000, and capital expenditures of $6,050,000. There are no planned dividend payments. The CFO calculates the ratio as:

$$\frac{\text{Total debt payments + Capital expenditures}}{\text{Cash flow}} =$$

$$\frac{\$4{,}025{,}000 \text{ Total debt payments} + \$6{,}050{,}000 \text{ Capital expenditures}}{\$10{,}500{,}000 \text{ Cash flow}} =$$

$$\frac{\$10{,}075{,}000}{\$10{,}500{,}000} =$$

96% Cash Flow Coverage Ratio

The CFO concludes that the budget model will generate enough cash to cover nonexpense payments; but because there is little slack in the model, the CFO decides to secure a backup line of credit to make payments on these items in case actual cash flows for the period are less than the budget predicts.

Cautions: The measure may be misleading in cases where a company has an upcoming balloon payment on its debt, since the measure is historical in nature and will not show the upcoming principal payback requirement. This issue can be avoided by calculating the measurement on a forward-looking basis. The same problem arises in the case of capital expenditures since the historical pattern of expenditures may not resemble upcoming capital expenditure requirements; once again, the problem can be resolved by including expected capital expenditures in the denominator.

CASH RECEIPTS TO BILLED SALES AND PROGRESS PAYMENTS

Description: This measure is useful for determining the amount of cash that is actually received from accounts receivable, with a 100% measure being the best possible case. It is most useful when compared to the number of days of accounts receivable outstanding, because this measure may reveal that not all cash is being collected at the same time that the days of receivables calculation may be low, which indicates that the collections staff is writing off a considerable proportion of receivables rather than going to the effort of collecting them.

Formula: Divide cash receipts by the combination of billed sales and billed progress payments. Credit card sales should be included on both sides of the formula, since there is no question that cash will be collected on them. The formula is:

$$\frac{\text{Cash receipts}}{\text{Billed sales} + \text{Billed progress payments}}$$

Example: The CFO of Magma Consulting Partners is not sure if the statements of the new collections manager are accurate, because the collections manager claims to have improved the average days of accounts receivable outstanding from 49 to 36 within three months. To test the validity of this claim, the CFO asks the programming staff to create a program that matches cash receipts to all billed items; this comparison of cash receipts to billed sales yields a significantly worse result than claimed by the collections manager. Further investigation reveals that the collections manager had written off all billed sales as soon as they were 40 days old, which makes his days of receivables measure look good but reduces the amount of cash collected. The CFO fires the collections manager and decides to measure the performance of the next collections manager with the cash receipts to billed sales ratio.

Cautions: It can be difficult to collect information for this measurement. The information in the denominator is simple enough to obtain, but the cash receipts figure must be derived from a precise review of actual receipts from each billing, which can be a labor-intensive process. It is not acceptable to use the grand total amount of cash receipts for a specific time period, since this will include cash receipts related to billings from some prior period.

CASH TO CURRENT ASSETS RATIO

Description: The cash to current assets ratio is useful for determining the proportion of cash within the current assets category. This is the most conservative way to measure a company's liquidity, since it ignores the liquidation value of accounts receivable and inventory. It is most useful for determining the ability of a company to pay off liabilities in the extremely short term.

Formula: Add together cash and short-term marketable securities, and divide by current assets. Current assets include cash, short-term marketable securities, accounts receivable, and inventory. The formula is:

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current assets}}$$

Example: The Blastomatic Bobsled Company has not exhibited good control over its inventories or customer credit, resulting in a large proportion of its current assets being composed of old accounts receivable and even older inventory. A potential investor is concerned that many of the assets of these two categories will never be converted into cash. To gain a better understanding of the company's existing cash situation, the investor decides to calculate the cash to current assets ratio, using the following information from the company's balance sheet:

Cash	$148,000
Short-term marketable securities	$81,000
Accounts receivable	$703,000
Inventory	$2,067,000

This information can then be used to calculate the following cash to current assets ratio:

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current assets}} =$$

$$\frac{\text{\$148,000 Cash + \$81,000 Securities}}{\text{\$148,000 Cash + \$81,000 Securities + \$703,000 Receivables + \$2,067,000 Inventory}} =$$

$$\frac{\$229{,}000}{\$2{,}999{,}000} =$$

7.6% Cash to current assets ratio

The ratio reveals that the company is having a very difficult time converting its inventory and accounts receivable into cash. The investor concludes that this could be a major opportunity to turn around the company with some improved management and makes a bargain-basement offer to buy the company.

Cautions: The amount of cash and short-term marketable securities on hand can vary significantly by day, given the need for payments to cover check runs and payrolls. Consequently, it is best to calculate this ratio using an average over several time periods. If it is being measured on a trend line, then an alternative is to calculate it for the same date within each month (presumably the last day), when the short-term impact of check runs and payrolls will be similar from month to month.

CASH FLOW TO FIXED ASSET REQUIREMENTS

Description: This is a useful measure for determining if a company can fund expected fixed asset purchases with internally generated funds. If the ratio indicates a cash shortfall, then a company must either curtail its asset-purchasing expectations or go to an outside source for additional funding.

Formula: Divide the total dollar amount of budgeted fixed asset purchases into annual cash flow. The basic formula is:

$$\frac{\text{Net income} + \text{Noncash expenses} - \text{Noncash sales}}{\text{Budgeted fixed asset purchases}}$$

The formula can be expanded to include other nonexpense payments, such as dividends and principal payments on loans, to gain a more accurate picture of a company's ability to purchase fixed assets. This expanded version of the formula is:

$$\frac{\text{Net income} + \text{Noncash expenses} - \text{Noncash sales} - \text{Dividends} - \text{Principal payments}}{\text{Budgeted fixed asset purchases}}$$

Example: Monty's Fun Park needs to acquire a new roller coaster for the upcoming summer season. The owner has no need to distribute dividends, but must make principal payments on amusement equipment purchased in previous years. The relevant information is shown in Table 4.4.

Table 4.4

Fund Type	Amount
Net income	$725,000
Depreciation	$125,000
Principal payments	$350,000
Budgeted fixed asset purchases	$800,000

Based on this information, the ratio calculation is:

$$\frac{\text{Net income + Noncash expenses – Principal payments}}{\text{Budgeted fixed asset purchases}} =$$

$$\frac{\$725{,}000 + \$125{,}000 - \$350{,}000}{\$800{,}000} =$$

$$\frac{\$500{,}000}{\$800{,}000} =$$

$$62.5\%$$

Since the ratio results in a value of less than one, the owner will have to obtain a loan in order to purchase the roller coaster.

Cautions: Cash flows can be altered by the presence of one-time expenses, some of which will appear in a company's financial statements from time to time. Accordingly, one should provide for these extra expenses in the ratio to ensure that the company has sufficient funds on hand to weather any unusual cash requirement situations. Also, if the ratio results in a figure close to 100%, management may want to arrange for a line of credit even if the amount of cash flow is sufficient, to leave itself with a reserve source of cash to cover contingencies.

CASH FLOW RETURN ON ASSETS

Description: This calculation is used to determine the amount of cash that a company is generating in proportion to its asset level. It can be used as a substitute for the popular return on assets measure, since the net income figure used in the return on assets calculation is subject to greater manipulation through the use of noncash accounting entries.

Formula: Add together net income and any noncash expenses, such as depreciation and amortization. Then subtract from this amount any noncash sales, such as revenue that has been recognized but is unbilled. Then divide the result by the *net* value of all assets; this should include accounts receivable net of a bad debt reserve, inventory net of an obsolescence reserve, and fixed assets net of depreciation. The formula is:

$$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total assets}}$$

Example: The president of the Glowering Tail Light Company, resellers of 1950s-era tail lights, has been told by the controller for several years that the company has a sterling return on assets. The president would like to verify this by comparing the measure to the cash flow return on assets and, therefore, collects the information shown in Table 4.5.

The return on assets figure listed at the bottom of the table is derived by dividing net income of $1,000,000 by total assets of $3,250,000. To arrive at the cash flow return on assets, the president must add back the noncash depreciation expense and then subtract a series of noncash accounting entries that have artificially increased the revenue level. The result is:

$$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total assets}} =$$

$$\frac{\begin{array}{c}\$1{,}000{,}000 \text{ Net income} + \$105{,}000 \text{ Noncash expenses} - \\ \$331{,}000 \text{ Noncash sales}\end{array}}{\$3{,}250{,}000 \text{ Total assets}} =$$

$$\frac{\$774{,}000 \text{ Cash flow}}{\$3{,}250{,}000 \text{ Total assets}} =$$

23.8% Cash flow return on assets

Though the cash flow return on assets percentage is acceptable, it is also considerably less than the reported return on assets.

Cautions: A company's managers can enhance their performance under this measurement by severely restricting the amount of fixed assets in which they are willing to invest cash. Though the intent of the measure is precisely this kind of behavior, it can also result in old assets not being replaced in a timely manner, which may cause capacity shortfalls when equipment fails. Managers may also interpret this measure in a conservative way when dealing with new products, since

Table 4.5

	Return on Assets	Cash Flow Return on Assets
Net income	$1,000,000	$1,000,000
Depreciation		+$105,000
Pension fund gains		–$45,000
Bill and hold revenue		–$132,000
Percentage of completion revenue		–$154,000
Total assets	$3,250,000	$3,250,000
Measurement	30.8%	23.8%

they may not want to invest in untried equipment or new products that will require large investments with an uncertain payoff.

CASH TO WORKING CAPITAL RATIO

Description: This ratio is useful for determining the proportion of working capital that is made up of cash or investments that can be readily converted into cash. If the ratio is low, it may be an indication that a company will have trouble meeting its short-term commitments because of a lack of cash. If this were the case, the next formula to calculate would be the number of expense coverage days (described earlier in this chapter) to determine exactly how many days of operations can be covered by existing cash levels.

Formula: Add together the current cash balance as well as any marketable securities that can be liquidated in the short term, and divide the total by current assets less current liabilities. The key issue is which investments to include in the measurement: since this is intended to be a measure of short-term cash availability, any investments that cannot be liquidated in one month or less should be excluded from the calculation. The formula is:

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current assets – Current liabilities}}$$

Example: The Arbor Valley Tree Company has a large inventory of potted plants and trees on hand, which comprises a large proportion of its inventory and is recorded as part of current assets. However, the inventory turns over only three times per year, which does not make it very liquid for the purposes of generating short-term cash. The company's financial analyst wants to know what proportion of the current ratio is really composed of cash or cash equivalents, since it appears that a large part of working capital is skewed in the direction of this slow-moving inventory. The relevant information is shown in Table 4.6.

Based on this information, the financial analyst calculates the cash to working capital ratio as:

Table 4.6

Fund Type	Amount	Liquidity
Cash	$55,000	Immediately available
Money market funds	$180,000	Available in one day
Officer loan	$200,000	Due in 90 days
Accounts receivable	$450,000	Due in 45 days
Inventory	$850,000	Turnover every 4 months
Current liabilities	$450,000	Due in 30 days

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current assets – Current liabilities}} =$$

$$\frac{\$55{,}000 + \$180{,}000}{(\$55{,}000 + \$180{,}000 + \$200{,}000 + \$450{,}000 + \$850{,}000) - (\$450{,}000)} =$$

$$\frac{\$235{,}000}{\$1{,}285{,}000} =$$

$$18\%$$

The financial analyst did not include the note receivable from the company officer, since it would be available for 90 days. This nearly halved the amount of the ratio to 18%, which reveals that the company should be extremely careful in its use of cash until more of the accounts receivable or inventory balances can be liquidated.

Cautions: This measurement can be considerably skewed by the timing of the measurement within the reporting period. For example, if a company has one large accounts payable check run scheduled each month, then its cash reserves will look large just prior to the check run and much lower afterward; the same situation will apply to payroll. In these situations, the measurement will drop precipitously right after the payment event, making the company cash situation look much worse than it really is.

CASH REINVESTMENT RATIO

Description: This ratio is useful for determining the amount of cash flow that a company is routinely plowing back into the business. This can be indicative of a strong commitment by the owners to build the business. However, it can also mean that a company is being so poorly run that it requires an excessive amount of working capital and fixed assets to stay in business.

Formula: To calculate the ratio, summarize cash flow for the period, subtract any dividends paid, and then divide the result by the combined incremental increase in both fixed assets and working capital. When determining the incremental increase in fixed assets, be sure to factor out the net impact of any fixed asset sales during the period—otherwise, the incremental increase in assets due to the acquisition of assets will appear to be deflated. An alternative calculation is to eliminate changes in working capital from the numerator, which allows one to focus on the key investments being made in a company's plant and equipment. The formula is:

$$\frac{\text{Increase in fixed assets + Increase in working capital}}{\text{Net income + Noncash expenses – Noncash sales – Dividends}}$$

Example: An investor wants to determine the amount of cash flow reinvestment for a target company. It is in a growth industry, and a high rate of reinvestment is expected. The ratio is:

$$\frac{\text{Increase in fixed assets + Increase in working capital}}{\text{Net income + Noncash expenses – Noncash sales – Dividends}} =$$

$$\frac{\$250{,}000 + \$450{,}000}{\$1{,}200{,}000 + \$125{,}000 - \$28{,}000 - \$50{,}000}$$

$$\frac{\$700{,}000}{\$1{,}247{,}000} =$$

$$56\%$$

From the investor's perspective, the target company does not appear to be investing a sufficient quantity of its cash flow back into the business; in a high-growth situation, a company should not only be reinvesting 100% of its cash flow, but also scrambling to line up additional funding for yet more reinvestment. The investor should closely question the management team regarding their perceived slow rate of internal asset growth.

Cautions: As noted in the description, this ratio can be an indicator of a continuing commitment to a business or mismanagement that requires the continual addition of assets to stay in business. To see if the underlying issue is related to mismanagement, calculate the ratio of fixed assets to revenue, and see how this correlates to the same ratio for other businesses in the same industry. The ratio of working capital to sales can be used in the same fashion. If these ratios indicate unusually high proportions of assets or working capital within the business, then there is either some mismanagement of assets or the company's operational structure is so different from other businesses that their results are not comparable.

CASH TO CURRENT LIABILITIES RATIO

Description: This ratio is useful for determining the ability of a company to meet its short-term liability obligations. A healthy cash situation is one in which the measurement's result is significantly higher than 100%.

Formula: Combine cash and short-term marketable securities, and divide current liabilities into the sum. If there are also marketable securities that cannot be liquidated for some time, then the deciding factor for whether to include them in the numerator is if their earliest possible liquidation date is equal to or less than the dates at which the current liabilities must be paid. The formula is:

Table 4.7

	Quarter 1	Quarter 2	Quarter 3
Cash	$120,000	$225,000	$288,000
Short-term marketable securities	$82,000	$61,000	$50,000
Current liabilities	$418,000	$682,000	$914,000
Cash to current liabilities ratio	48%	42%	37%

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current liabilities}}$$

Example: The Video Café Store, a rapidly expanding coffee bar that sells televisions to its drinkers, has had continuing problems with cash flow for a number of years. Its new CFO needs a brief overview of the severity of the problem and chooses to use the cash to current liabilities ratio to provide this information. Table 4.7 shows the relevant information for the last three quarters.

The measurement for any of the three quarters indicates a considerable cash shortage, with a trend line that indicates a worsening problem. Part of the problem may be indicated by the rapidly expanding current liabilities, which are probably caused by the company's rapid rate of growth. Based on this information, the CFO schedules a discussion with the executive team to discuss a reduction in the rate of growth.

Cautions: This measurement can yield incorrect results, based on cash requirements within a reporting period. For example, a company that pays its employees once a month will presumably do so on the last day of the month, based on work performed during that month. In this common situation, the current liabilities listing in the balance sheet will not list the payroll expense, since it is incurred and paid for entirely within the month. Nonetheless, the measurement ignores this key expense item, which can mislead one into thinking that a company can easily cover its liabilities with existing cash, when in reality its unreported liabilities may far exceed the amount of cash available.

CASH FLOW TO DEBT RATIO

Description: This ratio is used to determine the amount of cash flow available to pay down fixed debt payment commitments. A ratio well above one is a sign of having not only enough cash to meet debt payment needs but also of sustaining more debt obligations, if necessary.

Formula: To calculate the ratio, summarize all debt and lease obligations for the reporting period and divide it into cash flow. Keep in mind that the interest ex-

pense associated with the debt has probably already been included in the derivation of the net income figure that is part of cash flow, so do not include it again in the denominator part of the ratio. The formula is:

$$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Debt + Lease obligations}}$$

A variation on the formula is to ignore all short-term debt payments, on the grounds that the ratio is only intended to measure a company's long-term ability to meet its debt obligations. This version of the ratio is:

$$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total long-term debt payments for the period}}$$

Example: The Saba Exploratory Consortium has requested a loan from the First Bank of the U.S. Virgin Islands so that it can purchase another deep sea submersible for the laying of underwater phone cables. To see if the Consortium will have enough money to pay back the debt, the bank compiles Table 4.8, which has financial information for the last three years.

Though the ratio reveals that the Consortium has twice as much cash flow as there are debt payments to be met, the bank should be concerned about the continuing decline in the ratio over the past three years, because the Consortium has consistently added more debt in relation to the amount of cash it is generating. The bank may want to consider granting a loan with a short payback period so that it can get its money out quickly, before the ratio worsens further.

Cautions: The amount of debt included in the denominator of the formula can vary considerably over the measurement period as short-term debt is paid off or acquired. Also, the ratio may be rendered irrelevant if there is a sudden increase in the level of debt acquired in the future, perhaps due to an aggressive acquisition or capital budgeting expansion. Consequently, it is best to estimate debt levels over the measurement period, as well as some time into the future, to yield a more accurate picture of how cash flow levels can be used to support both the actual and future estimated level of debt.

Table 4.8

	2002	2003	2004
Cash flow	$11,500,000	$12,250,000	$12,100,000
Debt payments	$4,200,000	$4,750,000	$5,250,000
Lease obligations	$100,000	$150,000	$200,000
Cash flow to debt ratio	2.7:1	2.5:1	2.2:1

STOCK PRICE TO CASH FLOW RATIO

Description: One way in which investors can value a company is by the amount of cash flow it generates. For example, a reasonable valuation method is to calculate the net present value of a company's cash flows for a five-year period, which may then be used as the basis for selling the company. The ratio may also be used to determine the stock price that a company will probably achieve if it can reach a specific level of cash flow.

Formula: Multiply the existing stock price by the number of shares outstanding, and then divide the result by annual cash flow from both operations and other accounting events. The stock price and number of shares outstanding should be averages for the period over which the cash flow was generated. The formula is:

$$\frac{\text{Stock price} \times \text{Number of shares outstanding}}{\text{Earnings before interest, taxes, depreciation and amortization}}$$

Example: The Audible Phone Company has a stock price to cash flow ratio of 3:1. The phone service provider industry, in which the Audible Phone Company operates, has a long history of generating a stock price to cash flow ratio of 6:1. With this ratio in mind, the president wants to create a budget that will generate enough cash flow to result in a stock price of $65. There are currently 13,750,000 shares outstanding. To achieve this price, what must be the annual cash flow? The calculation is:

$$\frac{\text{Stock price} \times \text{Number of shares outstanding}}{\text{Predetermined stock price to cash flow ratio}} =$$

$$\frac{\$65 \text{ Stock price} \times 13{,}750{,}000 \text{ Shares outstanding}}{6} =$$

$$\frac{\$893{,}750{,}000}{6} =$$

$148,958,333 of cash flow is required to achieve a stock price of $65

Cautions: There are other determinants of stock price besides cash flow, though it is one of the most consistent reasons why investors will purchase a company's stock. If there are future expectations of unusually high or low sales volume, then investors will bid the stock to correspondingly high or low levels that may have nothing to do with the stock price to cash flow ratio. This ratio tends to work best in settled industries where sales levels and corresponding cash flow levels do not change much from year to year, so investors tend to focus primarily on cash flows.

DIVIDEND PAYOUT RATIO

Description: This ratio is used by investors to see if a company is generating a sufficient level of cash flow to assure a continued stream of dividends to them. A ratio of less than one indicates that existing dividends are at a level that cannot be sustained over the long term.

Formula: Divide total annual dividend payments by annual cash flow. If there is a long-standing tradition by the board of directors of continually increasing the amount of the dividend, then annualize the last (and presumably largest) dividend only and use the resulting figure in the numerator of the calculation. The formula is:

$$\frac{\text{Total dividend payments}}{\text{Net income + Noncash expenses – Noncash sales}}$$

Example: The Williams Fund is a major investor in the Continental Gas and Electric Company. The Fund is controlled by the Williams family, whose primary concern is long-term, predictable flow of cash from its various investments. The family is concerned that electricity deregulation may be impacting the ability of Continental Gas to pay dividends. It has collected information about Continental for the past three years, shown in Table 4.9.

The table reveals that Continental's board of directors is continuing to grant increasing amounts of dividends, despite a steady drop in cash flow. At the current pace of cash flow decline, Continental will be unable to support its current dividend rate in less than two years.

Cautions: Cash flows can vary significantly by year, so calculating this ratio for one year only may not yield sufficient information about a company's ability to pay dividends over the long term. A better approach, as was used in the example, is to run a trend line on the ratio for several years to see if a general pattern of decline emerges.

Table 4.9

	2002	2003	2004
Total dividend	$43,000,000	$45,000,000	$48,000,000
Cash flow	$215,000,000	$180,000,000	$144,000,000
Dividend payout ratio	5:1	4:1	3:1

5

Liquidity Measurements

This chapter is filled with measurements that are of considerable use to lenders, investors, and investment analysts. The measures are used to evaluate a company's viability. This is accomplished by examining a company's ability to collect accounts receivable in an efficient manner, use its inventory within a short time frame, pay its accounts payable when due, and maintain a sufficient amount of liquid funds to pay off short-term liabilities.

The titles of the measurements in this chapter are:

- Accounts Receivable Turnover
- Average Receivable Collection Period
- Days Delinquent Sales Outstanding
- Days' Sales in Receivables Index
- Accounts Receivable Investment
- Ending Receivable Balance
- Inventory to Sales Ratio
- Inventory Turnover
- Inventory to Working Capital Ratio
- Liquidity Index
- Accounts Payable Days
- Accounts Payable Turnover
- Current Ratio
- Quick Ratio
- Cash Ratio
- Sales to Current Assets Ratio
- Working Capital Productivity
- Defensive Interval Ratio
- Current Liability Ratio
- Required Current Liabilities to Total Current Liabilities Ratio
- Working Capital to Debt Ratio
- Risky Asset Conversion Ratio
- Noncurrent Assets to Noncurrent Liabilities Ratio
- Short-term Debt to Long-term Debt Ratio
- Altman's Z-Score Bankruptcy Prediction Formula

ACCOUNTS RECEIVABLE TURNOVER

Description: The speed with which a company can obtain payment from customers for outstanding receivable balances is crucial for the reduction of cash

requirements. A very high level of accounts receivable turnover indicates that a company's credit and collections function is very good at avoiding potentially delinquent customers, as well as collecting overdue funds.

Formula: Divide annualized credit sales by the sum of average accounts receivable and notes due from customers. The key issue in this calculation is the concept of annualized credit sales. If a company is estimating very high sales levels later in the year, this can result in an inordinately large figure in the numerator, against which current receivables are compared, which in turn results in an inaccurately high level of turnover. A better approach is to simply multiply the current month's sales by 12 to derive the annualized credit sales figure. Another alternative is to annualize the last two months of sales, on the grounds that the receivables balance relates primarily to sales in those two months. The exact measurement method used can result in some variation in the reported level of turnover, so one should model the results using several different approaches to arrive at the one that most closely approximates reality. The basic formula is:

$$\frac{\text{Annualized credit sales}}{\text{Average accounts receivable + Notes payable by customers}}$$

Example: The Samson Baggage Company, maker of indestructible luggage for adventure travelers, is growing at a very fast clip—so fast that it is running out of money. The management team needs to conserve cash and decides to review accounts receivable to see if this might be a likely source. The controller accumulates the data in Table 5.1.

The table indicates that accounts receivable turnover has worsened from eight to six within the past year. If the turnover rate had remained the same as one year ago, the amount of accounts receivable outstanding would have been $3,562,500, which is derived by dividing annualized sales of $28,500,000 by turnover of eight. The difference between the $3,562,500 in receivables at eight turns and the current $4,750,000 at six turns is $1,187,500 that could be converted into cash. Based on this information, the management team decides to tighten credit policies, purchase collection software, and add more collections staff.

Cautions: Many accounting software packages will derive the accounts receivable turnover figure for the user. However, these packages use a different calcu-

Table 5.1

	One Year Ago	Today
Annualized credit sales	$13,100,000	$28,500,000
Average accounts receivable	$1,637,500	$4,750,000
Accounts receivable turnover	8	6

lation, which is to calculate the average number of days outstanding for each open invoice. This method works fine, but only if the calculation is a weighted average that is based on the amount of each receivable. Otherwise, a very small invoice that is many days overdue can skew the turnover figure considerably.

AVERAGE RECEIVABLE COLLECTION PERIOD

Description: Some people find that the accounts receivable turnover figure is easier to understand if it is expressed in terms of the average number of days that accounts receivable are outstanding. This format is particularly useful when it is compared to the standard number of days of credit granted to customers. For example, if the average collection period is 60 days and the standard days of credit is 30, then customers are taking much too long to pay their invoices. A sign of good performance is when the average receivable collection period is only a few days longer than the standard days of credit.

Formula: Divide annual credit sales by 365 days, and divide the result into average accounts receivable. The formula is:

$$\frac{\text{Average accounts receivable}}{\text{Annual sales} / 365}$$

Example: The new controller of the Flexo Paneling Company, makers of modularized office equipment, wants to determine the company's accounts receivable collection period. In the June accounting period, the beginning accounts receivable balance was $318,000, and the ending balance was $383,000. Sales for May and June totaled $625,000. Based on this information, the controller calculates the average receivable collection period as:

$$\frac{\text{Average accounts receivable}}{\text{Annual Sales} / 365} =$$

$$\frac{(\$318{,}000 \text{ Beginning receivables} + \$383{,}000 \text{ Ending receivables}) / 2}{(\$625{,}000 \times 6) / 365} =$$

$$\frac{\$350{,}500 \text{ Average accounts receivable}}{\$10{,}273 \text{ Sales per day}} =$$

34.1 Days

Note that the controller derived the annual sales figure used in the denominator by multiplying the two-month sales period in May and June by six. Since the company has a stated due date of 30 days after the billing date, the 34.1 day collection period appears reasonable.

Cautions: The main issue is what figure to use for annual sales. If the total sales for the year are used, this may result in a skewed measurement, since the sales associated with the current outstanding accounts receivable may be significantly higher or lower than the average level of sales represented by the annual sales figure. This problem is especially common when sales are highly seasonal. A better approach is to annualize the sales figure for the period covered by the bulk of the existing accounts receivable.

DAYS DELINQUENT SALES OUTSTANDING

Description: There is no collection problem with the vast majority of accounts receivable. Recognizing this, some managers prefer to focus the attention of their collection staffs more precisely on their ability to collect money from those few accounts that do not pay on time. The days delinquent sales outstanding measure is an effective way to use this, since it only addresses those invoices that are overdue.

Formula: Divide annualized credit sales from delinquent accounts by the average amount of delinquent accounts receivable, and then divide the result into 365 days. The formula is:

$$\left(\frac{\text{Annualized credit sales from deliquent accounts}}{\text{Average delinquent accounts receivable}}\right) \div 365$$

Example: The Clean Carburetor Company (CCC) sells its product to several specialty engine manufacturers, some of whom are being squeezed on prices by the major car manufacturers, and so pay their bills late. The collections manager of CCC wants to reduce this problem by aggressively pursuing slow payers. The first step in this process is to measure the days of delinquent sales outstanding. The annualized credit sales from delinquent accounts is $4,350,000 and that the average delinquent accounts receivable figure is $815,000. With this information, the collections manager uses the following formula to arrive at the ratio:

$$\frac{365}{\dfrac{\text{Annualized credit sales from delinquent accounts}}{\text{Average delinquent accounts receivable}}} =$$

$$\frac{365 \text{ Days}}{\dfrac{\$4{,}350{,}000 \text{ Annualized credit sales from delinquent accounts}}{\$815{,}000 \text{ Average delinquent accounts receivable}}} =$$

68.4 Days delinquent sales outstanding

Cautions: One problem with this measure is determining the point at which an account receivable is considered to be delinquent. For example, if the allowable payment period for an invoice is 30 days, most customers will pay the bill on the 30th day, so it will not arrive by mail for several more days. Consequently, using 30 days as the cutoff period will include nearly all unpaid invoices. There is no standard approach to determining the cutoff point, but it is reasonable to allow up to a week of extra time beyond the allowed payment period before classifying an invoice as delinquent.

Another problem with this measurement is determining the amount of the *average* delinquent account receivable. If the subject company is small, it is likely that there are only a few delinquent invoices, so the collection of just a few of them will significantly alter the average amount; this is less of an issue for large companies, where there are so many more outstanding invoices that the collection of one or two will not have a significant impact on the average amount outstanding.

DAYS SALES IN RECEIVABLES INDEX

Description: Although changes in credit policies and collection activities can alter the ratio of accounts receivable to sales, this tends to be a consistent ratio from period to period. When the ratio increases over the preceding period (e.g., is greater than one), it is possible that a company is reporting false sales figures in order to buoy its reported level of profitability. The days sales in receivables index is a simple approach for determining if this may be the case. The underlying concept for the index is that the offsetting entry to a false sale will be accounts receivable, which will therefore increase, since there is no way that the false receivable can be collected and converted into cash. A sudden jump in the proportion of accounts receivable to sales can therefore be construed as being caused by the addition of false sales.

Formula: Divide the sales in period two (the most recent period) by accounts receivable for the same period. Then run the same calculation for period one (the preceding period), and divide the result into the ratio for period two. The formula is:

$$\frac{\dfrac{\text{Accounts receivable in period two}}{\text{Sales in period two}}}{\dfrac{\text{Accounts receivable in period one}}{\text{Sales in period one}}}$$

Example: The management of the Optico Fiber Company, a publicly held manufacturer of fiber cables and connection equipment, is suspicious of a sudden rise

Table 5.2

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Sales	$3,500,000	$3,850,000	$4,050,000	$5,150,000
Average accounts receivable	$1,250,000	$1,309,000	$1,418,000	$2,060,000
Days' sales in receivables index	—	95%	103%	114%

in reported sales levels, especially since the increase was just enough for several sales personnel to achieve their year-end bonuses. They bring in a fraud auditor, who compiles information for all four quarters of the year, shown in Table 5.2.

There is no ratio calculation for the first quarter, since there is no preceding period against which a comparison can be made. In the remaining quarters, the fraud auditor finds that the ratio is roughly the same for the second and third quarters, and then jumps dramatically in the final quarter. This is reasonable grounds for suspecting fraud, so the management team authorizes a more in-depth analysis of the situation.

Cautions: As noted in the description, a change in credit policy or collection methods can also impact this ratio. For example, if a company loosens its credit policy, it is likely that the amount of accounts receivable in relation to sales will increase. Similarly, a reduction in the number of collections personnel will likely result in an increase in the volume of delinquent accounts receivable, which will have a similar result.

ACCOUNTS RECEIVABLE INVESTMENT

Description: The accounts receivable investment calculation is useful for determining the cost of maintaining a company's accounts receivable balance. By highlighting the lost interest income on accounts receivable that have not yet been collected, one can prove the need for expending additional funds on collection personnel or, alternatively, show the incremental cost of having a loose credit granting policy.

Formula: Divide the average days taken by customers to pay their accounts payable (as described earlier in this chapter in the Average Receivable Collection Period section) by 365 days, in order to determine the fraction of a year that accounts receivable are outstanding. Then multiply this figure by total annualized credit sales, which yields the dollar value of accounts receivable that is usually outstanding. Then subtract from this figure the average gross margin on products sold, which yields the average cost of goods sold that has not yet been collected. Finally, multiply this figure by the corporate cost of capital (which is described in the Cost of Capital section in Chapter 8). This results in the investment cost to the

company of not collecting the cost of goods sold portion of the accounts receivable. The formula is:

$$\frac{\text{Average days to payment}}{\text{360 Days}} \times \text{Annual credit sales} \times (1 - \text{Gross margin \%}) \times (\text{Cost of capital})$$

Example: The Unibody Plastics Company, maker of blow-molded miniature cars for children's toys, has a collections problem that is caused by the company's loose credit policy. The CFO wants to bring this issue to the president's attention by using the accounts receivable investment calculation. The current days to payment is 72 days, as opposed to 38 days before the looser credit policy was implemented. In addition, the company has annual credit sales of $14,250,000, an average gross margin of 35%, and a cost of capital of 14.5%. The CFO calculates the measurement as:

$$\frac{\text{72 Days to payment}}{\text{360 Days}} \times \$14{,}250{,}000 \text{ Sales} \times (1 - \text{Margin \%}) \times (14.5\% \text{ Capital cost}) = \$268{,}613 \text{ Accounts receivable investment}$$

The CFO then runs the same calculation, but using the original 38 days to payment that was the case prior to the change in credit policy. The calculation is:

$$\frac{\text{38 Days to payment}}{\text{360 Days}} \times \$14{,}250{,}000 \text{ Sales} \times (1 - \text{Margin \%}) \times (14.5\% \text{ Capital cost}) = \$141{,}768 \text{ Accounts receivable investment}$$

The CFO finds that the difference between the accounts receivable investments under the two credit policy scenarios is $126,845, which is derived by subtracting the accounts receivable investment under the 38-day payment scenario from the $268,613 investment under the 72-day payment scenario. To see if the company has lost money by using this credit policy, the CFO should also determine the incremental increase in gross margin that was brought about by the looser credit policy. If the incremental cost of the accounts receivable investment exceeds the incremental increase in gross margin, then the CFO can make a strong case for tightening the company's credit policy.

Cautions: The annual credit sales portion of the calculation may need to be adjusted to reflect the annualized amount of sales at the time of the measurement rather than the estimated amount of sales for the full year. If an estimate is used, it may vary significantly from actual sales levels (since budgeted sales figures are sometimes incorrect!).

Also, the gross margin deduction may be excluded from the calculation, since it focuses attention only on the cost of capital associated with the uncollected cost of goods sold. There is a strong case that the cost of capital should be associated

with the *full* amount of outstanding accounts receivable, since the company is losing interest income on any amount that is not collected.

Finally, the incremental rate of investment income rather than the corporate cost of capital can be used, because this more appropriately reflects the incremental amount of income to the company that is being lost when an account receivable is not collected.

ENDING RECEIVABLE BALANCE

Description: It is useful for working capital budgeting and cash flow forecasting purposes to have some idea of the approximate receivable balance at the end of a reporting period. This ratio yields information that is used to determine how much cash will be invested in accounts receivable at that time, which is crucial for such activities as fund-raising, investment activities, and payables planning.

Formula: Divide the number of business days in the reporting period by the forecasted amount of sales in that period, which yields the average dollar volume of sales that should be shipped in each day of that period. Then multiply this daily sales amount by the average accounts receivable collection period (as calculated earlier in this chapter's Average Receivable Collection Period. The formula is:

$$\text{Average receivable collection period} \times \frac{\text{Sales forecast for period}}{\text{Days in period}}$$

Example: The growth of the Occam's Razor Philosophy Calculator Company, maker of the first ethical calculator, is phenomenal. The company's CFO is concerned about running out of cash, because the firm's rapid growth is requiring a great deal of cash to support its working capital needs. For the upcoming month of February, the CFO needs to estimate the amount of accounts receivable that the company will probably have on hand. The month has 28 days, the sales forecast for the period is $418,000, and the average collection period is 39 days. Based on this information, the CFO derives the following ending receivable balance:

$$\text{Average receivable collection period} \times \frac{\text{Sales forecast for period}}{\text{Days in period}} =$$

$$\text{39 Days average collection period} \times \frac{\text{\$418,000 Sales forecast}}{\text{28 Days in period}} =$$

$$\text{39 Days average collection period} \times \text{\$14,929 Sales per day} =$$

$$\text{\$582,214 Ending receivable balance}$$

Cautions: This calculation is based on the steady flow of sales to customers over the course of a reporting period (typically a month). In reality, many companies

frantically ship products to customers during the last few days of the month to empty the backlog for the first few weeks of the next month. This practice creates the month-end rush problem again in the following month. The problem also arises in services businesses, which frequently bill their customers at the end of the month, based on hours worked for the entire month. For these reasons, there tends to be a large volume of invoicing that comes due for payment in exactly one month from the end of the shipping month (because most companies pay their bills after 30 days, irrespective of actual payment terms). Consequently, it is common to see significant incoming cash flows from accounts receivable either just before or after the month-end. If these cash flows arrive just before the month-end, then the predicted level of month-end accounts receivable will be significantly off.

INVENTORY TO SALES RATIO

Description: This calculation is used to determine the amount of inventory that is kept on hand to support a specific level of sales. It is particularly useful when tracked on a trend line, which will show if there is an increasing inventory investment in proportion to sales that may be indicative of slow-moving or obsolete inventory. It can also be used as a substitute for the inventory turnover calculation, which compares inventory to the cost of goods sold instead of sales. The inventory to sales ratio will result in a higher ratio than the inventory turnover ratio, since the comparison is to sales, which is always a larger number than the cost of goods sold.

Formula: Divide annualized sales by total inventory. This measure can also be subdivided into the various components of total inventory so that raw materials, work-in-process, or finished goods can be compared to sales. The formula is:

$$\frac{\text{Sales}}{\text{Inventory}}$$

Example: The controller of the Shapiro Pool Company suspects that a series of poor purchasing decisions over the years has led to the accumulation of a large number of obsolete items in its massive inventory of pool supplies. To test this theory, the controller accumulates information for the past three years in Table 5.3:

Table 5.3

	2000	2001	2002
Annualized sales	$8,250,000	$8,400,000	$8,475,000
Inventory	$1,650,000	$1,866,667	$2,119,000
Inventory to sales ratio	5:1	4.5:1	4:1

The ratio shows a gradual decline over the past three years, thereby proving the theory. The controller proceeds to a detailed review of inventory sales patterns for each stocked product, with the intention of either returning products to suppliers or gradually writing off the inventory.

Cautions: A seasonal business may have inventory levels that fluctuate dramatically over the course of a year, with a gradual increase in inventory up to the prime selling season, followed by a dramatic drop-off in inventory levels immediately thereafter. If this is the case, it is better to use a once-a-year measurement or compare the measurement with the results from the same month in the previous year so that the figures are reasonably comparable.

INVENTORY TURNOVER

Description: Inventory is frequently the largest component of a company's working capital; in such situations, if inventory is not being used up by operations at a reasonable pace, then the company has invested a large part of its cash in an asset that may be difficult to liquidate in short order. Accordingly, keeping close track of the rate of inventory turnover is a significant function of management. This section describes several variations on the inventory turnover measurement, which may be combined to yield the most complete turnover reporting for management to peruse. In all cases, these measurements should be tracked on a trend line in order to see if there are gradual reductions in the rate of turnover, which can indicate to management that corrective action is required in order to eliminate excess inventory stocks.

Formula: The most simple turnover calculation is to divide the period-end inventory into the annualized cost of sales. One can also use an average inventory figure in the denominator, which avoids sudden changes in the inventory level that are likely to occur on any specific period-end date. The formula is:

$$\frac{\text{Cost of goods sold}}{\text{Inventory}}$$

A variation on the preceding formula is to divide it by 365 days, which yields the number of days of inventory on hand. This may be more understandable to the layperson; for example, the phrase *43 days of inventory* is more clear than *8.5 inventory turns*, even though they represent the same situation. The formula is:

$$365 \Big/ \left(\frac{\text{Cost of goods sold}}{\text{Inventory}} \right)$$

The preceding two formulas use the entire cost of goods sold in the numerator, which includes direct labor, direct materials, and overhead. However, only direct material costs directly relate to the level of raw materials inventory. Consequently, a clearer relationship is shown by comparing the value of direct materials expense to raw materials inventory, yielding a raw materials turnover figure. This measurement can also be divided into 365 days to yield the number of days of raw materials on hand. The formula is:

$$\frac{\text{Direct materials expense}}{\text{Raw materials inventory}}$$

The preceding formula does not yield as clear a relationship between direct material expense and work-in-process or finished goods, since these two categories of inventory also include cost allocations for direct labor and overhead. However, if these added costs can be stripped out of the work-in-process and finished goods valuations, then there are reasonable grounds for comparing them to the direct materials expense as a valid ratio.

Example: The Rotary Mower Company, maker of the only lawn mower driven by a Wankel rotary engine, is going through its annual management review of inventory. The information the CFO had is shown in Table 5.4.

To calculate total inventory turnover, the CFO creates the following calculation:

$$\frac{\text{Cost of goods sold}}{\text{Inventory}} =$$

$$\frac{\$4{,}075{,}000 \text{ Cost of goods sold}}{\$815{,}000 \text{ Inventory}} =$$

$$5 \text{ Turns per year}$$

To determine the number of days of inventory on hand, the CFO divides the number of turns per year into 365 days:

Table 5.4

Balance Sheet Line Item	Amount
Cost of goods sold	$4,075,000
Direct materials expense	$1,550,000
Raw materials inventory	$388,000
Total inventory	$815,000

$$365 \Big/ \left(\frac{\text{Cost of goods sold}}{\text{Inventory}} \right) =$$

$$365 \Big/ \left(\frac{\$4{,}075{,}000 \text{ Cost of goods}}{\$815{,}000 \text{ Inventory}} \right) =$$

73 Days of inventory

The CFO is also interested in the turnover level of raw materials when compared only to direct materials expenses, using this calculation:

$$\frac{\text{Direct materials expense}}{\text{Raw materials inventory}} =$$

$$\frac{\$1{,}550{,}000 \text{ Direct materials expense}}{\$388 \text{ Raw materials inventory}} =$$

4 Turns per year

The next logical step for the CFO is to compare these results to those for previous years, as well as to the results achieved by other companies in the industry. One result that is probably not good in any industry is that the comparison of direct materials to raw materials inventory yielded only four turns per year. This means that the average component sits in the warehouse for 90 days before being used, which is far too long if any reliable materials-planning system is used.

Cautions: The turnover ratio can be skewed by changes in the underlying costing methods used to allocate direct labor and especially overhead cost pools to the inventory. For example, if additional categories of costs are added to the overhead cost pool, then the allocation to inventory will increase, which will reduce the reported level of inventory turnover—even if the turnover level under the original calculation method has not changed. The ratio can also become skewed if the method of allocating costs is changed; for example, it may be shifted from an allocation based on labor hours to one based on machine hours, which can alter the total amount of overhead costs assigned to inventory. The problem can also arise if the inventory valuation is based on standard costs and the underlying standards are altered. In all three cases, the amount of inventory on hand has not changed, but the costing systems used have altered the reported level of inventory costs, which impacts the reported level of turnover.

A separate issue is that the basic inventory turnover figure may not show where the inventory overage problem is. Accordingly, the measurement can be subdivided so that there are separate calculations for raw materials, work-in-process, and finished goods (perhaps subdivided further by location). This approach enables more precise management of inventory-related problems.

INVENTORY TO WORKING CAPITAL RATIO

Description: Inventory can be a large component of working capital—so large that it skews the perception of a company's ability to raise cash from working capital, especially if the inventory has a slow rate of turnover and/or contains a high proportion of obsolete inventory. Consequently, if the proportion of inventory to working capital is too high, its ability to obtain cash for short-term accounts payable requirements is questionable.

Formula: Divide inventory by working capital, which can be defined as current assets minus current liabilities or as accounts receivable plus inventory minus accounts payable. The formula is:

$$\frac{\text{Inventory}}{\text{Accounts receivable} + \text{Inventory} - \text{Accounts payable}}$$

Example: The First Union Bank has received a loan application from the International Guild of Metalworkers, which is a sheet steel-rolling facility. The bank is not familiar with this company's business or its ability to generate sufficient cash to pay back the loan. Accordingly, it obtains the information in Table 5.5 from the company.

The trend of the inventory to working capital ratio reveals a continual increase in the proportion of inventory. The bank investigates further and finds that the inventory turnover rate has been declining over the three years measured. Since it appears that the company's steel inventory may be difficult to liquidate in case the bank calls the loan, it elects not to grant the requested loan.

Cautions: This measurement should be accompanied by an inventory turnover calculation, since a company may still be relatively liquid even with a high proportion of inventory to working capital, as long as the inventory turns over so rapidly that converting it to cash is not a problem. This is an excellent measurement to track on a trend line, since a continual increase in the ratio is indicative of operating problems involving poor sales forecasting, inadequate purchasing control, or increasing levels of obsolete inventory.

Table 5.5

	2000	2001	2002
Inventory	$1,450,000	$2,005,000	$2,875,000
Working capital	$4,145,000	$5,141,000	$6,117,000
Inventory to working capital ratio	35%	39%	47%

LIQUIDITY INDEX

Description: The liquidity index measures the number of days it would take to convert accounts receivable and inventory into cash. This is useful in determining a company's ability to generate sufficient cash to meet upcoming liabilities.

Formula: Multiply the accounts receivable balance by the average number of days required to liquidate it (see this chapter's "Average Receivable Collection Period" calculation). Then multiply the inventory balance by the average number of days required to liquidate it (which includes both the number of days to sell the inventory and the number of days to collect the resulting accounts receivable). Then add these two items together and divide them by the sum of all accounts receivable and inventory. If the accounts receivable or inventory balances tend to fluctuate significantly, an average figure can be used for both. The formula is:

$$\frac{(\text{Accounts receivable} \times \text{Days to liquidate}) + (\text{Inventory} \times \text{Days to liquidate})}{\text{Accounts receivable} + \text{Inventory}}$$

Example: The Doughboy Donut Company's president wants to determine the company's ability to convert its short-term assets into cash and decides to use the liquidity index to provide this information. The controller reports that the company has $382,000 of accounts receivable, which typically require 47 days to liquidate. The company also has $712,000 of inventory, which turns over six times per year. With this information, the president calculates the liquidity index as:

$$\frac{(\text{Accounts receivable} \times \text{Days to liquidate}) + (\text{Inventory} \times \text{Days to liquidate})}{\text{Accounts receivable} + \text{Inventory}} =$$

$$\frac{(\$382{,}000 \text{ Receivables} \times 47 \text{ Days to liquidate}) + (\$712{,}000 \text{ Inventory} \times 107 \text{ Days to liquidate})}{\$382{,}000 \text{ Receivables} + \$712{,}000 \text{ Inventory}} =$$

86 Days to convert accounts receivable and inventory into cash

Note that the number of days to liquidate the inventory is not 60 days, as would be indicated by the six inventory turns per year, but rather 107 days, which includes the additional 47 days to collect the accounts receivable into which the inventory will be converted once it is sold. Because of the preponderance of inventory in this computation, which requires extra time to liquidate, the liquidity index is a lengthy 86 days.

Cautions: The chief difficulty with the liquidity index is that it is based on average collection periods, and so does not yield a great deal of precision in regard to the exact amount of cash that will be available on a certain day. For example, if a company tends to collect the bulk of its cash on a specific date (perhaps from a sin-

gle large customer), real cash flows will be largely based on the arrival of that single payment, despite the average cash flow figure revealed by the liquidity index.

ACCOUNTS PAYABLE DAYS

Description: A calculation of the days of accounts payable gives an outside observer a fair indication of a company's ability to pay its bills on time. If the accounts payable days are inordinately long, this is probably a sign that the company does not have sufficient cash flow to pay its bills and may find itself out of business in short order. Alternatively, a small number of accounts payable days indicate that a company is either taking advantage of early payment discounts or is simply paying its bills earlier than it has to.

Formula: Divide total annualized purchases by 365 days, and then divide the result into the ending accounts payable balance. An alternative approach is to use the *average* accounts payable for the reporting period, since the ending figure may be disproportionately high or low. The amount of purchases should be derived from all nonpayroll expenses incurred during the year (payroll is not included because it is not a part of the accounts payable listed in the numerator). Also, depreciation and amortization should be excluded from the purchases figure since they do not involve cash payments. The formula is:

$$\frac{\text{Accounts payable}}{\text{Purchases} / 365}$$

Example: The Drain-Away Toilet Company has beginning accounts payable of $145,000 and ending accounts payable of $157,000. On an annualized basis, its total expenses are $2,400,000, of which $600,000 is payroll and $50,000 is depreciation. To determine its accounts payable days, we plug this information into this formula:

$$\frac{(\text{Beginning accounts payable} + \text{Ending accounts payable}) / 2}{(\text{Total Expenses} - \text{Payroll} - \text{Depreciation}) / 360} =$$

$$\frac{(\$145{,}000 \text{ Beginning payables} + \$157{,}000 \text{ Ending payables}) / 2}{(\$2{,}400{,}000 \text{ Total expenses} - \$600{,}000 \text{ Payroll} - \$50{,}000 \text{ Depreciation}) / 360} =$$

$$\frac{\$151{,}000 \text{ Average accounts payable}}{\$1{,}750{,}000 \text{ Purchases} / 360} =$$

31 Days

Cautions: The most difficult part of this formulation is determining the amount of annualized purchases. If a company has an irregular flow of business over the

course of a year, then estimating the amount of purchases can be quite difficult. In such cases, annualizing the amount of purchases for only the past month or two will yield the most accurate comparison to the current level of accounts payable because these purchases are directly reflected within the accounts payable in the numerator.

The measurement can yield inaccurate results if a company is making large additional purchases that are being capitalized into inventory or fixed assets. These purchases represent a drain on cash, yet they are not included in the formula and so can lead one to assume that a company has more liquidity than is really the case. This situation can be reversed if a company is drawing down its inventory stockpiles to make sales rather than purchasing new inventory to meet the sales requirements, which will yield greater liquidity than is indicated by the measurement.

ACCOUNTS PAYABLE TURNOVER

Description: A slightly less sophisticated version of the accounts payable days calculation is accounts payable turnover. This variation does not yield the number of days of outstanding accounts payable but rather the number of times per year that purchases are being paid off. For example, turnover of 12 times per year is the equivalent of 30 accounts payable days, while turnover of 24 times per year is the equivalent of 15 accounts payable days. Accounts payable turnover is most understandable when tracked on a trend line, an increasing turnover trend indicates more rapid payment of accounts payable, while a declining trend indicates the reverse.

Formula: Divide total annual purchases by the ending accounts payable balance. An alternative approach is to use the average accounts payable for the reporting period, since the ending figure may be disproportionately high or low. The amount of purchases should be derived from all nonpayroll expenses incurred during the year (payroll is not included because it is not a part of the accounts payable listed in the numerator). Also, depreciation and amortization should be excluded from the purchases figure since they do not involve cash payments. The formula is:

$$\frac{\text{Total purchases}}{\text{Ending accounts payable balance}}$$

Example: Use the example of the Drain-Away Toilet Company, which was used in the accounts payable days calculation. It has ending accounts payable of $157,000 and annualized purchases of $1,750,000. To determine its accounts payable turnover, we plug this information into the formula:

$$\frac{\text{Total purchases}}{\text{Ending accounts payable balance}} =$$

$$\frac{\$1{,}750{,}000 \text{ Total purchases}}{\$157{,}000 \text{ Ending accounts payable}} = 11.1 \text{ Accounts payable turnover}$$

Cautions: The same cautions noted for the accounts payable days measurement apply to the accounts payable turnover calculation as well.

CURRENT RATIO

Description: The current ratio is used by lenders to determine whether a company has a sufficient level of liquidity to pay its liabilities. A current ratio of 1:1 is considered to be the absolute minimum level of acceptable liquidity, whereas a ratio closer to 2:1 is preferred.

Formula: Divide all current assets by all current liabilities. The formula is:

$$\frac{\text{Current assets}}{\text{Current liabilities}}$$

Example: A prospective purchaser is interested in the current financial health of the Ginseng Plus retail chain, which sells herbal remedies for common maladies. The purchaser obtains the information in Table 5.6 about the company for the past three years.

The rapid increase in the amount of current assets indicates that the retail chain has probably gone through a rapid expansion over the past few years. The sudden jump in current liabilities in the last year is particularly disturbing and is indicative of the company suddenly being unable to pay its accounts payable, which have correspondingly ballooned. The purchaser elects to reduce the offer for the company because of the likely prospect of an additional cash infusion to bring its operations onto an even keel.

Cautions: This measurement can be misleading if a company's current assets are heavily weighted in favor of inventories, since this current asset can be difficult to liquidate in the short term. The presence of this problem can be revealed by using the inventory to working capital ratio or the inventory turnover ratio.

Table 5.6

	2000	2001	2002
Current assets	$4,000,000	$8,200,000	$11,700,000
Current liabilities	$2,000,000	$4,825,000	$9,000,000
Current ratio	2:1	1.7:1	1.3:1

The current ratio can be unusually high if a company uses an aggressive cost capitalization approach when costing its inventory. In these instances, a company will add all possible costs to its cost allocation pools and then use allocation methods that tend to charge the highest possible amounts of these costs to inventory. This situation can be spotted by watching the inventory turnover level on a trend line to see if the valuation spikes and then remains at the higher level.

Another problem is that the current ratio will look abnormally low for those companies that are drawing down cash from a line of credit, since they tend to keep cash balances at a minimum and only replenish their cash when it is absolutely required to pay for liabilities. In that case, a current ratio of 1:1 or less is common, even though the company's line of credit makes it unlikely that there will be a problem with the payment of liabilities.

QUICK RATIO

Description: Because of the presence of inventory in the current ratio that was covered in the last section, the current ratio may not be the best measure of a company's liquidity. One alternative is to use the quick ratio, which excludes inventory from the current assets portion of the current ratio. By doing so, one can gain a better understanding of a company's very short-term ability to generate cash from more liquid assets, such as accounts receivable and marketable securities.

Formula: Add together cash, marketable securities, and accounts receivable, and then divide the result by current liabilities. Be sure to include only those marketable securities that can be liquidated in the short term and those receivables that are not significantly overdue. The formula is:

$$\frac{\text{Cash + Marketable securities + Accounts receivable}}{\text{Current liabilities}}$$

Example: The Huff-Puff Shed Company, makers of sheds that are guaranteed not to blow down in any wind under 100 miles per hour, appears to have a comfortably high current ratio of 2.5:1. The components of that ratio are broken down in Table 5.7.

This more detailed analysis reveals that the presence of an excessive amount of inventory is making the company's liquidity look too high with the current ratio. Only by switching to the quick ratio is this problem revealed.

Cautions: This measure may still not give a true measure of corporate liquidity if most of the accounts receivable are not due for some weeks yet, whereas accounts payable may be due immediately. If this may be a problem, use the cash ratio, which is described in the next section.

Table 5.7

Account	Amount
Cash	$120,000
Marketable securities	$53,000
Accounts receivable	$418,000
Inventory	$2,364,000
Current liabilities	$985,000
Current ratio	3:1
Quick ratio	0.6:1

CASH RATIO

Description: If there are cases where the current ratio or quick ratio are not considered to be evidence of a company's very short-term ability to pay off its liabilities, then the most conservative measure to use is the cash ratio. This ratio uses only cash and short-term marketable securities in the numerator, and so it is the best way to see what proportion of liabilities absolutely, positively can be paid right away. A ratio of 1:1 is reasonable evidence of liquidity.

Formula: Add together all cash and short-term marketable securities, and divide the sum by the total of all current liabilities. The formula is:

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current liabilities}}$$

Example: The controller of the Nash Bridge Construction Company has unexpectedly departed. The CFO is concerned that some liabilities may not have been paid on time and orders an immediate calculation of the cash ratio to see if the company has the wherewithal to meet its obligations. The CFO finds that the company has cash on hand of $123,000 and short-term marketable securities of $218,000. Current liabilities are $415,000. The cash ratio is calculated as:

$$\frac{\text{Cash + Short-term marketable securities}}{\text{Current liabilities}} =$$

$$\frac{\$123{,}000\text{ Cash} + \$218{,}000\text{ Short-term marketable securities}}{\$415{,}000\text{ Current liabilities}} =$$

$$\frac{\$341{,}000}{\$415{,}000} =$$

82% Cash ratio

With a cash ratio of 82%, the company is close to paying all its cash from cash reserves. The CFO takes immediate steps to create a factoring arrangement with the local bank, in case the company needs to sell off any accounts receivable to meet its obligations.

Cautions: There may be cases where some cash cannot be used because of restrictions that are based on loan covenants, compensating balance agreements with banks, or board-mandated restricted funds that can only be tapped to pay for certain types of liabilities. Though rare, one should explore this possibility to ensure that the results of the cash ratio are valid.

SALES TO CURRENT ASSETS RATIO

Description: The sales to current assets ratio is useful for determining whether there is a liquidity problem. If a company is forced to use such financing techniques as accounts receivable factoring to pay for its ongoing operations, then the amount of its current assets will be very low. Consequently, if the ratio is extremely high, indicating the presence of few assets to support sales, a company is likely to not only have trouble filling orders (since it has an inadequate inventory), but it also may go out of business suddenly if it cannot cover its short-term accounts payable. The size of the ratio will vary considerably by industry, so a better sign of problems is a steady increase in the ratio over time, no matter what the exact ratio measurement may be.

Formula: Divide annualized sales by current assets. The ratio is:

$$\frac{\text{Sales}}{\text{Current assets}}$$

Example: An auditor is preparing the annual report for the Snowflake Sled Company. A key issue is whether a "going concern" warning should be included in the auditor's opinion, which essentially means that there are reasonable doubts that the company can stay out of bankruptcy. To research this issue, the auditor compiles Table 5.8.

Table 5.8

	2000	2001	2002
Sales	$4,100,000	$4,350,000	$4,750,000
Current assets	$1,640,000	$1,522,500	$712,500
Sales to current assets ratio	40%	35%	15%

The table shows that the sales to current assets ratio is increasing over time, with an especially dramatic jump in the last year that is caused by a rapid decline in the amount of current assets. This means that the company may fail suddenly. The auditor decides to conduct some tests to verify whether a major liquidity problem exists.

Cautions: This ratio is not valid in situations where a company is selling goods on a drop-ship arrangement with its supplier, since this means that the company records sales even though it never has possession of the goods, which are shipped directly from the supplier to the customer. Under this arrangement, a company can theoretically have no inventory at all.

The ratio's results can also be suspect in cases where a company accepts a large part of its sales with credit card payments, since this will drop accounts receivable balances to near zero, depending upon whether cash receipts are recognized at the time when a credit card sale is recorded or when cash is received from the bank supporting the customer's credit card. In both the drop-shipping and credit card situations, current assets are legitimately reduced by the type of logistical and sales operations conducted by a company and so should not be construed as being an indicator of poor liquidity.

WORKING CAPITAL PRODUCTIVITY

Description: The working capital productivity measure is similar to the sales to current assets ratio, in that both are used to see if there are enough assets available to support a given level of sales activity. The working capital productivity measure tends to be somewhat more accurate, since it subtracts current liabilities from current assets to arrive at a net current asset figure that may be considerably less than the total current assets figure used in the other measurement.

Alternatively, an excessively low working capital productivity measurement reveals that a company is inefficient at producing sales because it has too much invested in accounts receivable and/or inventory to produce a given level of sales. The measure can be compared to the results of competitors to see if the company is using its working capital in the most effective manner.

Formula: Divide annual sales by total working capital. It may also be useful to calculate average working capital, in case the ending working capital for the reporting period is unusually high or low. The formula is:

$$\frac{\text{Annual sales}}{\text{Working capital}}$$

Example: The Twosome Toboggan Company, makers of extra-large toboggans for wide loads, has reported a reasonable sales to current assets ratio of 4:1, which is comparable to the rest of the industry. However, one lender has heard rumors

that the company is very slow in paying its bills, which indicates that its liquidity is not as good as indicated by the sales to current assets ratio. Accordingly, the lender obtains the company's most recent balance sheet, which contains the following information:

Annual sales	$6,500,000
Cash	$150,000
Accounts receivable	$400,000
Inventory	$1,075,000
Accounts payable	$695,000

With this information, the lender derives the working capital productivity measurement as follows:

$$\frac{\text{Annual sales}}{\text{Working capital}} =$$

$$\frac{\$6{,}500{,}000 \text{ Annual sales}}{\$150{,}000 \text{ Cash} + \$400{,}000 \text{ Receivables} + \$1{,}075{,}000 \text{ Inventory} - \$695{,}000 \text{ Payables}} =$$

$$\frac{\$6{,}500{,}000 \text{ Annual sales}}{\$930{,}000 \text{ Working capital}} =$$

7:1 Working capital productivity

An inordinate amount of accounts payable reduces the amount of working capital available to support sales, resulting in far fewer net assets than was initially indicated by the sales to current assets ratio. The lender should be concerned about the ability of the company to continue as a going concern.

Cautions: This is generally a reliable measure, but its main failing is in the derivation of the annual sales figure in the numerator. If the sales figure used here departs considerably from the annualized amount of sales within the recent past, then the ratio will not result in a good comparison of sales level to working capital requirements. There can also be a problem if the measurement is made at the end of a high seasonal sales peak, since annualized sales will appear to be quite high, but the inventory component associated with working capital will have been greatly reduced, resulting in a ratio that appears to be too high.

DEFENSIVE INTERVAL RATIO

Description: The defensive interval ratio shows the number of days that a company can operate with its existing liquid assets, based on an expected amount of upcoming operating expenses. There is no set minimum number of days that is

considered acceptable; instead, this measure should be tracked on a trend line to see if a company's ability to pay its bills is gradually being reduced over time.

Formula: Add together all cash, marketable securities, and accounts receivable. Then determine the amount of expected daily operating expenses by compiling known upcoming expenses and creating a daily average expense. Finally, divide the average daily expense into the liquid assets. When deriving the amount of liquid assets, do not include any marketable securities that cannot be liquidated in the short term nor any of the accounts receivable for which collection is in doubt. The formula is:

$$\frac{\text{Cash + Marketable securities + Accounts receivable}}{\text{Expected daily operating expenses}}$$

Example: The Intrusive Burglar Alarm Company, maker of really loud alarm sirens, is short on cash. It is expecting a large payment in 40 days that will relieve its cash difficulties. In the meantime, the CFO needs to determine if there is enough liquidity to cover short-term expense requirements. The company requires roughly $13,000 on a daily basis to cover its expenses and that it has cash of $42,000, marketable securities of $119,000, and accounts receivable of $255,000. Using this information, the CFO calculates the defensive interval ratio as:

$$\frac{\text{Cash + Marketable securities + Accounts receivable}}{\text{Expected daily operating expenses}} =$$

$$\frac{\text{\$42,000 Cash + \$119,000 Marketable securities + \$255,000 Accounts receivable}}{\text{\$13,000 Expected daily operating expenses}} =$$

$$\text{32 Days}$$

Based on this calculation, it appears that the company will run out of cash after 32 days, leaving eight days before the large cash inflow will occur. The CFO begins calling lenders to obtain a short-term loan to cover the projected shortfall.

Cautions: The amount of expected daily operating expenses used in the denominator is an average figure; however, the actual amount of expenses paid on a daily basis is more uneven. For example, a large rent or payroll payment may be due on a specific date, although it is incorporated into the expected daily operating expense figure as a much smaller daily payment that is spread over the entire rent period. The presence of one or more of these large lump-sum payments can rapidly drain a company's cash reserves, resulting in a much lower amount of liquid assets than the measurement would otherwise indicate. To avoid this problem, one should supplement the measure with a detailed review of the exact timing of payments for upcoming accounts payable.

Another problem with this measurement is that it assumes a static amount of accounts receivable. However, any business with ongoing sales will have a constant inflow of new accounts receivable, as customers are provided with goods and services. Consequently, the defensive interval ratio can be much longer than the initial calculation may indicate, as long as new accounts receivable are being generated that will be converted into cash during the time period when existing liquidity is projected to cover daily expenses.

CURRENT LIABILITY RATIO

Description: The current liability ratio is used to determine the proportion of total liabilities that are due for payment in the near term. This is only an approximate measure of liquidity, since it does not indicate the ability of a company to pay its liabilities, whether the liabilities are extensive or small. Consequently, it is most useful when tracked on a trend line, to see if a company's proportion of current liabilities to total liabilities is worsening or improving over time.

Formula: Divide current liabilities by total liabilities. An alternative approach is to list in the numerator only those liabilities that are due for payment within a shorter time frame, such as the next month or quarter. This approach gives a better idea of the proportion of very short-term liabilities to all liabilities. The basic formula is:

$$\frac{\text{Current liabilities}}{\text{Total liabilities}}$$

Example: The Powder Hound Snowmobile Company's new CFO thinks that it may be time to restructure the company's debt so that more of it can be shifted out into the future. The CFO begins by reviewing the current liability ratio for the past three years to see if the proportion of short-term liabilities to total liabilities has increased, and accumulates the information shown in Table 5.9.

The data reveal that the company has come to rely upon short-term debt. Consequently, the CFO elects to conduct negotiations with lenders, with the objective of converting many of these short-term liabilities into long-term ones.

Table 5.9

	2000	2001	2002
Current liabilities	$329,000	$384,000	$407,000
Total liabilities	$940,000	$800,000	$690,000
Current liability ratio	35%	48%	59%

Cautions: As noted in the description, this ratio yields an approximate view of a company's liquidity, since it does not show the ability of the company to pay any amount of liabilities. Also, the dividing line for determining the presentation of a liability as current or not is its requirement to be paid within one year; if a liability's due date is slightly longer than one year, it will only appear in the denominator. Therefore, the one-year cutoff is an arbitrary factor that can skew the results of the measurement.

Another issue is that a company may have a very high current liability ratio, simply because it has paid off its long-term debt or is in its final year of debt payments (which are categorized as short-term debt). Similarly, there may be no need for any long-term debt. In both cases, the ratio appears to reveal an unwise dependence on short-term debt, when in reality the company is in good financial condition.

REQUIRED CURRENT LIABILITIES TO TOTAL CURRENT LIABILITIES RATIO

Description: A comparison of required current liabilities to total current liabilities is a good measure for determining a company's extremely short-term liability problems. If the numerator increases over time as a proportion of the total ratio, then this indicates that creditors are maintaining a close watch over payment due dates, which shows that the company is having difficulty obtaining credit that does not have extremely tight payment requirements.

Formula: Divide the total amount of all current liabilities with required payment dates by the total of all current liabilities. The amount of liabilities recorded in the numerator is subject to some degree of interpretation; for example, it may include only those liabilities coming due within the next week, or month, or quarter. Some experimentation with the ratio's results is needed to determine the exact time period used and the relevance of the resulting information. The formula is:

$$\frac{\text{Current liabilities with required payment dates}}{\text{Total current liabilities}}$$

Example: A small fertilizer company is rapidly running out of cash. It needs to get through the next month to enter its prime spring selling season and bring in some cash. Accordingly, the controller decides to measure the proportion of current liabilities with a one-month due date or less to total current liabilities in order to gain a better understanding of how many dollars of payments are coming due. Within the one-month time frame, the company must pay $148,000, while its total current liabilities are $197,000. Using this information, the controller calculates the ratio as:

$$\frac{\text{Current liabilities with required payment dates}}{\text{Total current liabilities}} =$$

$$\frac{\$148{,}000 \text{ Current liabilities with required payment dates}}{\$197{,}000 \text{ Total current liabilities}} =$$

75% Required current liabilities to total current liabilities ratio

Cautions: This ratio does not reveal a great deal of information if measured only for a single period, since there is no way to compare it to historical information. A better approach is to measure it on a trend line, or to compare it to the same period in the preceding year, when the liability proportion should have been about the same.

Also, the ratio does not reveal how much cash is actually needed for short-term payment requirements, so it should be supplemented with a short-term cash forecast that itemizes the precise cash flows to be expected over the measurement period.

WORKING CAPITAL TO DEBT RATIO

Description: The working capital to debt ratio is used to see if a company could pay off its debt by liquidating its working capital. This measure is used only in cases where debt must be paid off at once, since the elimination of all working capital makes it impossible to run a business and will likely lead to its dissolution.

Formula: Add up cash, accounts receivable, and inventory, and subtract all accounts payable from the sum. Then divide total debt into the result. A variation is to use only short-term debt in the denominator, on the grounds that only this portion of the debt will come due for payment. The formula is:

$$\frac{\text{Cash} + \text{Accounts receivable} + \text{Inventory} - \text{Accounts payable}}{\text{Debt}}$$

Example: The financial performance of the Open Sesame Door Company, makers of voice-activated door systems, has been so poor that it has violated all of its bank covenants. Because of the covenant violations, the bank has elected to call in its loan immediately. The bank vice president wants to see if the company can pay off the loan from its current resources and so examines the company's latest balance sheet and sees this information:

Balance Sheet Line Item	Amount
Cash	$20,000
Accounts receivable	$65,000
Inventory	$110,000
Accounts payable	$80,000
Debt	$185,000

The vice president uses this information to calculate the working capital to debt ratio:

$$\frac{\text{Cash + Accounts receivable + Inventory – Accounts payable}}{\text{Debt}} =$$

$$\frac{\$20{,}000 \text{ Cash} + \$65{,}000 \text{ Receivables} + \$110{,}000 \text{ Inventory} – \$80{,}000 \text{ Payables}}{\$185{,}000 \text{ Debt}} =$$

$$\frac{\$115{,}000 \text{ Working capital}}{\$185{,}000 \text{ Debt}} =$$

62% Working capital to debt ratio

The ratio shows that the bank could call the loan and receive nearly two thirds of its money back. However, a closer examination of the components of working capital reveals that current cash and receivable levels would only pay off accounts payable, leaving the loan to be paid from the much less liquid inventory balance. Consequently, the company may have a very difficult time paying back *any* of the loan. The bank vice president elects to work with company management to achieve a payback over a longer time period.

Cautions: As noted in the example, one component of the working capital figure that is used in the numerator is inventory, which is not nearly as liquid as cash or accounts receivable. If the proportion of inventory to working capital is high, then a company's apparent ability to pay off a debt in the short term will be exaggerated by this ratio.

RISKY ASSET CONVERSION RATIO

Description: The risky asset conversion ratio is a useful way to determine the proportion of a company's recorded assets that are unlikely to be easily convertible into cash. This is of considerable interest to an acquirer or lender, since these entities need to understand the underlying value of the corporation in which they are investing debt or equity. The ideal ratio result should be as small as possible. If a company has a high ratio, then it not only has little liquidation value, but also may be in danger of going out of business if it must suddenly pay off a large amount of liabilities with its small proportion of concrete assets.

Formula: Summarize the cost of all assets with a minimal conversion value, net of depreciation and amortization, and divide by total assets. The numerator should include all intangibles as well as all highly customized equipment (since these may be especially difficult to sell). The formula is:

$$\frac{\text{Cost of assets with minimal cash conversion value}}{\text{Total assets}}$$

Table 5.10

Asset Type	Book Value
Gross intangible assets	$225,000
Gross customized equipment	$450,000
Amortization of intangible assets	$60,000
Depreciation on customized equipment	$120,000
Total assets	$3,050,000

Example: A potential acquirer is reviewing the financial information of the Peterson Motor Company (PMC), with the intention of selling off its assets. The acquirer has conducted a brief review of all PMC assets and elects to calculate the risky asset conversion ratio with the information shown in Table 5.10.

The acquirer inserts this information into the risky asset conversion formula, which is:

$$\frac{\text{Cost of assets with minimal cash conversion value}}{\text{Total assets}} =$$

$$\frac{\begin{array}{c}\$225{,}000 \text{ Intangibles} - \$60{,}000 \text{ Amortization} + \\ \$450{,}000 \text{ Custom equipment} - \$120{,}000 \text{ Depreciation}\end{array}}{\$3{,}050{,}000 \text{ Total assets}} =$$

16.2% Risky asset conversion ratio

The acquirer's preliminary review shows a relatively low proportion of risky assets, so it proceeds with its due diligence by hiring an outside appraisal firm to conduct a more detailed review of the PMC assets.

Cautions: The components of this measurement are subject to a great deal of interpretation, since few people have a clear understanding of the market value of assets, especially those that are customized and therefore have a limited resale market. For an accurate measurement, an appraiser should regularly review a company's entire list of assets.

NONCURRENT ASSETS TO NONCURRENT LIABILITIES RATIO

Description: This ratio is used by lenders to determine the amount of long-term assets on hand that can be used to pay off long-term debt. A ratio equal to or greater than one is indicative of having a reasonable ability to do so. However, there are several problems with this ratio, as enumerated later in the Cautions section.

Formula: Divide the net book value of all noncurrent assets by all noncurrent liabilities. To be more conservative, eliminate from the numerator all intangible assets, since the liquidation value of these assets may be minimal. The formula is:

$$\frac{\text{Non-current assets}}{\text{Non-current liabilities}}$$

Example: The lender for the Primo Sport Fishing Company is considering calling its loan to the company and is concerned that the company cannot pay off the loan in the short term. The lending officer notes that the company has a 1:1 current ratio and so assumes that all current assets and liabilities will offset each other. Information from the company's balance sheet is shown in Table 5.11.

The lending officer elects to exclude the goodwill asset from the noncurrent assets to noncurrent liabilities ratio, since this item may not have any resale value. The measurement is calculated as:

$$\frac{\text{Noncurrent assets}}{\text{Noncurrent liabilities}} =$$

$$\frac{\$815{,}000 \text{ Fixed assets} - \$350{,}000 \text{ Depreciation}}{\$1{,}500{,}000 \text{ Long-term debt}} =$$

31% Noncurrent assets to noncurrent liabilities ratio

Based on the low percentage results of the ratio, the lending officer concludes that the company must be allowed to pay off the loan over several more years and decides not to call the loan.

Cautions: The primary problem with this ratio is its assumption that all of the funds needed to pay down debt are located in the noncurrent assets portion of the balance sheet. In reality, there is no reason why a relatively cash-flush entity should not have put a large amount of cash in its short-term marketable securities account, which would not be counted in this ratio. In order to include this extra source of funds, the current assets should be netted against all current liabilities, and then any excess current liabilities included in the numerator of the ratio.

Table 5.11

Account	Amount
Fixed assets	$815,000
Depreciation	$350,000
Goodwill	$725,000
Long-term debt	$1,500,000

Another problem with this ratio is that it assumes a lender will require a complete pay-down of its long-term debt with immediately available assets, which most companies will not have. Instead, they count on a continuing stream of funds from ongoing operations to pay down the debt.

A third issue is that the valuation of the noncurrent assets listed in the denominator may bear little comparison to their actual resale values; for example, a company could liquidate its fixed assets and obtain far less cash from the transaction than the listed book value would indicate. Consequently, using the book value of the long-term assets to determine the amount of funding available to pay down long-term debt may not reflect a company's actual ability to pay off the debt.

SHORT-TERM DEBT TO LONG-TERM DEBT RATIO

Description: The ratio of short-term debt to long-term debt reveals the proportion of total debt that is coming due for payment in the near term. It can be indicative of a company's inability to roll its short-term debt forward into longer-term debt instruments, which in turn indicates a lack of confidence in a company's ability to pay its debts.

Formula: Divide total short-term debt by total long-term debt. The short- and long-term payment amounts due on leases should be included in the calculation in order to include all possible types of debt. The formula is:

$$\frac{\text{Total short-term debt}}{\text{Total long-term debt}}$$

Example: The Guttering Candle Company, maker of beeswax candles, has applied to the First National Industrial Bank for a loan. The loan officer's review of Guttering Candle's balance sheet for the past three years includes the information shown in Table 5.12.

The table shows that the company appears to have been unable to convert its short-term debt into long-term debt, so its long-term debt has gradually declined over time, whereas its short-term debt has increased. This can indicate that other lenders have turned down the company's loan application in the past. The loan of-

Table 5.12

	2000	2001	2002
Short-term debt	$480,000	$620,000	$804,000
Long-term debt	$965,000	$925,000	$880,000
Short-term debt to long-term debt ratio	50%	67%	91%

ficer decides to review the company's ability to pay off loans with great care before issuing any funds.

Cautions: The ratio may not make much difference if a company has such a strong cash flow that it can easily fund any reasonable amount of short-term debt. It can also be misleading if a debt balloon payment has recently shifted from the long-term debt category to the short-term category, although a company must be making arrangements to roll forward the balloon payment if it does not expect to pay it off in the short term.

One can review this measurement more appropriately by combining it with an examination of its available borrowing base. If this ratio shows a large proportion of short-term debt coming due, but there is a large amount of available borrowing base, then it is reasonable to assume that the company can obtain additional financing, up to the amount of the available borrowing base, to shift debt to the long-term category.

ALTMAN'S Z-SCORE BANKRUPTCY PREDICTION FORMULA

Description: The Z-score bankruptcy predictor combines five common business ratios, using a weighting system that was statistically calculated by Dr. Edward Altman to determine the likelihood of a company going bankrupt at some point in the future. It was derived based on data from manufacturing firms, but has since proven to be highly effective in determining the risk that a service firm will go bankrupt. The calculation can also be used by a lender to determine the creditworthiness of a company.

If the calculation results in a score above 2.99, a company is probably in safe financial condition. A score between 3.0 and 2.7 is a gray area, indicating that a company is in acceptable condition at the moment but could slide into a more difficult financial condition in the future. A score between 2.7 and 1.8 indicates that a company will probably be bankrupt within two years. Any score below 1.8 indicates a high risk of bankruptcy in the near future.

Formula: Add together the following five ratios, multiplied by the indicated weighting factors:

1. Return on total assets × 3.3 weighting factor
2. Sales to total assets × 0.999 weighting factor
3. Equity to debt × 0.6 weighting factor
4. Working capital to total assets × 1.2 weighting factor
5. Retained earnings to total assets × 1.4 weighting factor

The formula, using more detailed derivations for each of these ratios, is:

(Operating income / Total assets) × 3.3
+
(Sales / Total assets) × 0.999
+
(Market value of common stock + Preferred stock) / (Total liabilities) × 0.6
+
(Working capital / Total assets) × 1.2
+
(Retained earnings / Total assets) × 1.4

This derivation of the Z-score uses weighting factors that are applicable to publicly held companies. If one is calculating the score for a privately held company, the weighting factors change slightly, and are:

- Return on total assets × 3.1 weighting factor
- Sales to total assets × 0.998 weighting factor
- Equity to debt × 0.42 weighting factor
- Working capital to total assets × 0.71 weighting factor
- Retained earnings to total assets × 0.84 weighting factor

Example: Calculate the Z-score for the Children's Furniture Factory, using the information in Table 5.13.

The calculation is:

($25,000 Operating income / $960,000 Total assets) × 3.3 = 0.09
+
($1,000,000 Sales / $960,000 Total assets) × 0.999 = 1.04
+
($485,000 Market value of stock) / ($705,000 Total liabilities) × 0.6 = 0.41
+
($175,000 Working capital / $960,000 Total assets) × 1.2 = 0.22
+
($180,000 Retained earnings / $960,000 Total assets) × 1.4 = 0.19

Table 5.13

Account Description	Amount
Sales	$1,000,000
Operating income	$25,000
Working capital	$175,000
Total assets	$960,000
Total liabilities	$705,000
Retained earnings	$180,000
Market value of stock	$485,000

Table 5.14

Ratio	Z-Score
Weighted return on total assets ratio	0.09
Weighted sales to total assets ratio	1.04
Weighted equity to debt ratio	0.41
Weighted working capital to total assets ratio	0.22
Weighted retained earnings to total assets ratio	0.19
Total Z-score	**1.95**

When these calculations are summarized, we arrive at the Z-score shown in Table 5.14.

With a low score of only 1.95, the Children's Furniture Factory should not be in business much longer.

Cautions: The results of this calculation are reliable only if there is no fraudulent financial reporting by a company that results in a higher Z-score than would otherwise be the case. Also, a sudden downturn in the economy, or some other factor impacting profits, such as a price war, can send a company's financial condition spiraling downward, irrespective of a high Z-score.

6

Capital Structure and Solvency Measurements

This chapter contains several measurements that can be used to determine the relationship between a company's debt and equity as well as the comparative proportions of different types of stock. It also addresses a company's ability to remain solvent. Solvency is a key concern in Chapter 4, which describes cash flow measurements. Consequently, the measures in both chapters can be used in combination to form a good overall opinion of a corporation's ability to stay in business.

The measurements discussed in this chapter are:

- Times Interest Earned
- Debt Coverage Ratio
- Asset Quality Index
- Accruals to Assets Ratio
- Times Preferred Dividend Earned
- Debt to Equity Ratio
- Funded Capital Ratio
- Retained Earnings to Stockholders' Equity
- Preferred Stock to Total Stockholders' Equity
- Issued Shares to Authorized Shares

TIMES INTEREST EARNED

Description: An investor or lender should be interested in a company's ability to pay its debts. The times interest earned ratio reveals the amount of excess funding that a company still has available after it has paid off its interest expense. If this ratio is close to one, then the company runs a high risk of defaulting on its debt, whereas any higher ratio shows that it is operating with a comfortable amount of extra cash flow that can cushion it if its business falters.

Formula: Divide the average interest expense by the average cash flow. Cash flow is a company's net income, to which all noncash expenses (such as depreciation

Table 6.1

	January	February	March
Interest expense	$45,000	$43,000	$41,000
Net income	$83,500	$65,000	$47,000
Depreciation	$17,000	$17,250	$17,500
Amortization	$2,500	$2,500	$2,500
Net cash flow	$103,000	$84,750	$67,000
Times interest earned	2.3	2.0	1.6

and amortization) have been added back. This ratio should be run on a monthly basis rather than annually, since short-term changes in the amount of debt carried or cash flow realized can have a sudden and dramatic impact on it. The formula is:

$$\frac{\text{Average cash flow}}{\text{Average interest expense}}$$

Example: The Cautious Bankers Corporation (CBC) is investigating the possibility of lending money to the Grasp & Sons Door Handle Corporation (GSR). Table 6.1 shows the information CBC has collected for the last few months on GSR's operations.

The table reveals that, although GSR's interest expense is dropping, its cash flow is dropping much faster so that the company will soon have difficulty meeting its interest payment obligations. The CBC examiner elects to pass on providing the company with any additional debt.

Cautions: This ratio assumes that there is no ongoing or balloon principal payment on debt; any such principal payments can greatly exceed the amount of cash outflow required by interest payments, and so must also be factored into the determination of a company's ability to pay its debt. Though many companies simply roll over expiring debt into new debt instruments, it is not always possible for those in difficult financial situations.

DEBT COVERAGE RATIO

Description: A key solvency issue is the ability of a company to pay its debts. This can be measured with the debt coverage ratio, which compares reported earnings to the amount of scheduled after-tax interest and principal payments to see if there is enough income available to cover the payments. If the ratio is less than one, it indicates that a company will probably be unable to make its debt payments. The measure is of particular interest to lenders, who are concerned about a company's ability to repay them for issued loans.

Formula: Divide the scheduled amount of principal payments by the inverse of the corporate tax rate. This yields the amount of after-tax income required by a company to pay back the principal. Then add the interest expense to be paid, and divide the sum into the net amount of earnings before interest and taxes. An alternative treatment of the numerator is to use earnings before interest, taxes, depreciation, and amortization, because this yields a closer approximation of available cash flow. The formula is:

$$\frac{\text{Earnings before interest and taxes}}{\text{Interest} + \dfrac{\text{Scheduled principal payments}}{(1 - \text{Tax rate})}}$$

Example: The Egyptian Antiques Company's controller wants to be sure that earnings will be sufficient to pay upcoming debt requirements before implementing the owner's suggested round of Christmas bonuses. The expected operating income for the year, prior to bonuses, is $135,000. The interest expense is expected to be $18,500. The tax rate is 34%. Upcoming principal payments will be $59,000. The controller uses the following debt coverage calculation to see if Christmas bonuses can still be paid:

$$\frac{\text{Earnings before interest and taxes}}{\text{Interest} + \dfrac{\text{Scheduled principal payments}}{(1 - \text{Tax rate})}} =$$

$$\frac{\$135{,}000 \text{ Operating income}}{\$18{,}500 \text{ Interest} + \dfrac{\$59{,}000 \text{ Principal payments}}{(1 - 34\% \text{ Tax rate})}} =$$

$$\frac{\$135{,}000 \text{ Operating income}}{\$107{,}894 \text{ Debt payments}} =$$

125% Debt coverage ratio

The ratio indicates that extra funds will be available for Christmas bonuses since operating income exceeds the amount of scheduled debt payments.

Cautions: The primary difficulty with this measurement is that it is focused strictly in the near term. It is usually derived from information contained within the financial statements, which report earnings on an historical basis, but gives no view of expected earnings levels, which may be considerably different. Consequently, it is best to accompany this measurement with another one that includes budgeted earnings levels for the next few earnings periods, which gives better insight into a company's ability to pay its debts.

ASSET QUALITY INDEX

Description: The asset quality index is an excellent measurement for locating companies that are capitalizing an increasing proportion of their costs over time, which can be a sign of changes in accounting methods that are designed to show an increased level of profitability than is really the case. Capitalization of costs most obviously occurs in the fixed assets area of the balance sheet but can also be found in the accounts receivable and inventory areas, by means such as overloading of allocated overhead costs and reducing reserves for bad debt or obsolete inventory. A measurement result of one is normal, while anything substantially below that figure is indicative of either financial distress or a push to increase the level of reported earnings above their rightful level.

Formula: Add together the current assets and net fixed assets in period two, divide them by total assets in the same period, and subtract the result from one. Then run the same calculation for period one, and divide the result for period one into the result for period two. The formula is:

$$\frac{1 - \dfrac{\text{Current assets in period two} + \text{Net fixed assets in period two}}{\text{Total assets in period two}}}{1 - \dfrac{\text{Current assets in period one} + \text{Net fixed assets in period one}}{\text{Total assets in period one}}}$$

Example: Glass Lamination International, a publicly held maker of rear-view mirrors for cars, appears to be having difficulty achieving its profit estimates. An investment analyst chooses to use the asset quality index to see if there is evidence that the company is shifting expenses into its fixed assets in order to bolster its reported earnings. The relevant information is shown in Table 6.2:

Table 6.2

	Period One	Period Two
Current assets	$1,275,000	$1,350,000
Net fixed assets	$6,300,000	$7,700,000
Total assets	$10,575,000	$11,050,000

The analyst plugs this information into the following asset quality index measurement:

$$\frac{1 - \dfrac{\text{Current assets in period two} + \text{Net fixed assets in period two}}{\text{Total assets in period two}}}{1 - \dfrac{\text{Current assets in period one} + \text{Net fixed assets in period one}}{\text{Total assets in period one}}} =$$

$$\frac{1 - \dfrac{\$1{,}350{,}000 \text{ Period two current assets} + \$7{,}700{,}000 \text{ Period two fixed assets}}{\$11{,}050{,}000 \text{ Period two total assets}}}{1 - \dfrac{\$1{,}275{,}000 \text{ Period one current assets} + \$6{,}300{,}000 \text{ Period one fixed assets}}{\$10{,}575{,}000 \text{ Period one total assets}}} =$$

$$\frac{1 - \dfrac{\$9{,}050{,}000}{\$11{,}050{,}000}}{1 - \dfrac{\$7{,}575{,}000}{\$10{,}575{,}000}} =$$

$$\frac{1 - 0.82}{1 - 0.72} =$$

$$\frac{0.18}{0.28} \quad 64\% \text{ Asset quality index}$$

Cautions: The measurement can yield incorrect results if a company has switched from the use of operating leases to capital leases, since this change in financing will shift assets onto the balance sheet that were already in use but which were previously owned by a lessor. For example, a manager may choose to swap out a copier that was used under an operating lease for one that the company owns under a capital lease; the nature of the asset has not changed, but the owner has, so the amount of fixed assets on the company's books will increase.

The measurement can also be altered by a change in the capitalization limit. For example, the company controller may request an increase in the capitalization limit, from $1,000 to $2,000, so that the accounting staff will not have so great an asset-tracking burden. By doing so, the company records fewer fixed assets, even though its spending habits have not changed at all.

The measurement can also be altered by changes in the depreciation calculation for fixed assets because the measurement records fixed assets net of depreciation. For example, if a company were to lengthen the period over which it depreciates assets, increase their assumed salvage values, or switch from accelerated to straight-line depreciation, the result would be less overall depreciation being charged against assets and an increase in the proportion of assets in later periods, assuming that assets continue to be purchased at a steady pace.

ACCRUALS TO ASSETS RATIO

Description: A key solvency issue for an outside investigator, such as an investor, lender, or investment analyst, is the presence of any changes in accruals over time that might be evidence of accounting tampering in order to modify a company's reported financial results. The accruals to assets ratio can be used on a trend line to show if the proportion of accruals (a key source of possible accounting

modifications) to assets is varying over time. If the proportion of accruals to assets is increasing, accounting tampering may be covering a solvency issue or at least pumping up reported earnings beyond their actual level.

Formula: Calculate the change in working capital from a predetermined earlier reporting period. Then subtract from this amount the net change in cash and depreciation over the same time period. Then divide the remainder by the change in total assets. There should be no excessive usage of accruals if the ratio results in the same figure over several periods, whereas it may indicate more aggressive accounting practices if the ratio increases over time. The formula is:

$$\frac{\text{Change in working capital} - \text{Change in cash} - \text{Change in depreciation}}{\text{Change in total assets}}$$

Example: An investment analyst is concerned about the reported performance of an international grain brokerage company whose financial statements are famous for their byzantine workings, vague footnotes, and general lack of understandability. The analyst suspects that the company is hiding weak financial results within this obfuscation. The balance sheet information for the company for two successive years is shown in Table 6.3.

Using this information, the analyst calculates the accruals to assets ratio with the following formula:

$$\frac{\text{Change in working capital} - \text{Change in cash} - \text{Change in depreciation}}{\text{Change in total assets}} =$$

$$\frac{\begin{array}{c}\$3{,}300{,}000 \text{ Change in working capital} - \$75{,}000 \text{ Change in cash} - \\ \$20{,}000 \text{ Change in depreciation}\end{array}}{\$3{,}400{,}000 \text{ Change in total assets}} =$$

94% Accruals to assets ratio

The analyst notes that the accruals to assets ratio of 94% is higher than the 75% figure that was calculated for it in the preceding year, indicating that working capital appears to be rising faster than assets as a whole. The analyst investigates fur-

Table 6.3

	Year One	Year Two	Net Change
Cash	$750,000	$825,000	+$75,000
Working capital	$4,075,000	$7,375,000	+$3,300,000
Depreciation	$135,000	$155,000	+$20,000
Total assets	$4,750,000	$8,150,000	+$3,400,000

ther by calculating the days of accounts receivable, inventory, and accounts payable on hand, and finds that the days of inventory has increased dramatically over the past few years. Yet another level of detailed research leads to the conclusion that the company has altered its inventory costing system in order to capitalize more overhead costs into inventory, thereby increasing the reported level of earnings. The accruals to assets ratio were the first clue that something was amiss.

Cautions: This measurement calculates the level of accruals that a company is using by assuming that the proportions of the various balance sheet line items to total assets will remain the same from year to year, and that only accruals will be the cause of any differences. This assumption can be significantly incorrect if the underlying nature of the business has changed in the interim, or if changes in management practices have resulted in significant changes in operational capabilities. For example, if the management team has elected to ease credit restrictions on new customers in order to increase sales, then the proportion of accounts receivable to total assets will very likely increase because of the addition of lower-credit customers. This increase in accounts receivable is not related in any way to an increase in accruals in the accounts receivable account. Consequently, these types of changes can make the accruals to assets ratio look substantially better or worse than it really is. To avoid this problem, use the measure as a general indicator of possible problems, and then conduct more in-depth analyses for individual accounts in order to determine where there may be actual changes in the proportions of accruals used.

TIMES PREFERRED DIVIDEND EARNED

Description: The owner of a company's preferred shares will have a considerable degree of interest in the company's ability to spin off enough cash flow to pay for any preferred dividends. This is also of interest to common shareholders, since they are usually not paid until the preferred shareholder dividends have been paid out. This is of particular interest to both parties when the amount of the preferred dividend is locked in by the preferred stock agreement rather than being a variable amount that is approved by the board of directors.

Formula: Divide the current amount of the preferred dividend due for payment into net income. The resulting number yields a high degree of confidence in a company's ability to pay the dividend if it is substantially greater than one. A variation on the calculation is to use the cumulative amount of preferred dividends due rather than the current amount, since some dividends may not have been paid in previous periods. Another variation is to use net cash flow in the numerator, rather than the reported amount of net income, since this strips away any noncash expense or revenue factors that may be included in the net income figure. The formula is:

$$\frac{\text{Net income}}{\text{Preferred dividend}}$$

Example: The Series A preferred shareholders of the Klaxon Fire Alarm Company have not been paid their 8% dividends for the past three years and are beginning to wonder if they will ever be paid. Under their shareholder agreement, they have the authority to force the sale of the company if preferred stock dividends are not paid in a timely manner. They want to know if this is the year in which they either force through the dividend payment or sell the company. In the current year, the company has earned $210,000. The number of preferred shares outstanding has been 48,000 for the past three years, and all shares were sold to the company for $18. To see if the payment can be made, they calculate the times preferred dividend earned measurement, as:

$$\frac{\text{Net income}}{\text{Preferred dividend}} =$$

$$\frac{\$210{,}000 \text{ Net income}}{48{,}000 \text{ Preferred shares} \times \$18 \text{ Price per share} \times 8\% \text{ Dividend} \times 3 \text{ Years}} =$$

$$\frac{\$210{,}000 \text{ Net income}}{\$207{,}360 \text{ Preferred dividend}} =$$

1.01 Times preferred dividend earned

The measurement indicates that the company can just barely pay for the entire amount of current dividends and dividends in arrears.

Cautions: The preferred stock dividend can be avoided under many preferred stock agreements; however, if it is not paid, it becomes cumulative and must be paid at some specific future date or, more commonly, prior to the distribution of dividends to common shareholders. In either case, because of the cumulative payout feature, a shareholder does not need to be concerned if this ratio does not reveal that a company can pay the dividend in the short term.

Also, the formula does not account for a company's prospective cash flow needs in the near term, such as capital expenditures, that may keep it from paying the dividend.

DEBT TO EQUITY RATIO

Description: This ratio is one of the most closely watched by creditors and investors, because it reveals the extent to which company management is willing to fund its operations with debt, rather than equity. For example, a company that wants to increase its return on equity can do so by obtaining debt, which it then

uses to buy back stock, thereby shrinking the amount of equity that is used to calculate the return on equity. This strategy works for as long as the after-tax interest cost of the debt does not exceed the benefit of the increased earnings per share resulting from the reduction in shares.

Lenders are particularly concerned about this ratio, since an excessively high ratio of debt to equity will put their loans at risk of not being repaid. Possible requirements by lenders to counteract this problem are the use of restrictive covenants that force excess cash flow into debt repayment, restrictions on alternative uses of cash, and a requirement for investors to put more equity into the company.

Formula: Divide total debt by total equity. For a true picture of the amount of debt that a company has obtained, the debt figure should include all operating and capital lease payments. The formula is:

$$\frac{\text{Debt}}{\text{Equity}}$$

A more restrictive view of the formula is to include only long-tem debt in the numerator, on the assumption that this variation gives a better picture of a company's long-term debt to equity structure. However, this view excludes situations where short-term debt, such as revolving credit lines, cannot be paid off in the short term and must eventually be converted into long-term debt, thereby increasing the amount of long-term debt.

Example: The Conemaugh Cell Phone Company has piled up a great deal of debt while purchasing new bandwidth from the federal government in the key St. Louis marketplace. Its existing debt covenants already stipulate that the company cannot exceed a debt to equity ratio of 1½ to 1. Its latest prospective purchase of a rival company, Grand Lake Wireless, will cost $55,000,000. Given its existing equity level of $182,000,000 and outstanding debt of $243,000,000, will it exceed the covenanted debt to equity ratio? To answer this question, the following formula is used:

$$\frac{\text{Debt}}{\text{Equity}} =$$

$$\frac{\$243{,}000{,}000 \text{ Outstanding debt} + \$55{,}000{,}000 \text{ Required debt}}{\$182{,}000{,}000 \text{ Existing equity}} =$$

$$\frac{\$298{,}000{,}000 \text{ Total debt}}{\$182{,}000{,}000 \text{ Total equity}} =$$

164% Debt to equity ratio

The debt to equity ratio resulting from the proposed deal will exceed the covenant, so Conemaugh must either renegotiate the covenant or complete the acquisition with a mix of debt and equity that will not violate the covenant.

Cautions: Consider calculating the debt to equity ratio for several years into the future, focusing on the relationship between interest and principal payments (rather than total debt) and equity for each year. The reason for this approach is that a large amount of total debt on the balance sheet may not reveal a true picture of a company's ability to pay it off if the debt is not due for payment until a required balloon payment at some point well into the future. However, a much smaller amount of debt on the balance sheet may be completely unsupportable if the bulk of it is due for payment in the near term.

FUNDED CAPITAL RATIO

Description: This ratio shows the proportion of fixed assets that are being funded by long-term funding, which is defined as long-term debt and stockholders' equity. If the ratio results in a figure substantially less than 100%, then one can assume that the company is being forced to use presumably higher-cost short-term debt to finance its base of long-term assets. At some point in the future, this could give rise to a dangerous situation where the company can only refinance its short-term debt at very high interest rates or is unable to refinance at all, possibly resulting in either corporate liquidation or the sale of assets.

Formula: Divide stockholders' equity and long-term debt by fixed assets. If generally accepted accounting principles (GAAP) are properly applied to the recording of capital leases, the debt associated with these leases that is not due for payment within one year will already be recorded as long-term debt. The fixed asset figure is typically recorded net of depreciation expense, on the grounds that the depreciation is approximately representative of the decline in market value of the related fixed assets over time. The formula is:

$$\frac{\text{Stockholders' equity + Long-term debt}}{\text{Fixed assets}}$$

Example: The Manila Rope Company has operated on a shoestring for a number of years, having financed its rope-making equipment with short-term loans from relatives and credit card providers. Its newly hired CFO wants to determine its funded capital ratio to see if there is an excessive degree of short-term financing that can be replaced with more stable long-term debt. The company's stockholders' equity is $128,000, its long-term debt is $30,000, and it has $311,000 in net fixed assets. The calculation is:

$$\frac{\$128{,}000 \text{ Stockholders' equity} + \$30{,}000 \text{ Long-term debt}}{\$311{,}000 \text{ Fixed assets}} =$$

$$\frac{\$158{,}000 \text{ Long-term funding}}{\$311{,}000 \text{ Fixed assets}} =$$

51% Funded capital ratio

The funded capital ratio is an anemic 51% and is sufficient evidence that longer-term financing is required. The CFO promptly arranges 10-year capital leases for the existing rope-making equipment.

Cautions: The net amount of fixed assets recorded on the company books may vary considerably from their actual value if the depreciation method, assumed salvage value, and expected life of the underlying assets result in depreciation that does not match their actual market value. To avoid this problem, use a periodic appraisal of the market value of the fixed assets, and use this amount in the denominator. However, appraisals can be expensive and will not necessarily result in accurate asset resale values.

RETAINED EARNINGS TO STOCKHOLDERS' EQUITY

Description: This ratio is used by lenders and investment analysts to see if a company is retaining earnings in the business or if they have a penchant for distributing it to the owners. If the latter situation is the case, then company managers are probably funding activities through the use of debt, which raises the level of risk to the lenders if there is a substantial amount of debt. This ratio is particularly applicable in situations where company ownership is closely held, since the small number of owners can vote themselves dividends out of retained earnings.

Formula: Divide retained earnings by total stockholders' equity. If the accounting staff has shifted retained earnings into a reserve for dividends payable, then this reserve should *not* be included in the formula, since the intent is to distribute it. The formula is:

$$\frac{\text{Retained earnings}}{\text{Total stockholders' equity}}$$

Example: The Teacher Equipment Company, which mates various extension housings to truck bodies for utility companies, is owned by a few family members. These owners regularly distribute the bulk of all earnings to themselves. The company is interested in expanding its business by purchasing a similar company in a different city, and appeals to a bank for a $5,000,000 loan. The investigating lender accumulates the information in Table 6.4.

Table 6.4

Net income from operations	$720,000
Retained earnings	$35,000
Total stockholders' equity	$225,000

The lender finds that the retained earnings to stockholders' equity ratio is only 15.6%, which is derived as:

$$\frac{\$35{,}000 \text{ Retained earnings}}{\$225{,}000 \text{ Total stockholders' equity}}$$

The ratio shows that the family is extracting a great deal of money from the business every year. However, the business also generates a large $720,000 profit, so it is theoretically capable of paying back the loan. Further questions that the lending officer needs to resolve are whether the company has a multiyear history of creating these large profits, and whether the family members will accept a lower distribution from earnings for a few years to pay off the loan in case the acquisition does not generate more cash flow.

Cautions: The reason why retained earnings may also be low in relation to total stockholders' equity is that a company has never had any earnings to place in the account, which would also lead a lender to decline issuing a loan to this type of company. However, it is also possible that the Internal Revenue Service has required a retained earnings dividend to investors on the grounds that the company is retaining more earnings than it needs to run the business. In the latter case, a low retained earnings level is not the company's fault and should not keep a lender from extending funds to it.

PREFERRED STOCK TO TOTAL STOCKHOLDERS' EQUITY

Description: A common stockholder does not want to see a high proportion of preferred stock to stockholders' equity, because preferred shares are frequently issued with a number of payment and liquidation preferences that can result in very little equity being left over for the common shareholders. For example, a preferred stock agreement may give an investor a dividend, as well as a guaranteed payback of the original investment (or more) in the event of a liquidation, plus control over any acquisitions or divestitures. Consequently, a high ratio of preferred stock to stockholders' equity can scare away likely common stock investors.

Formula: Divide total preferred stock by total stockholder's equity. The formula is:

$$\frac{\text{Preferred stock}}{\text{Stockholders' equity}}$$

Example: The DbIndex Consulting firm is a Washington, DC-based company that specializes in security consulting for large government database projects. It has run into serious cash flow difficulties because of a delay in the approval of the federal budget, and so it has sold Series A preferred shares to an outside investor in exchange for $600,000 in cash. The total amount of stockholders' equity prior to the transaction is $1,350,000. The ratio of preferred stock to stockholders' equity is:

$$\frac{\text{Preferred stock}}{\text{Total stockholders' equity}} =$$

$$\frac{\$600{,}000 \text{ Preferred stock}}{\$600{,}000 \text{ Preferred stock} + \$1{,}350{,}000 \text{ Stockholders' equity}} =$$

30.7% Preferred stock to stockholders' equity ratio

Though the ratio reveals that the preferred shareholder owns a minority position in the company, the president of DbIndex Consulting does not realize until later, when the president tries to sell the company, that the investor, according to the preferred stock agreement, must vote in favor of any such decision. The president ends up having to cede many extra common shares to the investor in order to obtain the investor's agreement to the sale transaction. In short, the measurement alone did not tell the whole story of how the preferred stock sale impacted the other shareholders in the business.

Cautions: This ratio by itself is not sufficient evidence of control by preferred shareholders. A potential common stock investor should obtain the preferred stock agreement and peruse it to see what special privileges have been guaranteed to the preferred shareholders in order to have an accurate idea of the payment and liquidation preferences that have been signed over to them. Footnotes to the financial statements contain much of this information, but reading the underlying legal document is best.

ISSUED SHARES TO AUTHORIZED SHARES

Description: The ratio of issued to authorized shares tells the CFO if it is necessary to go to the board of directors to ask for an additional authorization of shares. This request usually comes up when the number of issued shares is approaching the total amount authorized, and there is an additional need to issue shares for a variety of reasons, for example, additional option grants are contemplated, shares are needed to pay for acquisitions, or more funding is needed from equity investors.

Formula: Divide the total number of issued shares by the total number of authorized shares. The formula is:

$$\frac{\text{Total issued shares}}{\text{Total authorized shares}}$$

A variation on the formula is to combine the number of issued shares with the number of stock options, warrants, and convertible securities, and then divide this amount by the total number of authorized shares. This gives a better feel for the number of shares that will be available if all of these stock rights are converted into shares. The formula can be fine-tuned by including only those stock rights that are currently vested, in the money, or both, since these rights are the ones most likely to be converted into shares. The formula is:

$$\frac{\text{Issued shares + Stock options + Stock warrants + Convertible securities}}{\text{Total authorized shares}}$$

Example: The CFO of the Prudent Insurance Company is conservative and wants to be certain that there are enough authorized shares available to meet all possible financing needs. According to the footnotes in the financial statements, the company faces the equity-related issues shown in Table 6.5.

In addition, the CFO expects to need an additional $98,000,000 of equity funding, which should sell for about $28 per share. By using the expanded form of the issued shares to authorized shares ratio, the CFO arrives at this result prior to the planned sale of additional equity:

$$\frac{\text{Issued shares + Stock options + Stock warrants + Convertible securities}}{\text{Total authorized shares}} =$$

$$\frac{\begin{array}{c}\text{23,524,000 Issued shares + 1,805,000 Stock options +} \\ \text{125,000 Stock warrants + 2,480,000 Shares from convertible securities}\end{array}}{\text{28,000,000 Total authorized shares}} =$$

Table 6.5

	Quantity	Converted to Shares
Number of authorized shares	28,000,000	28,000,000
Number of issued shares	23,524,000	23,524,000
Number of stock warrants outstanding	125,000	125,000
Number of convertible securities outstanding (conversion ratio of one bond to eight shares)	310,000	2,480,000
Number of stock options outstanding	1,805,000	1,805,000

$$\frac{\text{27,934,000 Issued shares}}{\text{28,000,000 Authorized shares}} = 99.8\%$$

The ratio shows that there is just barely enough authorized shares on hand to cover all possible demands on the number of authorized shares. However, if the CFO chooses to pursue the sale of new equity, the board will have to be petitioned for the authorization of additional shares. The new equity offering would require 3,500,000 additional shares ($98,000,000 of total equity divided by $28 share), which would increase the ratio to 112%. However, if most of the options, warrants, and convertible securities are unlikely to be converted into shares in the short term, this would leave enough room to sell existing authorized shares in the new equity offering without the addition of more shares.

Cautions: Good judgment is required when using the expanded form of this measurement, because some or all of the existing options, warrants, and convertible securities may never by converted into shares, depending on whether options are vested or if any of the various categories of near-stock are in the money, so investors will have an incentive to purchase the stock. If many options are currently not vested, then it may make sense to run the calculation both for the current date and for the future date when the options will become vested to see how the timing would impact the issued to authorized shares ratio. The determination of when near-stock will be "in the money" at some future date is much more difficult to predict, so it is generally best to calculate the ratio based on low-medium-high predictions of conversions to stock to see if there are any scenarios where the number of shares authorized would not be sufficient.

All of these issues are avoided in those cases where company bylaws expressly disallow company management from issuing near-stock whose potential conversion into stock would exceed the amount of authorized stock.

7

Return on Investment Measurements

This chapter is aimed squarely at measurements that can be used to determine a company's ability to create a return on investment. These measures encompass net worth, several types of return on assets and equity, earnings per share, economic value added, and return on dividends. They can be used by investors to determine what to pay for a company's shares as well as to measure the return on investment. Company management can use these measures to determine its ability to generate a reasonable rate of return. The measures discussed in this chapter are:

- Net Worth
- Book Value per Share
- Tangible Book Value
- Return on Assets Employed
- Return on Operating Assets
- Return on Equity Percentage
- Return on Common Equity
- Financial Leverage Index
- Equity Growth Rate
- Earnings per Share
- Percentage Change in Earnings per Share
- Economic Value Added
- Dividend Payout Ratio
- Dividend Yield Ratio

NET WORTH

Description: A company's net worth is the amount of money that is left over after all its liabilities have been deducted from its assets. This is theoretically the amount of funds that would be left over for distribution to investors if a company were to be liquidated. A negative net worth is a reasonable indicator of serious fiscal problems. This measure is sometimes used by lenders, who may require that a minimum net worth be maintained for a loan to be left outstanding.

Formula: In its simplest form, the net worth calculation is found by subtracting total liabilities from total assets. The formula is:

$$\text{Total assets} - \text{Total liabilities}$$

A more detailed version of the measurement is found by subtracting any preferred stock dividends from total assets; dividends may only be listed alongside the balance sheet as a footnote and so would not otherwise be included in the calculation. In essence, every obligation of the company to make a payment, whether it be included on the balance sheet as a liability or not, should be subtracted from total assets in order to arrive at a company's net worth. The revised calculation is:

$$\text{Total assets} - \text{Total liabilities} - \text{Preferred stock dividends}$$

Investors may be interested in the net worth calculation on a per-share basis. If so, the preceding calculation can be divided by the total amount of outstanding common shares. A variation on this approach is to expand the number of outstanding common shares to include the potential addition of shares due to outstanding options, warrants, and convertible bonds. The formula is:

$$\frac{\text{Total assets} - \text{Total liabilities} - \text{Preferred stock dividends}}{\text{Total outstanding common shares}}$$

Example: The Bottomless Bathtub Company, maker of fine porcelain tubs, has obtained a $2,000,000 loan from the First Federal Bank to cover the cost of a facility expansion. One condition of the loan is that the company's net worth at the end of each quarterly reporting period does not drop below $500,000. The controller is reviewing the balance sheet for February, which is one month prior to its quarterly report to the bank. The balance sheet is:

Cash and receivables	$475,000
Inventory	800,000
Fixed assets	4,305,000
Total assets	$5,580,000
Accounts payable	590,000
Loans outstanding	4,500,000
Total liabilities	$5,090,000
Stockholders' equity	490,000
Total liabilities and equity	$5,580,000

The company's net worth is currently $490,000, which is derived as:

$$\text{Total assets} - \text{Total liabilities} = \$5{,}580{,}000 - \$5{,}090{,}000 = \$490{,}000$$

The company needs to increase its net worth by $10,000 by the end of the following month so that the quarterly report to the bank will still meet the minimum net worth requirement. The controller knows that March is expected to be a breakeven month, so liabilities will not be reduced. Accordingly, the controller recommends to the CFO either an investment of $10,000 in equity that would be used to reduce the loan balance (or increase cash), or an immediate layoff that will reduce liabilities in the short run.

Cautions: The primary difficulty with the net worth measurement is that it is based on historical valuations that may have little basis in present market conditions. For example, if a company has a production line that is composed of several custom-built machines, there may be no resale market for the machines, rendering them valueless in the event of a corporate liquidation. Similarly, if a company holds title to a valuable patent, only the capitalized legal costs associated with the patent will appear as an asset, even though the value of the patent itself may be much higher. Also, the value of brand names is not noted in the balance sheet. For these reasons, detailed knowledge of a company's individual assets and liabilities is a better tool for determining net worth than the simple calculation presented here, which is based on historical accounting information.

BOOK VALUE PER SHARE

Description: The book value per share measurement is used by investors and analysts to see if the market price of a share is in excess of or less than its book value. A higher market price indicates that investors have assigned extra value to a company, perhaps due to excellent management, products, patents, and so on. This measurement can also be used to determine the same information for subsets of stock, such as preferred stock.

Formula: Determine the amount of the payout needed to liquidate all preferred stock, which may include not only the payback of the original stock purchase price but also a preferential return and accumulated but unpaid dividends. Then subtract this amount from total equity (paid-in capital, the par value of stock, and retained earnings), and divide the remainder by the total number of common shares outstanding. The formula is:

$$\frac{\text{Total equity} - \text{Cost to liquidate preferred stock}}{\text{Total number of common shares outstanding}}$$

This measure can also be targeted at specific types of stock. The following formula shows the calculation for the book value per share of preferred stock:

$$\frac{\text{Liquidation value of preferred stock} + \text{Unpaid preferred dividends}}{\text{Number of preferred shares outstanding}}$$

shareholders are uncomfortable with the goodwill concept, since it does not translate into a discernible asset that would be available to shareholders in the event of a liquidation. Accordingly, the tangible book value measurement can be used to strip the value of goodwill and other intangibles from a company's book value.

Formula: Add together the recorded cost of goodwill and all other intangible assets, and subtract this amount from a company's book value. The amount of all intangibles used in the calculation should be net of any amortization and valuation write-downs. The formula is:

Book Value – (Goodwill + Other intangibles)

Example: The Book Rack Company has gone on an acquisition binge, purchasing a number of retail booksellers. All of the purchases involved prices well above the fair market value of the assets bought, resulting in substantial increases in the Book Rack's goodwill account. Its shareholders are concerned about the value added to the company by these transactions, and decide to calculate the tangible book value measurement to see how much the company is worth after intangibles are removed. The company's book value is $43,800,000, the total goodwill on its books is $29,300,000, and the capitalized legal costs associated with its trademarks is $439,000. Based on this information, the company's tangible net worth is:

Book value – (Goodwill + Other intangibles) =

$43,800,000 Book value – ($29,300,000 Goodwill + $439,000 Other intangibles) =

$14,061,000 Tangible net worth

The shareholder's concerns may be well founded, since 68% of the company's book value comprises intangible assets.

Cautions: This measure can focus too exclusively on tangible assets, since there may be extremely valuable intangible assets on the books, such as patents or brands. If so, specific intangible assets can be added back into the measurement at the user's discretion. If this approach is used, it would be useful to itemize in a footnote the specific intangibles that were added back, as well as the cost assigned to them.

RETURN ON ASSETS EMPLOYED

Description: A company is deemed efficient by investors if it can generate an adequate return while using the minimum amount of assets to do so. This also keeps investors from having to put more cash into the company and allows the company to shift its excess cash to investments in new endeavors. Consequently, the return on assets employed measure is considered a critical one for determining a company's overall level of operating efficiency.

Formula: Divide net profits by total assets. Although the assets figure is sometimes restricted to just fixed assets, it should include accounts receivable and inventory, since these areas can be major users of cash. The amount of fixed assets included in the denominator is typically net of depreciation; it can also be recorded at its gross value, as long as the formula derivation is used consistently over multiple time periods, thereby ensuring consistent long-term reporting. The formula is:

$$\frac{\text{Net profit}}{\text{Total assets}}$$

Example: Mr. Willston is the new owner of Southern Sheet Metal, a metal stamping company. He purchased the company for $3 million, and wants to retrieve as much of these funds as possible by increasing the company's return on assets. He has the controller collect the information about company income and assets that is shown in Table 7.1.

Based on the table, the calculation of net assets employed is:

$$\frac{\text{Net profit}}{\text{Total assets}} =$$

$$\frac{\$215{,}000}{\$2{,}923{,}000} =$$

$$7.4\%$$

As the new owner, Mr. Willston is not certain which of the fixed assets can be safely eliminated while maintaining productive capacity. However, he is sure that the days of accounts receivable and inventory, as noted in the table, are much too high. Accordingly, he improves collection activities and early payment discounts and drops the outstanding accounts receivable balance from 60 days to 45, reducing this asset to $384,000. He also installs an improved inventory management system, reducing the on-hand inventory balance from 90 to 60 days, which reduces this asset to $309,000. By taking these actions, he has eliminated $280,000

Table 7.1

	Year-end Results	Days on Hand
Sales	$3,070,000	
Net income	$215,000	—
Accounts receivable	$512,000	60
Inventory	$461,000	90
Fixed assets	$1,950,000	—
Total assets	$2,923,000	—

of assets, which he can take out of the business. He has also improved the net assets employed measurement to 8.1%, which is calculated as:

$$\frac{\text{Net profit}}{\text{Total assets}} =$$

$$\frac{\$215{,}000}{(\$2{,}923{,}000 - \$280{,}000)} =$$

$$8.1\%$$

Cautions: This measurement is of no use in cases where there are minimal profits, since the ratio can fluctuate considerably on a percentage basis with slight changes in the level of profit. Of more concern is the historical basis of accounting that is used to derive the value of total assets. Although the value of short-term assets such as accounts receivable is probably quite accurate, this may not be the case for facilities and equipment that were obtained many years ago. To obtain a more accurate determination of this measure, one should consider conducting an appraisal of major assets and using this value in place of their historical cost.

RETURN ON OPERATING ASSETS

Description: This measure varies somewhat from return on assets employed because only those assets actively used to create revenue are used in the denominator. This focuses management attention on the value of assets actually required to run the business, so it has a theoretical targeted asset level to achieve. A typical result of this measurement is an ongoing campaign to eliminate unnecessary assets.

Formula: Divide net income by the gross valuation of all assets used to create revenue. An asset valuation that is net of depreciation can also be used, but the type of depreciation calculation can skew the net amount significantly, since some accelerated depreciation methods eliminate as much as 40% of an asset's value in its first full year of usage. Also, if a significant proportion of net income comprises income or losses due to extraordinary items that have nothing to do with ongoing revenue creation, then the impact of these items should be eliminated from net income for the purposes of the calculation. The formula is:

$$\frac{\text{Net income}}{\text{Assets used to create revenue}}$$

Example: Quality Cabinets, an old maker of fine mahogany cabinets, has accumulated several pieces of equipment over the years that are only occasionally used in the production process. The new CFO suspects that there is considerable equipment redundancy and some degree of protectiveness by the staff of the older

pieces of equipment, some of which are old enough to have value as antiques (the equipment, not the staff). The company had income of $230,000 in the last year. The CFO accumulates the following information about its fixed assets:

Total asset base	$700,000
Band saws required for maximum capacity	4
Total band saws available	7
Average band saw cost	$15,000
Belt sanders required for maximum capacity	3
Total belt sanders available	8
Average belt sander cost	$8,000

By avoiding the opinions of the production staff and instead relying on a quantitative comparison of capacity levels and available equipment, the CFO has determined that there are three extra band saws and five extra belt sanders, with a combined cost of $85,000. With this information, the CFO calculates the return on operating assets as:

$$\frac{\text{Net income}}{\text{Assets used to create revenue}} =$$

$$\frac{\$230{,}000 \text{ Net income}}{\$700{,}000 \text{ Total assets} - \$85{,}000 \text{ Unproductive assets}} =$$

$$37\% \text{ Return on operating assets}$$

Cautions: The specific assets included in the denominator can be subject to a great deal of interpretation, since managers realize that any assets not included in it will eventually become targets for elimination. Consequently, the list of assets used should be carefully reviewed, preferably with the industrial engineering staff, to ensure that each asset has a direct role in the production of revenue.

RETURN ON EQUITY PERCENTAGE

Description: This calculation is used by investors to determine the amount of return they are receiving from their capital investment in a company. This is a commonly used measure, but can be misleading, as discussed under the Cautions section.

Formulas: Divide net income by total equity. To obtain a better picture of the ability of a company to generate a return from operating activities only, the measure can be modified to be net income *from operations* divided by total equity. The basic formula is:

$$\frac{\text{Net income}}{\text{Total equity}}$$

Example: The president of the Lounger Chairs Furniture Company has been provided with a bonus plan that is largely based on the increase achieved on return on equity for the shareholders. There is $1,000,000 of equity on the books, of which $400,000 is closely held and the other $600,000 is held by a variety of small investors. The president estimates that it will be possible to buy back $300,000 of the stock from small investors by obtaining a loan that has an after-tax interest rate of 8%. The president compiles the information in Table 7.2 to see if the stratagem makes sense:

Table 7.2

	Before Stock Buyback	After Stock Buyback
Sales	$5,000,000	$5,000,000
Expenses	$4,850,000	$4,850,000
Debt interest expense	—	$24,000
Profits	$150,000	$126,000
Equity	$1,000,000	$700,000
Return on equity	15%	18%

The strategy appears to be a good one. Though expenses will be driven up by the interest cost of the debt, the amount of equity will be reduced to such an extent that the return on equity will increase by 3%. However, before implementing this strategy, the president should investigate the company's ability to generate enough cash flow to pay off or at least maintain the debt.

Cautions: A management team that is eager to increase a company's return on equity can easily do so by incurring new debt and using these funds to buy back stock. Although the amount of equity is thereby reduced, making the ratio more favorable, the company also has an obligation to pay back the debt and related interest. An overly zealous pursuit of this approach can result in such a large debt load that a small downturn in sales will not allow it to pay off the debt, possibly ending in bankruptcy. An astute investor should combine this ratio with an analysis of how much debt a company has incurred, as well as its interest cost.

RETURN ON COMMON EQUITY

Description: A variation on the last measurement (return on equity percentage) is return on common equity. The calculation is the same one used for return on equity, except that preferred stock dividends are removed from the net income listed

in the numerator, whereas only common stockholders' equity is used in the denominator. Thus a more accurate estimate is obtained of the return to common shareholders excluding the returns to the holders of all other types of stock. This is useful in situations where stock has been issued that yields large dividends or preferential returns, so common shareholders can see the minimized amount of return left for them.

Formula: Subtract any preferred stock dividends from net income, and divide the result by common stockholders' equity. The formula is:

$$\frac{\text{Net income} - \text{Preferred stock dividends}}{\text{Common stockholders' equity}}$$

Example: Premium Data Corporation, a provider of databases to the military, finds itself in difficult financial circumstances and must issue a round of Series A preferred stock to a new group of investors in order to bring in more cash. The original owners of the firm's common stock would like to see how their return has been diminished by this transaction, and they calculate the return on common equity to find out. The new Series A stock includes a provision for a mandatory $3.50 dividend per share at the end of the fiscal year. Net income for the year was $128,000. Common stockholders' equity was $585,000. A total of 25,000 shares of Series A stock were sold. Using this information, the return on common equity is calculated as:

$$\frac{\text{Net income} - \text{Preferred stock dividends}}{\text{Common stockholders' equity}} =$$

$$\frac{(\$128{,}000 \text{ Net income}) - (\$3.50 \times 25{,}000 \text{ Preferred stock dividends})}{\$585{,}000 \text{ Common stockholders' equity}} =$$

$$\frac{\$128{,}000 - \$87{,}500}{\$585{,}000} =$$

6.9% Return on common equity

If the Series A stock had not been issued, then the preferred dividend could have been eliminated from the transaction, which would have increased the common shareholders' return to a much higher 22%. Consequently, one can conclude that this latest round of equity financing was extremely expensive for the common shareholders.

Cautions: A common clause in preferred stock agreements is that preferred stock shareholders will receive dividends in the same amount as any given to common shareholders. This requirement may be buried deep in the preferred stock purchase agreement and involve some digging to find. Also, there may be a cumulative

dividend clause that pays dividends to preferred shareholders if the company did not make such payments at an earlier date; any of these unpaid amounts should be included in the numerator portion of the measurement.

FINANCIAL LEVERAGE INDEX

Description: The financial leverage index can indicate whether a large proportion of debt in relation to equity is being used to fund a company's operations. It compares the rate of return on equity to the rate of return on assets. If the rate of return on equity is significantly higher than the return on assets, then the equity base is comparatively small in relation to the base of assets, which inherently means that the difference between the two is composed of nonequity sources of funding.

Formula: Divide net income by the total amount of equity, and divide net income by the total amount of assets. Then divide the return on equity percentage by the return on assets percentage. The formula is:

$$\frac{\text{Return on equity}}{\text{Return on assets}}$$

Example: The Everlast Shoe Company, maker of steel-toed boots, has generated the following financial information for its last fiscal year:

Net income	$140,000
Total equity	315,000
Total assets	875,000

Based on this information, the financial leverage index is calculated in the following manner:

$$\frac{\text{Net income/Total equity}}{\text{Net income/Total assets}} =$$

$$\frac{\$140{,}000 \text{ Net income}/\$315{,}000 \text{ Total equity}}{\$140{,}000 \text{ Net income}/\$875{,}000 \text{ Total assets}} =$$

$$\frac{44.4\% \text{ Return on equity}}{16.0\% \text{ Return on assets}} =$$

278% Financial leverage index

With such a high financial leverage index, it is apparent that the company is financing a significant proportion of its growth with liabilities.

Cautions: This is a complex approach to a simple problem, which is discovering if there is a large amount of debt on the balance sheet. This can be easily obtained by a glance at the financial statements rather than by laboriously compiling this calculation.

EQUITY GROWTH RATE

Description: The equity growth rate is used to determine the rate at which additional funds are being added to the equity account from operations. By doing so, shareholders can see if their equity pool is increasing or decreasing and by how much. This information is usually masked in the financial statements, since dividends are not subtracted from the net income figure in the income statement, forcing investors to manually merge this information from dividends listed in the Statement of Changes in Equity.

Formula: Subtract all nonexpense payments from net income, which are dividends for both common and preferred shareholders, and divide the result by beginning common stockholders' equity. Any payments made to buy back stock can also be included in the numerator, since this results in a reduction in equity. The formula is:

$$\frac{\text{Net income} - \text{Common stock dividends} - \text{Preferred stock dividends}}{\text{Beginning common stockholders' equity}}$$

Example: The Altruistic Gasket Company had net income of $420,000 in the last year. In addition, it paid out $80,000 in common stock dividends, $25,000 in preferred stock dividends, and bought back $120,000 of both kinds of stock. The beginning balance in the common stockholders' equity account was $1,635,000. Based on this information, the equity growth rate was:

$$\frac{\text{Net income} - \text{Common stock dividends} - \text{Preferred stock dividends} - \text{Stock repurchases}}{\text{Beginning common stockholders' equity}} =$$

$$\frac{\$420{,}000 \text{ Net income} - \$80{,}000 \text{ Common dividends} - \$25{,}000 \text{ Preferred dividends} - \$120{,}000 \text{ Stock repurchases}}{\$1{,}635{,}000 \text{ Beginning common stockholders' equity}} =$$

$$\frac{\$195{,}000 \text{ Net increase in equity}}{\$1{,}635{,}000 \text{ Beginning equity}} =$$

12.0% Equity growth rate

Cautions: There may be very good reasons for issuances of dividends that prevent the amount of equity from growing. For example, the Internal Revenue Service may have warned the company that it is retaining an excessive amount of equity and will be taxed on the excess amount unless it is distributed; also, the board of directors may have concluded that dividends in arrears must be paid out, stock must be bought back to shore up the market price of the stock, or a liquidating dividend is in order. In short, there may be good reasons for a moderate or negative equity growth rate.

EARNINGS PER SHARE

Description: This measure is the standard used to compare the financial results of publicly held companies. It is useful for shareholders to determine changes in earnings per share held over a period of time.

Formula: Subtract the dividends on preferred stock from net income, and divide the result by the combination of all outstanding common shares and all common stock equivalents. The amount of common stock equivalents is the total of all vested warrants and options as well as all convertible securities that have not yet been converted into common stock; this figure tends to be too high, since the holders of these common stock equivalents will frequently not exercise their rights to purchase common stock. If the terms for purchase of common stock equivalents are currently higher than the price at which they can be purchased on the open market, it is not very likely that they will be converted to common stock, and they can be safely excluded from the calculation. The formula is:

$$\frac{\text{Net income} - \text{Dividends on preferred stock}}{\text{Number of outstanding common shares} + \text{Common stock equivalents}}$$

Example: The controller of the Open Sesame Garage Door Company is calculating the earnings per share for the company, given the following information:

Net income	$250,000
Preferred stock dividends	$28,000
Shares of common stock	4,500,000
Number of vested options	125,000
Number of convertible bonds	20,000
Number of warrants	50,000

If the controller calculates earnings per share on a nondiluted basis, the formula will not include the options, convertible securities, or warrants shown. The formula will look like this:

$$\frac{\$250{,}000 - \$28{,}000}{4{,}500{,}000 \text{ shares}} =$$

$$\frac{\$222{,}000}{4{,}500{,}000} =$$

$$\$.049/\text{share}$$

If the options, convertible securities, and warrants *are* added to the calculation on a fully diluted basis, then the calculation is:

$$\frac{\$250{,}000 - \$28{,}000}{4{,}500{,}000 + 125{,}000 + 20{,}000 + 50{,}000} =$$

$$\frac{\$222{,}000}{4{,}695{,}000} =$$

$$\$.047/\text{share}$$

Cautions: Net income is a key component of this ratio. Although it is indicative of a company's overall operating condition, it can be skewed by nonoperating charges or credits, and it will also not reveal a company's cash position. Consequently, it should be combined with a review of operating results, as well as a careful examination of all cash inflows and outflows. Also, as noted in the Formula section, the amount of common stock equivalents is frequently overstated, which tends to artificially reduce the amount of earnings per share.

PERCENTAGE CHANGE IN EARNINGS PER SHARE

Description: Earnings per share (EPS) is one of the most closely watched measures of corporate performance, so it makes sense for outside investment analysts, investors, and managers to regularly review the rate at which EPS changes from period to period. A company producing a lengthy string of gradual increases in EPS over many quarters is considered to be evidence of good management.

Formula: Divide the incremental change in EPS in the most recent reporting period by the EPS in the preceding period. It is possible that EPS will be modified by the management team in order to report a string of continuing increases (see the Cautions section); an alternative form of reporting is to base this measurement on cash flow per share, which is more difficult to alter. The formula is:

$$\frac{\text{Incremental change in earnings per share}}{\text{Earnings per share from previous period}}$$

Example: The Bouncing Billiard Ball Company's earnings have just been reported to the public. Its EPS in the preceding period were $1.14. During the current period, it increased its common stock outstanding from 1,725,000 to 1,850,000, whereas the earnings reported were $2,300,000. To determine the percentage change in EPS, first calculate the average amount of shares outstanding in the period, which is:

(1,725,000 Beginning shares + 1,850,000 Ending shares) / 2 =
1,787,500 Average shares

We then divide the reported earnings of $2,300,000 by the average shares outstanding of 1,787,500 to arrive at EPS of $1.29. We then use the following formula to arrive at the percentage change in earnings per share:

$$\frac{\text{Incremental change in earnings per share}}{\text{Earnings per share from previous period}} =$$

$$\frac{\$1.29 \text{ Latest earnings per share} - \$1.14 \text{ Preceding earnings per share}}{\$1.14 \text{ Preceding earnings per share}} =$$

$$\frac{\$0.15 \text{ Incremental change in earnings per share}}{\$1.14 \text{ Preceding earnings per share}} =$$

13.2% Incremental change in earnings per share

Cautions: A long string of increases in EPS can be considered evidence of good management, but it also places a great deal of pressure on the management team to continue to create earnings jumps that match those from previous years. To do this, managers may engage in a high degree of earnings management that shifts revenues and expenses into and out of different periods or asset-holding accounts, thereby modifying earnings to such an extent that it is not possible to tell if the reported level of earnings is the real level of earnings. Also, if a company's underlying business falls on hard times, managers may be tempted to fabricate earnings in order to maintain their unending string of earnings per share increases. For these reasons, several other performance measures should be reviewed to see if changes in the revenue level and expense structure appear to add up to the reported earnings per share, or if there is so much variation in these proportions between reporting periods that there is a good chance of management interference in the reported numbers.

ECONOMIC VALUE ADDED

Description: Economic value added (EVA) shows the incremental rate of return in excess of a firm's total cost of capital. Stated differently, this is the surplus

value created on an initial investment. It is *not* just the difference between a firm's percentage cost of capital and its actual rate of return percentage, since it is designed to yield a dollar surplus value. If the measurement is negative, then a company is not generating a return in excess of its capital costs. It is extremely important to break down the drivers of the measurement to determine what parts of a company are keeping the measure from reaching its maximum potential.

EVA has become the most fashionable measurement for determining the ability of a company to generate an appropriate rate of return, thanks in part to the efforts of several consulting firms that specialize in installing the systems that roll up into this measurement. Some studies have shown that a favorable EVA measurement correlates closely with the market price achieved by a company's stock, so it can become the cornerstone of a company's efforts to increase its market value. It can also be linked to a company's compensation system, meaning that managers are paid based on their ability to combine efficient asset utilization with profitable operating results.

Formula: Multiply the net investment by the difference between the actual rate of return on assets and the percentage cost of capital. The three elements of the calculation are:

1. *Net investment*. The net investment figure used in the formula is subject to a great deal of variation. In its most limited form, net valuation can be used for all fixed assets. However, some assets may be subject to accelerated depreciation calculations, which reduce the amount of investment used in the calculation; a better approach is to use the straight-line depreciation method for all assets, with only the depreciation *period* varying by type of asset. A variation on this approach is to also add research and development, as well as training costs, back into the net investment, on the grounds that these expenditures are made to enhance the company's value over the long term. Also, if assets are leased rather than owned, they should be itemized as assets at their fair market value and included in the net investment figure so that managers cannot use financing tricks to enhance their return on investment.
2. *Actual return on investment*. When calculating the return on investment, research and development, as well as training expenses, should be shifted out of operating expenses and into net investment (as noted in 1). In addition, any unusual adjustments to net income that do not involve ongoing operations should be eliminated. This results in an income figure that is related to those costs that can be legitimately expensed within the current period.
3. *Cost of capital*. The formulation of the cost of capital is complex; please refer to the discussion of the cost of capital in Chapter 8.

The formula is:

(Net investment) × (Actual return on investment – Percentage cost of capital)

Table 7.3

Type of Funding	Amount of Funding	Cost of Funding
Debt	$2,500,000	8.5%
Preferred stock	$4,250,000	12.5%
Common stock	$8,000,000	16.0%
Total	$14,750,000	**13.7%**

Example: The CFO of the Miraflores Manufacturing Company wants to see if the company has a positive economic value added. Based on calculations of outstanding debt, preferred stock, and common stock, as noted in Table 7.3, the CFO estimates that the firm's cost of capital is 13.7.%.

The CFO then takes the balance sheet and income statement and redistributes some of the accounts in them, in accordance with Table 7.4, so some items that are usually expensed under generally accepted accounting principles are shifted into the investment category.

The return on investment, as based on the net income and investment figures in Table 7.4, is 13.5% (net income divided by the total net investment). Using this information, the CFO derives the following calculation to determine the amount of economic value added:

(Net investment) × (Actual return on assets – Percentage cost of capital) =

($3,115,000 Net investment) × (13.5% Actual return – 13.7% Cost of capital) =

$3,115,000 Net investment × –0.2% =

– $6,230 Economic value added

In short, the company is destroying its capital base by creating actual returns that are slightly less than its cost of capital.

Table 7.4

Account Description	Performance	Net Investment
Revenue	$8,250,000	
Cost of goods sold	$5,950,000	
General and administrative	$825,000	
Sales department	$675,000	
Training department		$100,000
Research and development		$585,000
Marketing department	$380,000	
Net income	**$420,000**	
Fixed assets		$2,080,000
Cost of patent protection		$125,000
Cost of trademark protection		$225,000
Total net investment		**$3,115,000**

Cautions: The focus of this measure is to increase the return on capital employed. However, this may keep managers from investing in assets that have problematic returns, but which may yield excellent returns if the company is willing to wait a few years to see if the market or the product matures. Also, if the calculation is being made for individual divisions of the same company, the person creating the measurement may become entangled in complex expense allocations from various corporate service centers to operating divisions, with constant bickering among the division managers to reduce their share of these costs.

DIVIDEND PAYOUT RATIO

Description: The dividend payout ratio tells an investor what proportion of earnings are being paid back in the form of dividends. This is particularly important when the ratio is greater than one, since it indicates that a company is dipping into its cash reserves in order to pay dividends, which is not a sustainable trend. Alternatively, if only a small proportion of earnings is being paid back as dividends, the remaining cash is likely being plowed back into operations, which should result in an increase in the stock price. If the stock price is stagnant or declining, then investors have a valid concern regarding the proper use of corporate earnings.

Formula: Divide the dividend per share by the earnings per share. The cash flow from nonoperating items may be included in the earnings per share figure, since they will impact the amount of cash available for distribution as dividends. However, if nonoperating items with no immediate cash flow impact, such as restructuring reserves, are included in the earnings per share figure, then they should be removed; such items do not properly reflect a company's ability to pay dividends. Also, it may be necessary to add expected capital expenditures to the earnings per share figure, if this figure is expected to require a significant proportion of the cash provided by earnings. The formula is:

$$\frac{\text{Dividend per share}}{\text{Earnings per share}}$$

Example: Mr. Jones has invested a large part of his savings in the stock of Illinois Gas Distribution Company, operator of a nationwide gas pipeline. He wants to see if the company can continue to issue its semiannual dividend of $4.00 per share, based on its most recent earnings report. The report contains the following information:

Net income	$15,430,000
Goodwill amortization	$7,000,000
Depreciation	$3,500,000
Capital purchases	$3,750,000

Restructuring reserve	$4,500,000
Number of shares outstanding	5,450,000

Mr. Jones adjusts the $15,430,000 by adding back $7,000,000 in goodwill amortization, depreciation of $3,500,000, and a restructuring reserve of $4,500,000, since none of them involve cash flows (though the restructuring reserve may require a cash outflow at some point in the future). He also adds back $3,750,000 of capital expenditures. The net income after all of these adjustments is $26,680,000. He then calculates the dividend payout ratio using:

$$\frac{\text{Dividend per share}}{\text{Earnings per share}} =$$

$$\frac{\text{\$4.00 Dividend per share}}{\text{\$26,680,000 Adjusted net income/5,450,000 Shares}} =$$

$$\text{82\% Dividend payout ratio}$$

The ratio reveals that the company is capable of paying out dividends from its earnings per share. However, nearly all the funds acquired through earnings are being paid out, so there may be some danger of a cutback in dividends in the future if the company's profit level drops by a small amount, or if it needs to use its earnings to fund an increase in its rate of growth.

Cautions: Earnings per share can be skewed by accounting accruals that do not reflect actual cash flows. For example, the revenues from a long-term construction project can be recorded on a percentage of completion basis, even if cash payments will occur at a later date. To avoid this problem, substitute the earnings per share in the denominator with cash flow per share. To derive the cash flow per share, subtract all noncash items, such as accrued revenues, depreciation, and amortization, from the earnings per share figure.

DIVIDEND YIELD RATIO

Description: The dividend yield ratio is useful for determining the return earned by investors from dividends, based on the current market price of a company's stock. This measurement inherently assumes that there is no other return to be gained from one's investment in stock, such as an increase in the stock price, so it should be coupled with an additional review of stock price changes in order to gain a true picture of the return to be gained from a stock.

Formula: Divide the dividend per share by the market price per share. An investor may wish to change the market price listed in the denominator to the price paid to buy the stock, since one could consider the appropriate dividend yield to

be based on the price originally paid. Also, in cases where the market price of a stock fluctuates significantly, the average market price during the measurement period may be used rather than its ending price. The formula is:

$$\frac{\text{Dividend per share}}{\text{Market price per share}}$$

Example: Over the course of a year, the Glittering Magic Factory pays out two dividends, the first for $1.38 and the second for $1.50. Its stock price for the period averaged $32.50. Based on this information, its dividend yield ratio is:

$$\frac{\text{Dividend per share}}{\text{Market price per share}} =$$

$$\frac{(\$1.38 + \$1.50)\text{ Dividends per share}}{\$32.50\text{ Average market price per share}} =$$

$$8.9\%\text{ Dividend yield ratio}$$

Cautions: As noted in the Description section, a stock's value is based on a combination of dividend payments and changes in its stock price, only the first half of which is covered by this calculation. If only the dividend yield ratio were used to value stocks, then most high-tech stocks would receive a valuation of zero, since they rarely issue dividends.

8

Market Performance Measurements

This chapter covers those measurements that are of most use to outsiders who are reviewing a company's market performance. It covers not just the popular price/earnings ratio, but also other issues that impact earnings on a per-share basis, such as several variations on the stock options to common shares ratio. It also addresses several capital-based measures, such as market value added and the cost of capital, that are driven by the equity and debt markets' perception of a company's valuation. The measurements discussed in this chapter are:

- Insider Stock Buy-Sell Ratio
- Market Value Added
- Stock Options to Common Shares Ratio
- Cost of Capital
- Sales to Stock Price Ratio
- Price/Earnings Ratio
- Capitalization Rate

INSIDER STOCK BUY-SELL RATIO

Description: This ratio is used by outside analysts to see if company employees are aware of information that is not available to the public, which may lead a disproportionate number of them to buy or sell stock in expectation of changes in company value. For some stock traders, this is a key part of their stock-pricing models.

Formula: Divide the number of stock *sale* transactions by company insiders by the number of stock *purchase* transactions by company insiders. If the resulting percentage is less than one, then the presumption is that insiders feel the company's value will increase. Conversely, a percentage greater than one indicates a rapid sell-off of stock, possibly caused by pessimism over the company's future prospects. The formula is:

$$\frac{\text{Number of stock sale transactions by insiders}}{\text{Number of stock purchase transactions by insiders}}$$

Since the number of stock transactions used in this formula can be skewed by a large number of small transactions, the calculation can be modified so that it is based on the total number of shares sold and purchased. Yet another variation is to calculate it based on the transactions of high-level company officers only, who are most likely to understand the condition of the company.

Example: An investment analyst watches the results of the Hardaway Hair Dryer Company on a regular basis. The analyst is trying to sort out some insider stock transactions that have recently occurred to see if there is a trend to use to make a recommendation to clients. The relevant information is shown in Table 8.1.

By summarizing the information in the table and calculating the insider stock buy-sell ratio, the analyst arrives at the following measurement:

$$\frac{\text{Number of stock sale transactions by insiders}}{\text{Number of stock purchase transactions by insiders}} =$$

3 Sale transactions/4 Purchase transactions =

75% Insider stock buy-sell ratio

At first glance, it appears that there is a trend toward the purchase of shares by company insiders. However, a careful review of the specific transactions is in order. One of the purchases was made by the company's employee stock ownership plan (ESOP), which probably purchases shares on an ongoing basis irrespective of the stock price. Also, two of the purchases, by the marketing director and engineering staff, are so small that they may be related to the exercise of stock options. Counterbalancing these purchases are sales by the CFO, assistant controller, and sales manager. Not only are these stock sales larger in quantity, they were also made by those employees who have the best knowledge of financial information. Since several of these sales are clustered near the beginning of November, it is

Table 8.1

Initiator of Transaction	Type of Transaction	Date	Number of Shares
CEO	Purchase	12/15/02	30,150
Company ESOP	Purchase	12/08/02	28,000
Marketing director	Purchase	11/29/02	2,850
CFO	Sale	11/03/02	42,000
Engineering staff	Purchase	11/02/02	1,500
Sales manager	Sale	11/01/02	12,500
Assistant controller	Sale	11/01/02	8,000

possible that some poor initial financial results for October were received that caused them to sell shares. This leaves the purchase of shares by the CEO: this was the last stock purchase of the year, and the last one prior to a conference call with investors. It is possible that the CEO calculated the number of shares sold and bought exactly enough shares to offset them, thereby putting him in the position of stating that insider purchases and sales for the period were exactly neutral. Based on this more detailed review, the investment analyst should suspect that financial results for the quarter will not be good.

Cautions: The problem with this measurement is that insider buy and sell transactions can occur for reasons other than the participants' perception of company value. For example, stockholders may sell stock based on an immediate need for cash. Also, option holders may decide to cash in their shares prior to leaving the company. Furthermore, stock purchases may be based on bargain purchase options that make stock an extremely attractive deal for the buyers even if the market price is not good at all. Given the number of conflicting factors that drive insider stock transactions, this measure is more useful to spot broad trends in purchases or sell-offs that override any of the reasons noted here for buying or selling stock.

MARKET VALUE ADDED

Description: This measurement shows the net difference between a company's market value and the cost of its invested capital. A negative amount indicates that management has done a poor job of creating value with the base of equity available to it, since investors have reduced the company's value below the amount of equity invested.

Formula: Multiply the number of common shares outstanding by their current market price. Then multiply the number of preferred shares outstanding by their market price, and add the result to the total market value for all common stock; then subtract from it the original amount of invested capital. When deriving this calculation, be sure to use only the number of shares outstanding exclusive of any treasury stock. The formula is:

(Number of common shares outstanding × Share price) + (Number of preferred shares outstanding × Share price) – (Book value of invested capital)

Example: The CFO of a company that trades on the Nasdaq is preparing a statement for investors, showing the increase in value that the management team has provided to investors during the past year. This statement will include the market value added measurement. The CFO obtains the information shown in Table 8.2.

Table 8.2

	Prior Year	Current Year
Number of common shares outstanding	3,500,000	4,000,000
Common stock price	$5.12	$7.03
Number of preferred shares outstanding	467,000	525,000
Preferred share price	$14.00	$14.93
Book value of invested capital	$20,000,000	$24,300,000

She calculates the prior year market value added:

(3,500,000 Common shares × $5.12 Price) + (467,000 Preferred shares × $14.00 Price) – $20,000,000 Equity book value =

($17,920,000 Common market value) + ($6,538,000 Preferred book value) – $20,000,000 Equity book value =

$4,458,000 Market value added

Using the same formula, the CFO calculates the market value added for the current year, as:

(4,000,000 Common shares × $7.03 Price) + (525,000 Preferred shares × $14.93 Price) – $24,300,000 Equity book value =

($28,120,000 Common market value) + ($7,838,250 Preferred book value) – $24,300,000 Equity book value =

$11,658,250 Market value added

The CFO can point out to investors that there is a net gain in market value added of $7.2 million in the past year, which is an increase of 161% over the past year.

Cautions: This calculation is a difficult one to make if a company's stock is either not publicly held or thinly traded, since it is difficult to obtain a market value for any outstanding shares. Even if shares are publicly held, it is possible that some classes of stock are so restricted, such as special voting stock among a few shareholders, that it is impossible to determine the value of these classes. This problem can be reduced by obtaining an outside valuation from an appraiser or by consistently using any of a number of valuation techniques, such as the present value of cash flows, a multiple of sales, or the fair market value of net assets.

Also, an increase in market value may be caused by a general run-up in the entire stock market, rather than any particular actions by the management team to improve company value; in a strong bull or bear market, this issue can make up the bulk of any changes in the market value added measure. Also, perceived investor

changes on an entire industry (such as changes in the price of jet fuel on the airline industry) can cause investors to drive the stock price of an individual company within that industry up or down, despite its having positioned itself to be immune from the changes that are driving investor behavior.

STOCK OPTIONS TO COMMON SHARES RATIO

Description: Investment analysts are very interested in this measurement, for it tells them how many additional shares may be issued to the holders of stock options, which in turn will water down the earnings per share for the holders of existing shares. A high percentage of outstanding options to common shares indicates a potential problem. However, as noted in the formula section, the basic formula includes *all* options, even those that are unlikely to be converted into stock. More precise versions of the measurement are therefore included in the formula section that eliminate this issue.

Formula: Divide the total number of stock options granted by the total number of common shares outstanding. The formula is:

$$\frac{\text{Total stock options}}{\text{Total common shares outstanding}}$$

Though this formula gives a general idea of the number of shares that may be converted eventually through the exercise of options, a great many of them may never be exercised because the time is nowhere near the period when they vest. Accordingly, the following more restrictive measurement may be used, which only includes vested stock options:

$$\frac{\text{Total vested stock options}}{\text{Total common shares outstanding}}$$

Even if options have been vested, there may be little chance that they will be exercised, since the designated stock purchase price is above the current market price. Accordingly, the most restrictive variation on the formula only includes those options that are in the money. This calculation is:

$$\frac{\text{Total vested options in the money}}{\text{Total common shares outstanding}}$$

Example: An investment analyst for a large cruise ship line wants to determine the stock options to common shares ratio to determine if there is a prospect of significant dilution in earnings per share. The analyst obtains the following information:

Total shares outstanding	42,500,000
Total options granted	5,250,000
Total options vested	1,250,000
Total options vesting in one year	3,000,000
Total options vesting in two years	250,000
Total options vesting in three years	750,000
Total vested options in the money	100,000

If all the outstanding options were used as the numerator in the calculation, an options-to-common shares ratio of 12.4% would be derived, which is calculated as:

$$\frac{\text{5,250,000 Total options granted}}{\text{42,500,000 Total shares outstanding}} = \text{12.4\% Options to shares ratio}$$

However, only 100,000 of these options are in the money, which is a miniscule 0.2% of the total number of shares outstanding, and so small as to have no impact on earnings per share. An additional issue is that the bulk of all unvested shares will be vested in one year, which will result in a ratio of vested shares to common stock of 4,250,000 vested options to 42,500,000 common shares, or 10%. Accordingly, the analyst should report to investors the minimal short-term impact of options, but add the comment that this could change in one year when many more options become vested. An additional issue that the analyst should explore is whether the newly vested shares will be in the money based on their designated exercise prices.

Cautions: It is best to use all three versions of the measurement in order to gain the best perspective on the full range of possible dilutions. For example, if only the most restrictive measurement, which uses the total number of shares in the money, were tracked, then it might come as a surprise if the market price of the stock suddenly jumps, thereby throwing a potentially large number of vested stock options into the money and altering the measurement. Furthermore, if only the measurement that included vested stock options were used, then it would be a surprise when the vesting date for a large new batch of options was reached, thereby shifting additional vested options into the measurement.

COST OF CAPITAL

Description: The cost of capital is the blended cost of debt and equity that a company has acquired in order to fund its operations. It is important, because a company's investment decisions related to new operations should always result in a return that exceeds its cost of capital; if not, then the company is not generating a return for its investors.

Formula: The cost of capital is composed of the costs of debt, preferred stock, and common stock. The formula for the cost of capital is composed of separate calculations for all three of these items, which must then be combined to derive the total cost of capital on a weighted average basis. To derive the cost of debt, multiply the interest expense associated with the debt by the inverse of the tax rate percentage, and divide the result by the amount of debt outstanding. The amount of debt outstanding that is used in the denominator should include any transactional fees associated with the acquisition of the debt as well as any premiums or discounts on sale of the debt. These fees, premiums, or discounts should be gradually amortized over the life of the debt, so that the amount included in the denominator will decrease over time. The formula for the cost of debt is:

$$\frac{\text{Interest expense} \times (1 - \text{Tax rate})}{\text{Amount of debt} - \text{Debt acquisition fees} + \text{Premium on debt} - \text{Discount on debt}}$$

The cost of preferred stock is a simpler calculation since interest payments made on this form of funding are not tax-deductible. The formula is:

$$\frac{\text{Interest expense}}{\text{Amount of preferred stock}}$$

The calculation of the cost of common stock requires a different type of calculation. It is composed of three types of return: a risk-free return, an average rate of return to be expected from a typical broad-based group of stocks, and a differential return based on the risk of the specific stock in comparison to the larger group of stocks. The risk-free rate of return is derived from the return on a U.S. government security. The average rate of return can be derived from any large cluster of stocks, such as Standard & Poor's 500 or the Dow Jones Industrials. The return related to risk is called a stock's *beta*; it is regularly calculated and published by several investment services for publicly held companies, such as Value Line. A beta value of less than one indicates a level of rate-of-return risk that is lower than average, while a beta greater than one would indicate an increasing degree of risk in the rate of return. Given these components, the formula for the cost of common stock is:

$$\text{Risk-free return} + (\text{Beta} \times (\text{Average stock return} - \text{Risk-free return}))$$

Once all of these calculations have been made, they must be combined on a weighted average basis to derive the blended cost of capital for a company. This is accomplished by multiplying the cost of each item by the amount of outstanding funding associated with it:

$$\begin{aligned} \text{Total debt funding} \times \text{Percentage cost} &= \text{Dollar cost of debt} \\ \text{Total preferred stock funding} \times \text{Percentage cost} &= \text{Dollar cost of preferred stock} \end{aligned}$$

$$\text{Total common funding} \times \text{Percentage cost} = \text{Dollar cost of common stock}$$
$$= \text{Total cost of capital}$$

Example: An investment analyst wants to determine the cost of capital of the Jolt Electric Company to see if it is generating returns that exceed its cost of capital. The return it reported for its last fiscal year was 11.8%. The company's bonds are currently priced on the open market at a total price of $50,800,000, its preferred stock at $12,875,000, and its common stock at $72,375,000. Its incremental tax rate is 34%. It pays $4,625,000 in interest on its bonds, and there is an unamortized debt premium of $1,750,000 currently on the company's books. The preferred stock pays interest of $1,030,000. The risk-free rate of return is 5%, the return on the Dow Jones Industrials is 12%, and Jolt's beta is 1.5. To calculate Jolt's cost of capital, first determine its cost of debt, which is:

$$\frac{(\$4{,}625{,}000 \text{ Interest expense}) \times (1 - 0.34 \text{ Tax rate})}{\$50{,}800{,}000 \text{ Debt} + \$1{,}750{,}000 \text{ Unamortized premium}} = 5.8\%$$

The investment analyst then proceeds to the cost of preferred stock, which is calculated as:

$$\frac{\$1{,}030{,}000 \text{ Interest expense}}{\$12{,}875{,}000 \text{ Preferred stock}} = 8.0\%$$

Finally, the analyst calculates the cost of common stock, which is:

$$5\% \text{ Risk-free return} + (1.5 \text{ Beta} \times (12\% \text{ Average return} - 5\% \text{ Risk-free return}) = 15.5\%$$

The analyst then creates the weighted-average table shown in Table 8.3 to determine the combined cost of capital for Jolt.

Based on these calculations, Jolt's return of 11.8% is a marginal improvement over its cost of capital of 11.2%.

Table 8.3

Type of Funding	Amount of Funding	Percentage Cost	Dollar Cost
Debt	$50,800,000	5.8%	$2,946,400
Preferred stock	$12,875,000	8.0%	$1,030,000
Common stock	$72,375,000	15.5%	$11,218,125
Totals	$136,050,000	**11.2%**	$15,194,525

Cautions: The dollar value of the preferred stock and common stock used in this calculation is based on the current market price of these items, rather than the price at which they were originally sold. The market rate, can help to accurately determine the assumed rate of return that investors are expecting at the moment; this is much preferable to using the book rate for either item, since this fixes the rate of return at the time when the shares were originally sold and gives no indication of current market expectations.

SALES TO STOCK PRICE RATIO

Description: This ratio indicates the opinion of investors regarding a company's ability to increase its sales volume. If sales increase and there is no change in the stock price, then the rate of growth in sales falls within the expectations of investors. If there is an increase in the stock price, then sales have exceeded their expectations; a drop in the stock price is indicative of sales levels that do not meet their expectations.

Formula: Divide annualized net sales by the average common stock price for the reporting period. The annualized net sales figure used in this calculation should be the prospective sales figure for the current reporting year, since this represents the announced sales figure that company management has released to investors, and it is the number on which they are basing their decisions to buy or hold the stock. The average common stock price should be used instead of the ending stock price, since this removes some fluctuation from the price.

$$\frac{\text{Annual net sales}}{\text{Average common stock price}}$$

Example: The president of the Gonging Clock Company has been given a stock compensation package that will be richly rewarding if the stock price doubles within one year. The president elects to do so by focusing solely on increases in sales. The display clocks that the company produces are sold almost entirely within the Christmas selling season. To increase sales, the president allows customers to pay for their clocks within 180 days, instead of the usual 30 days, and also offers discounts for bulk purchases. As a result, the company experiences a massive increase in sales, investors bid up the stock price, and the president retires with a large stock bonus. Unfortunately, the president's actions so thoroughly clog the company's distribution pipeline with product that its sales volume in the following year dives down to less than one-quarter of the sales level in the preceding year. The board of directors learns its lesson from this experience and subsequently revises its senior management incentive plan to focus on more long-term value objectives.

Cautions: A stock's price is influenced by a number of variables besides sales, such as the general trend of the stock market, profitability, and the general perception of investors in regard to the prospects of the industry in which the company is located. For example, if the price of aviation fuel goes up, the price of airline stocks will likely go down, because of the perception that this cost increase will reduce airline profits. Consequently, the overall correlation between sales and stock price is not perfect.

PRICE/EARNINGS RATIO

Description: Comparing earnings to the current market price of the stock gives a general idea of the perception of investors of the quality of corporate earnings. For example, a ratio that is substantially lower than the average rate for the industry could indicate an expectation among investors that a company's future earnings are expected to trend lower. Alternatively, a high ratio could indicate the excitement of investors over a new patent that a company has just been granted or the expected favorable results of a lawsuit—the possible explanations are legion. The key point when using this ratio is that a result that varies from the industry average probably indicates a change in investor perceptions from the rest of the industry in regard to a company's ability to continue to generate income.

Formula: Divide the average common stock price by the net income per share. The net income per share figure is typically used on a fully diluted basis, accounting for the impact of options, warrants, and conversions from debt that may increase the number of shares outstanding. The formula is:

$$\frac{\text{Average common stock price}}{\text{Net income per share}}$$

Example: An investment analyst wants to determine the price/earnings ratio for the Mile-High Dirigible Company. The industry average price/earnings ratio for lighter-than-air transport manufacturers is 18:1. The analyst accumulates the following information:

Most recent stock price	$32.87
Number of shares outstanding	3,875,000
Net income	$8,500,000
Extraordinary income	$2,250,000

If the analyst chooses to leave the extraordinary amount in the total net income figure, then the following calculation will be used to derive the price/earnings ratio:

$$\frac{\$32.87 \text{ Stock price}}{(\$8{,}500{,}000 \text{ Net income}/3{,}875{,}000 \text{ Shares outstanding}} = 15{:}1 \text{ Price/earnings}$$

So far, the price/earnings ratio appears to compare favorably to the industry average. However, if the analyst excludes the extraordinary gain from net income, the earnings per share figure drops to $1.61 per share. When incorporated into the price/earnings formula, this change increases the ratio to 20:1, which is higher than the industry average. Accordingly, the analyst considers the stock to be overpriced relative to the industry and refrains from recommending it to clients.

Cautions: If a stock tends to fluctuate widely over the short term, then it is difficult to arrive at an average common stock price that yields a valid price/earnings ratio. In such cases, it is better to calculate the price/earnings ratio with the most current common stock price as the numerator and view it on a trend line to monitor changes.

Another issue is that the net income figure can be significantly altered by the presence of large reserves or extraordinary items that skew operating results. In these cases, it is better to examine the underlying financial reports, determine the net income from operations, and use that number as the net income figure in the measurement.

Yet another issue is that the stock price is based on a number of factors besides net income, such as an industry-wide drop in revenue prospects, legal action against the company, well-publicized warranty claims, the presence of valuable patents, and so on. These factors may result in a stock price that is substantially different from what would otherwise be the case if only net income were the driving factor behind the stock price.

CAPITALIZATION RATE

Description: The capitalization rate is simply the reverse of the price/earnings ratio. It can be used in concert with the price/earnings ratio to see what the implied rate of return is on a company's stock, given the price at which its shares currently sell on the open market.

Formula: Divide earnings per share by the market price per share. The net income per share figure is typically used on a fully diluted basis, accounting for the impact of options, warrants, and conversions from debt that may increase the number of shares outstanding. If the capitalization rate measurement is being used to decide whether to purchase or sell stock, brokerage and other fees required to complete the transaction should be included in the calculation. The formula is:

$$\frac{\text{Earnings per share}}{\text{Market price per share}}$$

Example: An investor is interested in buying the stock of a high-tech company that specializes in the production of wireless Internet connections. This company's stock has experienced a considerable run-up in its stock over the past few months, and the investor is concerned that it may have gone too high to be a valid investment. Its earnings per share are $2.18, and its stock price is $159.14. This means that its capitalization rate is 1.4% ($2.18 earnings per share, divided by $159.14 stock price), which represents a return on investment of 1.4%. The investor therefore considers the stock to be too expensive and elects to wait for its price to drop before making an investment.

Cautions: As was the case for the price/earnings ratio, the capitalization rate can be skewed by the presence of extraordinary items that do not properly reflect the earnings stream from operations. If the proportion of extraordinary charges or income in the earnings per share figure is significant, then these should be stripped away, leaving earnings from operations in the numerator of the formula.

9

Measurements for the Accounting/Finance Department

The accounting department spends the bulk of its time processing standard transactions, such as billings, cash receipts, expense report processing, and payments to suppliers. Accordingly, many of the measurements in this chapter focus on the efficiency of these types of activities. There are also measurements covering the payroll, general ledger, taxation, collections, and treasury functions.

A key problem with all of the measurements noted in this chapter is that the accounting department is usually responsible for compiling the performance measurements of the entire company—which includes, in this case, itself. If the controller or CFO comes upon a measurement that shows poor accounting performance, there will be a temptation to delay release of the measurement or to alter its calculation to make the result look better. Consequently, the measurements noted here should be assigned to some other department, such as the internal auditing staff, to complete. Alternatively, the measures should be periodically reviewed by someone independent of the accounting department to ensure that they are being properly completed. Measurements to be examined in this chapter include:

- Purchase Discounts Taken to Total Discounts
- Percentage of Payment Discounts Missed
- Transactions Processed per Person
- Transaction Error Rate
- Average Time to Issue Invoices
- Average Employee Expense Report Turnaround Time
- Payroll Transaction Fees per Employee
- Time to Produce Financial Statements
- Percentage of Tax Filing Dates Missed
- Proportion of Products Costed Prior to Release

Internal Audit Savings to Cost Percentage
Internal Audit Efficiency
Bad Debt Percentage
Percent of Receivables over XX Days Old
Percentage Collected of Dollar Volume Assigned
Percent of Cash Applied on Day of Receipt
Cost of Credit
Earnings Rate on Invested Funds
Brokerage Fee Percentage
Borrowing Base Usage Percentage

PURCHASE DISCOUNTS TAKEN TO TOTAL DISCOUNTS

Description: Few accounting activities can be shown to directly save money, but taking early payment discounts is one of them. From the accounting perspective, this means examining incoming invoices from suppliers to see if a discount is offered, determining if the discount is economical, and scheduling it for early payment. Comparing the proportion of purchase discounts taken to total discounts available can show how effective the accounts payable staff has been at saving money for the company. Any measurement result less than 100% should be considered unacceptable.

Formula: Divide total purchase discounts taken by the total amount of economical discounts available. The information needed for the numerator is generally simple to collect, because a typical accounting system will store the amount of the discount in a separate line item in the chart of accounts. The problem is in deriving the information needed for the denominator, since this information is not stored anywhere. One can query the supplier database in an automated accounting system to see which suppliers are listed as having discounts, but this will ignore any suppliers for whom the accounts payable staff has missed the presence of discounts on their invoices. Consequently, a better approach is to supplement the review of the existing accounts payable database with an ongoing audit sample of supplier invoices, to see what other invoiced discounts have been missed.

Also, all offered discounts with terms so poor that they should be excluded from the denominator (since they are not viable discounts). The formula is:

$$\frac{\text{Total purchase discounts taken}}{\text{Total economical discounts available}}$$

Example: The internal auditing staff of the Masterson Brick Company has been asked to calculate the accounting department's ability to take all purchase discounts offered by suppliers. The auditors compile the information about discounts shown in Table 9.1.

Table 9.1

Supplier Name	Potential Discount Amount	Economically Viable Amount	Discount Taken?
Adabrick Construction	$458	Yes	Yes
Charleston Paving	$1,015	Yes	Yes
Des Moines Edging	$209	Yes	No
Raster Builders	$32	No	Yes
Topeka Basements	$718	Yes	Yes

The internal auditing staff finds that four of the five potential discounts were taken, but that one discount was taken that was not economically viable. Consequently, they choose to exclude the noneconomically viable discount from the numerator, since this figure should only relate to the total number of economically viable discounts available that are noted in the numerator. Their calculation is:

$$\frac{\text{Total purchase discounts taken}}{\text{Total economical discounts available}} =$$

$$\frac{\$458 \text{ Discount} + \$1{,}015 \text{ Discount} + \$718 \text{ Discount}}{(\$458 + \$1{,}015 + \$209 + \$718) \text{ Economic discounts available}} =$$

91.3% Purchase discounts taken

Also, since the company's automated accounts payable system is set up for continuing early payments to Raster Builders (whose discount is not economically viable), the internal auditors inform the accounts payable supervisor and controller of this problem, so that the payment record for this supplier can be altered.

Cautions: The results of this measurement can be misleading if invoices are sent outside of the accounting department for approvals, since a delayed approval can take longer than the required payment date on a discount. The same problem arises for centralized accounts payable departments that service many company locations, because invoices may be sent to outlying locations by suppliers, which builds in a time delay while these locations send the invoices to the central accounts payable location. If the approvals problem is evident, the accounts payable function can be restructured so that all invoices are logged into the system for payment before they are sent back out for approvals, and then they can be paid on the required date without having to wait for an overdue approval. If delays are caused by a centralized accounts payable system, then the accounting staff can contact suppliers to have them change their "bill to" addresses to match that of the accounts payable center.

PERCENTAGE OF PAYMENT DISCOUNTS MISSED

Description: This is the same measurement shown in the last section, except that its focus is on the proportion of valid discounts *not* paid, rather than paid. It is most effective when presented alongside a detailed listing of specific discount-related payment problems, with the reasons why those discounts were missed.

Formula: Divide the number of payment discounts missed by the total number of valid payment discounts available. An alternative is to divide the dollar volume of payments missed by the total dollar volume of payment discounts available, which focuses attention on the presence of large missed discounts. The formula is:

$$\frac{\text{Number of payment discounts missed}}{\text{Total number of payment discounts available}}$$

Example: The Charleston Paving Company has missed taking several purchase discounts. To bring the issue to the attention of the controller, the assistant controller decides to calculate the percentage of payment discounts missed. Here is the relevant information:

Total number of discounts available	142
Total number of discounts missed	6
Total dollars of discounts available	$91,500
Total dollars of discounts missed	$31,250

If the controller chooses to calculate the measurement based on the number of discounts missed, the result will be:

$$\frac{\text{6 Payment discounts missed}}{\text{142 Payment discounts available}} = 4\% \text{ of Discounts missed}$$

The measurement appears to show that the number of discounts missed is a small issue. However, the assistant controller sees that, contained within the small number of missed discounts, is a very large dollar volume of lost discounts. Consequently, the assistant controller prepares the following alternative measurement, which clearly shows the dollar value of the problem:

$$\frac{\text{\$31,250 Payment discounts missed}}{\text{\$91,500 Payment discounts available}} = 34\% \text{ of Discounts missed}$$

Cautions: The same cautions apply as were described for the last measurement (the purchase discounts taken to total discounts formula).

TRANSACTIONS PROCESSED PER PERSON

Description: In the accounting department of a larger company, the bulk of the staff is occupied with the repetitive processing of various types of transactions, such as billing, cash receipts, and payments to suppliers. If there is little focus on improving the efficiency of these basic functions, then the company may find itself paying for the wages of far more accounting personnel than comparable departments in competing companies. The number of transactions processed per person can be applied to any repetitive transactions and tracked on a trend line in order to see changes in efficiencies within these areas.

Formula: Divide the total number of transactions processed during the measurement period by the number of full-time equivalent employees required to complete the transactions. The formula is:

$$\frac{\text{Total number of transactions processed}}{\text{Number of full-time equivalents required to complete transactions}}$$

Example: The Jester Playing Card Company has a large billing staff to handle the thousands of invoices that it sends out to buyers of its high quality playing cards. The controller wants to improve the efficiency of the billing operation, and decides to track the number of billing transactions processed per person to determine the effectiveness of improving this operation. The controller elects to track this efficiency on a trend line, which is shown in Table 9.2 for the last three months.

The controller has picked a good area for improvement, since the measurement shown at the bottom of the table reveals that the efficiency level is dropping in this area. A likely reason is that the department added a part-time person in February, whose efficiency level is probably less than that of the more experienced people who have worked there longer. The controller can likely improve the transaction efficiency measurement by concentrating on improving the other staff to the point where the new part-time position can be eliminated.

Cautions: Transaction processing rates per person are not very effective if a company is so small that it does not require accounting staff members who are solely

Table 9.2

	January	February	March
Number of invoices issued	1,950	2,125	2,005
Total full-time billing staff	3	3	3
Total half-time billing staff	1	2	2
Total full-time equivalents	3.5	4.0	4.0
Number of invoices processed per person	557	531	501

dedicated to the completion of specific types of transactions, such as supplier payments. If a staff person is required to complete several types of transactions during a measurement period, then it becomes difficult to clearly identify the time required to complete each type of transaction.

An additional problem is that the measurement should not be used on a summary level to determine the average number of transactions processed by employees who work on several types of transactions during a single measurement period. Though this may at first appear to be a reasonable method for deriving some general level of staff efficiency, it assumes that the mix of transactions stays exactly the same from period to period. Actually, the proportions of different transaction types vary constantly, so that a greater volume of labor-intensive transactions will be required in one period, and a lower percentage in the next. This results in an efficiency measurement that reveals no relevant information.

TRANSACTION ERROR RATE

Description: The preceding measurement addressed efficiency, that is, how many transactions an employee or function can complete. However, it did not measure the number of transactional errors, which can climb dramatically if the focus is only on pushing through the largest possible volume of transactions. The cost of correcting an error is many times higher than the cost of doing it right the first time, so the transaction error rate should be used in concert with the number of transactions processed per person in order to ensure that efficiency improvements leading to increased volume are not also spewing out many additional errors. Also, the error rate can be used by itself as a valid measure of departmental performance, since error correction can tie up the services of a multitude of senior accounting staff, who can be better used for other activities.

Formula: Summarize the total number of transactional errors and divide them by the total number of transactions processed for the same period. Be careful to match transactional errors to the same period in which the transactions occurred; it is common for errors not to be spotted and corrected until a later period, so they are compared to total transaction volumes for the later period that may be quite different from the volumes in the period when they occurred. The formula is:

$$\frac{\text{Number of errors}}{\text{Total number of transactions processed}}$$

Example: The Chillo Ice Cream Company's accounting manager is focusing on eliminating several of the senior accounting clerks whose entire jobs consist of error correction. The relevant information is in Table 9.3.

The accounting manager sees that the highest error rate is in the payables transactional area, with billings being a close second. However, because the time required to fix errors is twice as high for each billing transaction, the manager

Table 9.3

Processes	No. of Errors	No. of Total Transactions	Transaction Error Rate
Billings transactions	140	1,190	11.8%
Cash receipts transactions	30	2,130	1.4%
Payables transactions	210	1,430	14.7%

directs correction efforts to the billing transactions first, since this will have the largest payback in terms of time saved.

Cautions: This is an excellent measurement. However, it should not be aggregated for all types of accounting errors, since some are easier to correct than others. For example, a large number of incorrect billings that are caused by an easily fixed change to the pricing file may make the proportion of billing errors look large, while a smaller number of errors related to cost allocations, which can be difficult to spot and correct, may actually represent a larger time commitment to correct. Consequently, the measure should be subdivided into each major type of transaction so that the impact of each error type can be more closely monitored.

AVERAGE TIME TO ISSUE INVOICES

Description: The accounting department can have a considerable impact on the timing of cash receipts, based on its ability to issue invoices to customers as soon as possible after shipments or services have been completed. If this critical step is delayed, then the processing time needed by customers to approve invoices and set them up for payment will *not* change, meaning that the date on which payments are made back to the company will be delayed. This can put a company in a dangerously low cash flow position, or at least reduce the amount of interest income it can earn on its excess cash. For these reasons, the average time needed to issue invoices should be constantly monitored.

Formula: Subtract the shipment date from the invoice date for each invoice, and summarize the number of days required for all invoices issued during the period. Then divide the result by the total number of invoices issued. The number of days on weekends and holidays can be included or excluded, depending on a company's emphasis on issuing invoices even during these traditional days off. Also, the measurement can be modified to include only the 10 to 20% of the invoices with the longest delays following shipment, which focuses management attention on the worst problems in the invoicing process. The formula is:

$$\frac{\text{Sum of invoice dates} - \text{Sum of shipment dates}}{\text{Number of invoices issued}}$$

Table 9.4

Order Number	Shipment Date	Invoice Date	Days Delay
4358A	1/05	1/10	5
4607A	1/17	1/23	6
4715A	2/11	2/15	4
4800A	2/16	2/21	5
4829B	2/22	2/29	7

Example: The Asian Doll Company, importer of high-quality antique Japanese dolls, is having some difficulty getting its invoices out on time, resulting in delayed customer payments. The controller believes that the problem lies in the slow transfer of paperwork from the shipping department to the billing department. The controller decides to use the average time to issue invoices to highlight the severity of the problem. She takes a random sample of five shipments and their associated invoices, which are shown in Table 9.4.

The total number of days required for invoicing is 27 (the total of the Days Delay column). After dividing this figure by the number of invoices sampled, this is the result:

$$\frac{\text{27 Total days of invoicing delay}}{\text{5 Invoices issued}} = \text{5.4 Average days to issue invoices}$$

The controller can go a step further and calculate the amount of cash that would otherwise be available for investment during those 5.4 days, which represents a lost amount of investment income.

Cautions: As noted in the Formula section, the calculation can be thrown off if weekends or holidays are included, since their inclusion can result in a calculation that shows an inordinate length of time between shipment and invoicing. For example, if the shipping department sends out a delivery at the end of the day prior to a three-day holiday, then the accounting department will not see the paperwork until the following Monday, at which point three days have already passed and will be counted in the measurement. Therefore, either discount these days from the calculation or assume that invoices will be issued on *all* days, irrespective of the presence of a holiday or weekend.

AVERAGE EMPLOYEE EXPENSE REPORT TURNAROUND TIME

Description: From the perspective of employees, there are only two accounting functions that matter: processing payroll and paying expense reports in a timely manner. The expense report turnaround time is critical to employees who have paid for company expenses on their own credit cards and need funds back in short

order so that they can pay the credit card balances. An accounting manager can use the average employee expense report turnaround time as an effective means for ensuring that these reports are quickly paid.

Formula: Subtract the date when an expense report was received by the accounting department from the date when payment was distributed to the employee. The formula is:

Date of payment to employees –Date of expense report receipt

Example: The manager of the local branch of the National Business Machines Company (NBM) is concerned that employees are not being paid for many weeks after they submit expense reports, resulting in credit card late fees and interest expense charges. To prove this point, the manager assembles the data in Table 9.5, which lists the expense report turnaround time for each employee.

The manager finds that the average delay in paying employees for their expense reports is 25.6 days, which is figured by summarizing the total interval in days from the table (128 days) and dividing by the number of sampled expense reports (five).

Cautions: There are several ways in which this measurement can be altered. First, the accounting department may not receive an expense report until much later than the date listed on the report, because it has been diverted for approval by a supervisor. This makes it difficult to determine the exact date on which the accounting staff received the report for processing. One way to avoid this problem is to stamp the receiving date on the expense report. The expense report routing can also be altered so that it goes to the accounts payable staff first and then to the supervisor for approval; by requiring the accounting staff to pay the expense report after a predetermined minimum time period, irrespective of the receipt of supervisory approval, employees will receive their payments on time.

Another problem is that the date of payment to employees may not coincide with the date on which checks are printed, since there can be delays both in signing the checks and in distributing them. A company can use automated clearing house (ACH) transfers to avoid these delays.

Table 9.5

Name	Date of Report Submission	Date of Report Payment	Interval in Days
B. Archebaugh	May 3	May 23	20
A. Deckers-Whidley	May 6	May 31	25
P. Goodenough	May 9	May 30	21
R. Quark	May 11	June 3	23
J. Smedley	May 14	June 22	39

PAYROLL TRANSACTION FEES PER EMPLOYEE

Description: A great many companies have found that it is well worth the effort of outsourcing their payroll processing functions to specialized service providers, thereby eliminating the hassle associated with payroll tax calculations and submissions. However, few companies go to the trouble of determining the annual cost of this processing on a per-person basis. They may be startled to find that the initial cost at which they agreed to the service has ballooned over time, because of extra fees tacked onto the base processing rate for such services as direct deposit, sealing checks in envelopes, calculating special deductions, and tracking garnishments. For these companies, the payroll transaction fee per employee measurement is a valuable tool.

Formula: Divide the total payroll outsourcing fee by the total number of employees itemized on the payroll. Be sure to exclude from the total fee any charges that cannot be directly related to individual employees, such as special reports or payroll shipping charges. The formula is:

$$\frac{\text{Total payroll outsourcing fee per payroll}}{\text{Total number of employees itemized in payroll}}$$

Example: A new payroll manager has been hired at the Jebson Maintenance Company, which has a large staff of heating and ventilation maintenance technicians. The payroll function is the main accounting activity. The new manager is interested in obtaining the best cost-benefit performance from the payroll function, which is currently outsourced, and so compares the cost of the current outsourcing provider and the fees charged by a competitor (see Table 9.6), which are all based on the processing of a single biweekly payroll.

The company has 26 payrolls per year and 120 employees, all of whom take direct deposit payments. The company has requested 401(k) and sick time reports once a month. There are 10 employees whose wages are garnished. Based on these volume considerations, the total cost of the current provider is:

Table 9.6

Types of Fees	Current Provider Fees	Competitor Fees
Minimum processing fee	$50	$15
Processing fee/each	$1.00	$1.25
Envelope stuffing fee/each	$.15	$.25
Delivery fee	$10	Free
Direct deposit fee/each	$0.50	$0.65
401(k) report	$12	$5
Sick time report	$10	$5
Garnishment fee/person	$2.50	$3.50

Variable cost per year = Processing fee of $1.00 × 120 employees × 26 payrolls
= Envelope stuffing fee of $.15 × 120 employees × 26 payrolls
= Direct deposit fee of $.50 × 120 employees × 26 payrolls
= Garnishment fee of $2.50 × 10 employees × 26 payrolls
= $5,148

Fixed cost per year = Minimum processing fee of $50 × 26 payrolls
= Delivery fee of $10 × 26 payrolls
= 401(k) report charge of $12 × 12 months
= Sick time report charge of $10 × 12 months
= $1,824

Total cost per year = $6,972

Using the same methodology, the total cost of the competitor's offer is:

Variable cost per year = Processing fee of $1.25 × 120 employees × 26 payrolls
= Envelope stuffing fee of $.25 × 120 employees × 26 payrolls
= Direct deposit fee of $.65 × 120 employees × 26 payrolls
= Garnishment fee of $3.50 × 10 employees × 26 payrolls
= $7,618

Fixed cost per year = Minimum processing fee of $15 × 26 payrolls
= Delivery fee of $0 × 26 payrolls
= 401(k) report charge of $5 × 12 months
= Sick time report charge of $5 × 12 months
= $510

Total cost per year = $8,128

This analysis shows that the competitor's bid is $1,156 higher than that of the existing service provider, primarily because the competitor charges higher per-employee fees (despite having lower fixed service costs). In this case, the variable

payroll cost per employee is $42.90 if the current supplier is used, and $63.48 if the competitor is used.

Cautions: As noted in the Formula section, segregate those charges that have nothing to do with the per-person fees associated with the payroll; in the example, these fees would be the minimum processing fee, delivery charge, and the two reports. By separating these costs, the pricing strategies of payroll suppliers can be determined, some of whom advertise low fixed fees to attract new customers, but who have so many extra per-employee fees that the total cost is higher.

TIME TO PRODUCE FINANCIAL STATEMENTS

Description: A key performance benchmark for any accounting manager is issuing accurate financial statements in the shortest possible time period. Consequently, this measurement should be used on a trend line to measure the accounting department's ability to gradually reduce the required time over a period of months. It can also be subdivided into the time periods required by the controllers of corporate subsidiaries to submit completed period-end financial statements to the corporate headquarters.

Formula: Subtract the statement issue date from the first day of the month following the reporting month. The formula is:

Financial statement issue date – First day of the month

Example: The new controller of the Smith & Wilberforce Pop-Gun Factory is concerned about the time required to produce financial statements. The time needed to complete the last set of financial statements was 10 days. The controller needs to determine how to shrink this time requirement. Table 9.7 shows the information about accounting work loads related to the close.

Table 9.7

Activity	Days Required	Dependent Upon
Inventory cutoff	2	None
Inventory count	5	Inventory cutoff
Accounts payable close	5	None
Billing close	2	None
Royalty calculations	2	Billing close
Wage accrual	2	None
Bank reconciliation	7	Arrival of bank statement
Variance analysis	3	All

The longest series of dependencies in the list of activities is the inventory cut-off (two days) plus the inventory count (five days) plus the variance analysis (three days). Logically, the controller elects to cut into this series of dependencies by focusing on cutting the inventory cut-off to one day and shifting some of the variance analysis into the last week of the preceding month, while also imposing a minimum variance cutoff size and thereby reducing the number of accounts being reviewed. These actions bring the series of dependencies down to a seven-day requirement, which matches the next longest activity (the bank reconciliation).

Cautions: An accounting manager can use this measurement to show an ongoing improvement in the speed of financial statement completion, but at the cost of cutting back on accompanying reports and analyses, which are an integral part of the statements. Watch for this stripping away of released information by comparing the documents in the financial package to those being released prior to using this measurement.

There are several actions required to improve the speed of financial statement production, such as achieving an instantaneous inventory cutoff, creating an accurate perpetual inventory database, and performing some variance analysis prior to period-end. Focus on these subsidiary activities with separate time-to-completion measurements to control those actions where efficiency continues to be a problem.

PERCENTAGE OF TAX FILING DATES MISSED

Description: Many types of tax forms can be delayed by filing for extensions, a practice that gives tax accountants a great deal of leeway in completing tax returns. In many cases, the information required to complete a tax return may not even be available, so that the tax staff has no choice but to ask for an extension. However, there are also many cases where lesser returns, such as sales tax payments or franchise tax returns, must be filed by a specific date, or else penalties will be incurred. The percentage of tax filing dates missed as an ongoing trend-line measurement can indicate if this is an ongoing problem. If the measurement shows that the percentage continues to increase over time, it is possible that the tax staff is understaffed and so is falling increasingly behind in its ability to complete tax filings.

Formula: Divide the total number of tax returns filed after their due dates by the total number of tax returns filed. An alternative is to focus on the total dollar volume of tax penalties paid, which should include both penalties and interest charges. The formula is:

$$\frac{\text{Total number of tax returns filed late}}{\text{Total number of tax returns filed}}$$

Table 9.8

	2000	2001	2002
Number of states added	5	5	13
Number of late filings	3	11	40
Total returns filed	42	57	96
Percentage of tax filings missed	7%	19%	42%

Example: The Albatross Shoe Company is expanding its operations from the central United States to the eastern seaboard. As it does so, the accounting department finds itself burdened with additional tax filings to cover franchise taxes, sales taxes, and income taxes for 13 additional states. The controller wants to determine if an additional staff person should be added to the department, which currently employs three people. Accordingly, the controller devises Table 9.8.

The measurement reveals that the company's expansion into the additional 13 states has completely overwhelmed the tax staff, which needs more help immediately. Furthermore, the percentage of missed filings was actually increasing even before the addition of these extra states. Consequently, the controller calls in the tax department of a nearby auditing firm to assist with the short-term problem of completing the overdue tax filings and also engages a recruiter to find more tax personnel for the department.

Cautions: There are many types of tax returns, each having different types of penalties. For example, a missed franchise tax return may carry a penalty of only $25, while a missed income tax return may involve penalties in the thousands of dollars. Given the disparity in potential liabilities, it may be helpful to eliminate all small-penalty tax returns from the equation, focusing only on those that can result in large penalties.

Another issue is that a tax form that is filed late, but for which an extension has been properly filed, will still appear in the numerator of the formula. If the purpose of the measurement is to determine the proportion of returns that will result in penalties, then those returns with extensions should be excluded; however, if the intent is to determine the proportion of returns that are late because of a labor shortage in the taxation department, then they should be included.

PROPORTION OF PRODUCTS COSTED PRIOR TO RELEASE

Description: Though it seems obvious that a company should know what a product costs before selling it, it is common for the company to be in such a rush that this task is not completed. The result can be sales of a product that makes no money, or for which there is a cash drain whenever one is sold. Equally important is ensuring that product costing occurs well *before* the product release date, and on

an ongoing basis during the design phase, to ensure that the design team is aware of the cost when it can still alter the design sufficiently to reduce excessive cost. The proportion of products costed prior to release is an easy measurement to make management aware of this issue.

Formula: Divide the number of total products costed prior to release by the total number of products released during the measurement time period. Of particular concern is establishing the exact date on which product costs must be completed—it can be the date of product release or substantially sooner so that the design teams will have sufficient cost-related input to alter their designs as needed. The formula is:

$$\frac{\text{Number of products costed prior to release}}{\text{Total number of products released}}$$

Example: The Hoosier Sneaker Company, maker of high-end high-topped basketball sneakers, releases new sneaker designs at a prodigious rate of one every 20 days. The cost accountant claims that there is no need to issue cost reports on each one, since they all use the same design platform. However, there has been a gradual and ongoing drop in company profits directly related to increases in the cost of goods sold. The controller asks the internal audit staff to review the situation. The lead auditor discovers that a key supplier has raised the price of its leather uppers on several occasions during the past year, which has contributed to a 10% drop in gross margins. During that period, the company produced 18 new sneaker designs, of which only the first three had costing reviews completed by the cost accountant. This represents a proportion of products costed prior to release of 17%. The controller promptly fires the cost accountant and decides to build this measurement into the performance appraisal of the next person hired into the position.

Cautions: The cost accountant may protest if this measurement includes the release of all product variations, since this may result in a very large number of costing tasks. However, the task is still necessary to ensure that there are no product variations that will result in inadequate margins. The only case where the measurement should not be used is when the incremental value of any minor product change is clearly so tiny that there will be no significant variation in the existing product cost.

INTERNAL AUDIT SAVINGS TO COST PERCENTAGE

Description: The internal audit staff provides a number of crucial functions, such as preventing or detecting fraud, passing judgment on the controls used for new accounting systems, and recommending changes that will result in lower costs. Of these activities, only the last one is easily measurable. Compare the sum total of all recommended cost savings by an internal audit group to its operating cost in

order to arrive at a proportion of savings to costs. This measurement is subject to the concerns noted later in the Cautions section.

Formula: Divide the total amount of savings recommended by the internal audit staff by the total internal audit expense, which should include all departmental costs, such as salaries, payroll taxes, travel and entertainment, and support costs. The measurement can also be subdivided and used to track the savings from individual audit teams. The measurement is:

$$\frac{\text{Internal audit recommended savings}}{\text{Internal audit expense}}$$

Example: The audit committee of the Amalgamated Munitions Factory is concerned about the total cost of the internal audit department. Its staff of four costs $285,000 per year, while its travel and support costs are $104,000 per year. The CFO explains that the department does not just search for fraud and review internal controls. On the contrary, it recommended the following three changes in the past year:

1. Eliminate half of the accounts payable staff by installing a preexisting automated three-way matching system for payable transactions, saving $185,000.
2. Outsource the telephone support function, eliminating one in-house position, saving $29,000.
3. Improve the accuracy of bills of material, thereby cutting excessive purchasing costs and eliminating excess parts from the warehouse, saving $52,000.

All of the suggestions were implemented. The proportion of internal audit savings to costs was calculated as:

$$\frac{\text{Internal audit recommended savings}}{\text{Internal audit expense}} =$$

$$\frac{\begin{array}{c}\text{\$185,000 Payables elimination + \$29,000 Phone elimination +} \\ \text{\$52,000 Bill accuracy}\end{array}}{\text{\$285,000 Audit payroll + \$104,000 Other audit expenses}} =$$

$$\text{68.4\% Proportion of internal audits savings to costs}$$

Since two-thirds of the department's costs are covered by its own savings suggestions, the audit committee is mollified.

Cautions: If this measurement is used as a key performance indicator for the internal audit group, then they will insist on conducting reviews that focus exclusively on potential cost savings, rather than also conducting control reviews that could potentially save a company much more money over the long run by preventing fraud. For this reason, the measurement should not be used as a key per-

formance indicator for the department, but rather as a lesser measure to which performance bonuses or evaluations are *not* tied.

Also, the recommended savings listed in the numerator can be wildly inflated or impractical, since they are strictly recommendations, and may never be tested for their validity. This problem can be reduced by the use of a review board that accepts or rejects recommended savings.

INTERNAL AUDIT EFFICIENCY

Description: The internal audit department's efficiency can be difficult to measure, since a significant finding, such as a fraud situation, may require much more staff time than was originally planned. Nonetheless, like other service functions, proper planning of audit requirements should result in a steady flow of completed audits on a continual timeline that can be measured. If additional work is required, such as may be caused by a fraud investigation, then it can be scheduled as a new project and included in an orderly manner into the work schedule of the department. Consequently, with proper planning, it is possible to use the internal audit efficiency measurement to gain a general understanding of the operating efficiency of the department.

Formula: Divide the number of internal audits completed by the total number of internal audits planned. If there are partially completed audits at the beginning and end of the measurement period, then these can be included in the measurement by using the percentage of completion method (see Example). The formula is:

$$\frac{\text{Number of internal audits completed}}{\text{Number of internal audits planned}}$$

Example: The Spiffy Soap Company, a large-volume soap producer, has a large internal audit department that performs over a hundred audits per year. Its manager wants to determine the efficiency of the group in completing its assigned audits. He scheduled 109 audits at the beginning of the year. In addition, five audits at the beginning of the year had 120 scheduled hours of work finished out of an initial budget of 720 hours. At the end of the year, three jobs were still open; they had accumulated 142 hours of work out of 310 scheduled hours. The manager calculates the internal audit efficiency measurement as follows:

+ Beginning equivalent audits completed = 120 Hours done / 720 Hours scheduled

+ Ending equivalent audits completed = 142 Hours done / 310 Hours scheduled

+ Audits completed = 91

=

+ 0.17 Beginning hours completed × 5 audits = 0.85 Beginning audits completed

$$+ 0.46 \text{ Ending hours completed} \times 3 \text{ audits} = 1.38 \text{ Ending audits completed}$$

$$+ \text{Audits completed} = \underline{91.00}$$

$$\text{Number of equivalent audits completed} = 93.23$$

$$=$$

$$\frac{93.23 \text{ Internal audits completed}}{109 \text{ Internal audits planned}}$$

$$= 85.5\% \text{ Internal audit efficiency}$$

Cautions: This measurement focuses solely on the ability of the internal audit staff to complete their audits, not on their ability to discern any systemic problems arising out of those audits. Consequently, the measurement must be supplemented by a qualitative review of the results of all completed audits.

BAD DEBT PERCENTAGE

Description: A company should keep track not only of the total amount of bad debts incurred each year, but also their trend line, the specific reasons why each one became a bad debt, the relationship between corporate credit policy and the amount of bad debts incurred, and the company's bad debt experience in relation to the rest of the industry. All of these comparisons are needed in order to determine how bad debt levels are being controlled. The most basic of these measurements is the bad debt percentage, which compares the amount of bad debt incurred to either the total amount of credit sales or total outstanding accounts receivable.

Formula: Divide total bad debt dollars by the total amount of accounts receivable. The formula is:

$$\frac{\text{Total bad debt dollars recognized}}{\text{Total outstanding accounts receivable}}$$

The problem with using accounts receivable as the denominator for this calculation is that it only shows the relationship of bad debts to a small proportion of sales, which are represented by the accounts receivable balance. An alternative approach is to divide total bad debt dollars by total annualized credit sales; however, if this approach is used, then the numerator will only be comparable to the denominator if the bad debt figure is annualized, either by using the last 12 months of bad debts on a rolling basis, or by annualizing the amount of bad debts incurred over a shorter period. The formula is:

Table 9.9

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Bad debt expense	$100,000	$112,000	$113,200	$120,400
Annualized credit sales	$1,250,000	$1,400,000	$1,415,000	$1,505,000
Bad debt percentage	8%	8%	8%	8%
Accounts receivable	$125,000	$156,000	$177,000	$215,000
Receivable turnover	10	9	8	7

$$\frac{\text{Total bad debt dollars recognized}}{\text{Total credit sales}}$$

Example: The auditors of the Night Vision Company, maker of night vision baby monitors, want assurance that the company has reserved a sufficiently large bad debt reserve to cover its year-end accounts receivable. The company has provided them with the quarterly information in Table 9.9.

Initially, the company's reserve of 8% of sales appears reasonable, since the bad debt percentage has been exactly 8% for the entire year. However, the accounts receivable turnover rate has been dropping throughout the year. This is a prime indicator to the auditors that some bad debts are not being recognized by the company, but instead are being held in accounts receivable. If the accounts receivable turnover at year-end were 10 turns, as they were during the first quarter of the year, then the accounts receivable balance should be only $150,500 ($1,505,000 annualized credit sales divided by 10 turns), as opposed to the $215,000 listed on the books. It is possible that the difference of $64,500 is unrecognized bad debts, which would increase the bad debt percentage to over 12%. The auditor's next action should be a detailed review of all overdue accounts receivable, to see if specific bad debts are not being recognized.

Cautions: This measurement can be easily altered by anyone who does not want to have a high bad debt percentage. The key problem is that the numerator is composed of the total bad debt dollars recognized. If the controller does not want to recognize a bad debt, the amount is simply left in accounts receivable. Another problem is that previously recognized bad debts that are later paid by customers must be backed out of the bad debt expense, rather than being reinvoiced as new sales. In the first case, the bad debt percentage will be too low; in the later case, it will be too high.

PERCENT OF RECEIVABLES OVER XX DAYS OLD

Description: A company can precisely tailor its accounts receivable measurements by calculating only that portion of receivables that are older than a specific date. This is particularly useful in industries where it is customary to pay late, so

a conventional days of receivables measurement will not tell an accounting manager if there is actually a problem with collections. For example, if the traditional payment period is 65 days, then it is difficult to tell from a days of receivables measurement of 60 days if all invoices are not quite due for payment, or if some proportion of them are well past the customary payment date. The percent of receivables of XX days old is a good way to define this problem.

Formula: Divide the total dollar amount of all outstanding receivables exceeding a user-specified age by the total amount of all accounts receivable outstanding. The measurement is more accurate if all bad debts for which a credit has already been created can be netted against their corresponding credits, thereby eliminating them from the numerator. Otherwise, an old bad debt may still appear in the numerator without an offsetting credit; the credit is usually much newer than the debt and so will be excluded from the date range used to select transactions for the numerator. The formula is:

$$\frac{\text{Dollar amount of outstanding receivables} > \text{XX days old}}{\text{Total dollars of outstanding receivables}}$$

Example: The Kensington Ski Company, maker of low-end parabolic skis for beginners, collects on its accounts receivables after an average of 80 days. The delay is caused by the cash shortage of skiing retailers, who must liquidate their ski stocks prior to Christmas before they can pay their suppliers. The company has average days of receivables of 85 days, which does not tell the collections manager if all invoices are just a few days overdue, or if there is a more substantial problem with very overdue accounts. The collections manager decides that any invoice more than 95 days old is a potential bad debt and calculates the percentage of receivables over 95 days old, comparing the measurement to the results for the same period in the preceding year. The comparison is shown in table 9.10.

The comparison shows that the company is having a better collections experience than in the previous year. However, the $142,000 of overdue accounts is still substantial, so the collections manager gets to work identifying the specific problem accounts and contacting them about payment.

Cautions: A self-serving collections manager can alter the number of days used in the formula so that the amount overdue always looks insignificant. For example, if a large unpaid invoice is 69 days old, the measurement can be set at any-

Table 9.10

	Current Year	Previous Year
Receivables over 95 days	$142,000	$121,000
Total receivables	$4,050,000	$2,881,000
Percent of receivables over 95 days old	3.5%	4.2%

thing over 69 days in order to exclude it, thereby making the collections department's performance look better than it really is. This problem can be avoided by consistently using the same number of days in the measurement for many periods, thereby also giving a better period-to-period comparison of results.

PERCENTAGE COLLECTED OF DOLLAR VOLUME ASSIGNED

Description: The collections function is difficult to manage, since it is highly dependent on the hiring and support of a skilled group of collections personnel. This requires constant monitoring of collection results and replacement of those who are not performing above a minimum level. To do so, a good measure is the percentage of overdue invoices collected out of all those that have been assigned to each member of the collections staff. The measure can be used to monitor the performance of either an internal collections staff or that of a collections agency to which accounts have been assigned.

Formula: If a collections agency is being monitored, divide the cash received back from the agency by the total amount of accounts receivable assigned to the agency. However, since the numerator will include the collection agency's fee (which is subtracted from any funds collected), it will tend to show an unusually low percentage; one may consider removing the fee deduction when running the calculation in order to get a better idea of the collection agency's performance. The formula is:

$$\frac{\text{Cash received from collection agency}}{\text{Total accounts receivable assigned to collection agency}}$$

If the entity being measured is the internal collections staff, the same measurement is used; however, it is more common to calculate the measure for individual employees within the department so that the most precise determination can be made of performance levels by person.

Example: The Meek Furniture Company has hired the Irascible Collection Agency to collect all of its accounts receivable that are more than 90 days old. The Irascible's standard fee is one-third of all moneys collected. In the past year, Meek passed $83,500 in 90-plus day receivables to Irascible, which returned $28,250 to Meek as a result of its activities. Company management is more interested in Irascible's collecting effectiveness than the amount of cash it collects, so it chooses to measure Irascible's collection performance with its one-third collection fee removed from the calculation. The formula is:

$$\frac{\text{Cash received from collection agency} / (1 - \text{Collection fee percentage})}{\text{Total accounts receivable assigned to collection agency}} =$$

$$\frac{\text{\$28,500 Cash received / (1 – 1/3 Collection fee)}}{\text{\$83,500 Assigned to collection agency}} =$$

51% Collected of dollar volume assigned

Cautions: This measurement can yield misleading results if the accounts receivable assigned to a collection agency or in-house collections staff are not compared to cash receipts related to those same receivables. For example, if a collection agency were given $100,000 to collect, followed by another $100,000 two months later, the cash received from its efforts should only be linked to the first $100,000 until a sufficient amount of time had passed for it to have made reasonable collection efforts on the second $100,000. If this problem is not addressed, a common result will be an excessively low percentage collected, because cash receipts are being compared to additional new receivables as well as the original base of receivables from which they were collected.

PERCENT OF CASH APPLIED ON DAY OF RECEIPT

Description: There is nothing more irritating for a collections person than to contact a customer about an overdue payment, only to find that the customer had already paid, and the company had already received the money without updating its accounts receivable records. This is caused by inefficiency within the collections staff. This problem can be tracked by measuring the percentage of cash receipts applied to the accounts receivable records on the day of cash receipt.

Formula: Summarize the dollars of cash applied on the day of cash receipt (which should be available in the cash receipts journal) by the total dollars of income on the day of receipt (which comes from the bank deposit slip for that day). If there are also wire transfers directly to the company's bank account, then these can be discovered by completing an on-line bank reconciliation on a daily basis; this information should then be included in the measurement. The formula is:

$$\frac{\text{Dollars of cash receipts applied on day of receipt}}{\text{Total dollars of incoming cash on day of receipt}}$$

Example: Today's cash receipts at the Holiday Health Spa include $1,200 in cash, $6,025 in checks, a $500 wire transfer, and a $3,250 automated clearing house (ACH) receipt. There is no indication of who sent the wire transfer, so the accountant entered this amount into a cash holding account, pending resolution. A total of $10,325 was applied to specific accounts receivable on the day of receipt. Based on this information, the measurement can have two results. First, include the wire transfer in the calculation, on the grounds that it is the accountant's responsibility to research the cash receipt and appropriately record it. This yields the following result:

$$\frac{\text{\$10,325 Applied on day of receipt}}{\text{Dollars of incoming cash = \$1,200 Cash + \$6,025 Checks + \$500 Wire + \$3,250 ACH}} = \text{94\% Application rate}$$

If the wire transfer is excluded from the calculation, on the grounds that the accountant has no way of knowing how it should be applied, then the calculation changes to the following format:

$$\frac{\text{\$10,325 Applied on day of receipt}}{\text{Dollars of incoming cash = \$1,200 Cash + \$6,025 Checks + \$3,250 ACH}} = \text{99\% Application rate}$$

Cautions: As just noted in Example, it may not be possible to apply cash to the receivable records, because customers have not indicated which invoices are to be paid with the cash. The amount of these funds must then be recorded in a holding account until the customers can be contacted about the problem. On the grounds that a missing cash application is the customer's fault, one can exclude the amount of this unapplied cash from the measurement. However, one can also include this cash in the measurement, on the grounds that this will force the cash applications staff to rapidly resolve the problem with customers in order to achieve the highest possible measurement result.

COST OF CREDIT

Description: The cost of credit is used to determine the cost of not taking a discount offered by a supplier. It is used by the purchasing department as a negotiating tool so that a company can receive a net return on early payments to suppliers. It is also used extensively by the accounts payable staff to verify that the early payment terms offered by suppliers continue to be valid as the company's cost of capital changes. Further, the sales staff uses the calculation in its dealings with the purchasing staffs of other companies, who are also interested in obtaining better early payment discounts.

Formula: Determine the proportion of a full year to which the discount period applies. This is the number of days between the end of the early payment period and the date when the payment would normally be due at full price, divided into 360 days. This is the time period over which the discount rate earned by a company is applied. Next, subtract the offered discount percentage from 100%, and divide the result into the discount percentage. This is the effective interest rate that a company will be earning when it takes a supplier-offered discount. Finally, multiply the effective interest rate by the proportion of the full year to which the discount

period applies. This yields the annualized cost of the credit being offered by a supplier through its early payment discount. The formula is:

$$\text{Discount \%}/(100\text{-Discount \%}) \times (360/\text{Full allowed payment days} - \text{Discount days})$$

Example: A supplier of the Newman Astronautics Company is offering early payment terms of 2/15 net 40, which is a discount of 2% if paid within 15 days, with regular payment due after 40 days. Newman's cost of capital is 14%. The accounts payable manager needs to decide if it is economically sensible to take advantage of the discount. The calculation is:

$$\text{Discount \%}/(100 - \text{Discount \%}) \times (360/(\text{Full allowed payment days} - \text{Discount days})) =$$

$$2\%/(100\% - 2\%) \times (360/(40 - 15)) =$$

$$2\%/(98\%) \times (360/25) =$$

$$.0204 \times 14.4 =$$

$$29.4\% \text{ Cost of credit}$$

Since the cost of credit of 29.4% is substantially higher than the corporate cost of capital of 14%, this is a good idea. The accounts payable manager authorized taking the early payment discount.

Cautions: Typically, the cost of credit is compared to a company's cost of capital, which is a blended rate composed of the cost of all corporate debt and equity. In reality, taking a discount tends to be an incremental decision related to the immediate cost of invested funds. For example, an accounts payable manager will draw down cash from a short-term cash supply, typically invested in a money market fund, to take advantage of an early payment discount. This means that the incremental investment trade-off is a few percent of interest earned in the money market fund, rather than the much higher cost of capital for the entire company.

EARNINGS RATE ON INVESTED FUNDS

Description: Most organizations have excess funds available that may be used eventually for working capital or asset purchase requirements, but which are unused at the moment. Others have considerable cash reserves that are being held for larger expenditures, such as acquisitions. In either case, these funds should be invested to derive some rate of return, which can include interest income or an increase in the market value of securities held. The earnings rate on invested funds is a good measurement for tracking the performance of this activity.

Formula: Summarize the interest earned on investments, as well as the change in market value of securities held, and divide by the total amount of funds invested. Because the amount of funds invested may fluctuate substantially over the measurement period, the average value can be used. The amount of interest earned should not be based on the actual interest paid to the company, but rather on the accrued amount (since the date of actual payment may fall outside of the measurement period). The formula is:

$$\frac{\text{Interest earned + Increase in market value of securities}}{\text{Total funds invested}}$$

Example: The Rake and Mow Garden Centers corporate parent is earning a considerable return from its chain of small-town garden centers. Its CFO wants to know its earnings rate on invested funds during the past year. It had $5,500,000 of invested funds at the beginning of the year and $6,200,000 at the end of the year. It earned $75,000 in interest income and had a net gain of $132,000 on its short-term equity investments. Its total earnings rate on invested funds was:

$$\frac{\text{Interest earned + Increase in market value of securities}}{\text{Total funds invested}} =$$

$$\frac{\$75{,}000 \text{ Interest earned} + \$132{,}000 \text{ Increase in market value of securities}}{(\$5{,}500{,}000 + \$6{,}200{,}000) / 2} =$$

3.5% Earnings rate on invested funds

Cautions: A company can place too much reliance on this measurement, resorting to increasingly risky investments in order to achieve a higher earnings rate. The board of directors must realize that a reasonable, but not spectacular, amount of return is perfectly acceptable, because a company should focus its investment strategy on other goals as well, such as liquidity and minimal loss of principal, which tend to result in lower rates of return.

BROKERAGE FEE PERCENTAGE

Description: Banks charge a significant amount of fees to their corporate clients under the guise of many different services, such as wire transfers, incoming check processing, returned check fees, and special reports. It is useful to compare this cost to either the total amount of transactions or the amount of funds invested (in case a broker is involved). Two variations on a brokerage fee percentage calculation are shown in this section.

Formula: If a company is interested in the cost of brokerage transactions, then it should divide the total amount of broker fees charged by the total amount of funds invested in the related account. The formula is:

$$\frac{\text{Bank / broker transaction fees charged}}{\text{Total funds invested}}$$

If a company is interested in the cost of all banking fees, which can cover a wide range of activities, then it should summarize all of the bank fees (which are typically listed on the monthly bank statement or a related statement of banking activities) and divide them by the total number of transactions processed that involve a fee. The formula is:

$$\frac{\text{Bank / broker transaction fees charged}}{\text{Number of bank / broker transactions processed}}$$

Example: The Universal Soccer Sports Company is evaluating the performance of its broker, who handles all transactions for its investment account. The amount of money invested with the broker was $1,575,000 at the beginning of the year and $1,705,000 at the end of the year. In the past year, the broker charged $23,625 as a management fee, as well as $16,525 for transactional fees associated with the purchase and sale of securities. The brokerage fee percentage is:

$$\frac{\text{Bank / broker transaction fees charged}}{\text{Total funds invested}} =$$

$$\frac{\$23{,}625 \text{ Management fee} + \$16{,}525 \text{ Transaction fees}}{(\$1{,}575{,}000 + \$1{,}705{,}000) / 2} =$$

2.4% Brokerage fee percentage

Cautions: There is a great deal of competitive fee information available from brokers who are interested in obtaining a company's investment business. It may be more useful to compare these fees to those charged by the existing broker on a transaction-by-transaction basis, rather than using the more summary-level measurement noted here.

The same problem applies to the brokerage fee percentage used for banking transactions because there are many types of bank fees, each of which can be compared to those of other banking institutions to see if they are reasonable. An additional problem for the banking measurement is that the bulk of all transactions relate to very small check processing fees, which cost very little on a per-transaction basis. When these fees are included in the measurement, they tend to water down the impact of other, larger-fee items. Consequently, it may be necessary to subdivide the measurement for banking fees so that larger fee items are segregated.

BORROWING BASE USAGE PERCENTAGE

Description: The borrowing base usage percentage is an excellent measure for keeping track of the amount of debt that a company can potentially borrow, based on that portion of its accounts receivable, inventory, and fixed assets that are not currently being used as collateral for an existing loan. A treasurer, controller, or CFO should have this information available on all standard internal accounting reports so that the company's available debt capacity is easily available. It is particularly useful within a cash budget, indicating not only the amount of any potential cash shortfalls but also the ability of the company to cover those shortfalls with collateralized debt from existing assets.

Formula: Multiply the current amount of accounts receivable, less those invoices that are more than 90 days old, by the allowable borrowing base percentage (per the loan document). Then multiply the current amount of inventory, less the obsolescence reserve, by the allowable borrowing base percentage (per the loan document). Add the results of these two calculations together and divide the sum into the amount of debt outstanding. It is also possible to include in the denominator the amount of fixed assets (net of a borrowing base percentage), but many lenders do not allow a company to use fixed assets as part of its collateral, on the grounds that fixed assets are too difficult to liquidate. The formula is:

$$\frac{\text{Amount of debt outstanding}}{(\text{Accounts receivable} \times \text{Allowable percentage}) + (\text{Inventory} \times \text{Allowable percentage})}$$

Example: The Spinning Wheel Company, maker of heirloom-quality spinning wheels, has been in a break-even cash flow situation for a number of years. The market for its products is gradually declining, and the president is searching for alternative products that will shift the company into a more profitable situation. In the meantime, the president needs to know the proportion of debt available under the company's borrowing arrangement, to see how much funding is available to start new lines of business. Under the terms of the loan, the borrowing base percentage is 70% for accounts receivable, 50% for inventory, and 20% for fixed assets. According to the company's balance sheet, it has the assets and liabilities shown in Table 9.11.

The borrowing base calculation for the denominator of the ratio is as follows:

$350,000 Accounts receivable × 70% Borrowing base	= $245,000
$425,000 Inventory × 50% Borrowing base	= $212,500
$140,000 Net fixed assets × 20% Borrowing base	= $28,000
Total borrowing base	= $485,500

Table 9.11

Account	Amount
Accounts receivable	$350,000
Inventory	$425,000
Fixed assets	$205,000
Accumulated depreciation	–$65,000
Loans	$250,000

Note that the fixed assets borrowing base calculation was net of the accumulated depreciation figure; otherwise, the borrowing base would not properly reflect the reduced resale value of older fixed assets.

Using the preceding borrowing base calculation, the president of Spinning Wheel can complete the borrowing base usage percentage:

$$\frac{\$250{,}000 \text{ Loans outstanding}}{\$485{,}500 \text{ Total borrowing base}} =$$

$$= 51.5\% \text{ Borrowing base usage}$$

The president sees that about one half of the total borrowing base has been used to collateralize existing debt levels. Subtracting the numerator from the denominator shows that the company can borrow another $235,500 before the borrowing base is maximized.

Cautions: This measurement is highly recommended. However, do not just calculate the measurement based on the borrowing base percentages contained within the existing lender agreement—an alternative is to search for an alternative lender who may offer higher borrowing base percentages and calculate it based on those figures as well, on the grounds that the company can change lenders in order to obtain a higher level of debt.

10

Measurements for the Engineering Department

This chapter focuses on the measurements that can be used to determine the performance of the engineering department, especially of its new-product design function. There are no financial measurements listed here at all. Instead, the formulas cover such operational issues as bill of material accuracy, reuse of parts in new product designs, and ability to reach target costs.

The measurements discussed in this chapter include:

- Bill of Material Accuracy
- Labor Routing Accuracy
- Percentage of New Products Introduced
- Percentage of Sales from New Products
- Percentage of New Parts Used in New Products
- Percentage of Existing Parts Reused in New Products
- Average Number of Distinct Products per Design Platform
- Percentage of Products Reaching Market before Competition
- Ratio of Actual to Target Cost
- Warranty Claims Percentage
- Time from Design Inception to Production
- Percentage of Floor Space Utilization

BILL OF MATERIAL ACCURACY

Description: The engineering department is responsible for the release of a bill of materials for each product that it designs. The bill of materials should specify exactly what components are needed to build a product, plus the quantities required for each part. This information is used by the logistics staff to ensure that the correct parts are available when the manufacturing process begins. An accuracy

Table 10.1

Part Description	Unit of Measure	Quantity	Check Off
Leg struts	Each	4	
Cross braces	Each	4	
Plastic leg tips	Each	4	
Plastic seat bucket	Each	1	
Safety harness	Each	1	
Safety buckle	Each	1	
Warning label	Each	1	
Product label	Roll	1	Incorrect
Styrofoam packing	Ounces	8	
Box	Each	2	Incorrect

rating of at least a 98% is needed for this measurement in order to manufacture products with a minimum of stoppages caused by missing parts.

Formula: Divide the number of accurate parts (defined as the correct part number, unit of measure, and quantity) listed in a bill of material by the total number of parts listed in the bill. The formula is:

$$\frac{\text{Number of accurate parts listed in bill of materials}}{\text{Total number of parts listed in bill of materials}}$$

Example: The Bouncing Baby High Chair Company makes high chairs. Its engineering group has just released the bill of materials for a new plastic chair. The production manager suspects that the new product's bill of materials is incorrect, given a long history of bill inaccuracies. Table 10.1 shows a copy of the bill.

The production manager's review reveals that there are two mistakes in the bill of materials. The unit of measure for the product label is incorrectly specified as being a roll, when it should be each, and the quantity listed for box should be one, rather than two. In both cases, using the bill of materials would have resulted in a considerable overordering of product labels and boxes for the product. Since two of the 10 items on the bill of materials are incorrect, the bill is only 80% accurate.

Cautions: Though the minimum acceptable level of accuracy is 98%, this is an area where nothing less than 100% accuracy is required to ensure that the production process runs smoothly. Consequently, a great deal of attention should be focused on this measurement.

The timing of the release of the bill of materials is another problem. If an engineering staff is late in issuing a proper bill of materials, then the logistics group must scramble to bring in the correct parts in time for the start of the production process. Measuring the timing of the bill's release as well as its accuracy can avoid this problem by focusing the engineering staff's attention on it.

LABOR ROUTING ACCURACY

Description: This measurement is created by the industrial engineering staff, and is intended to provide the production planning staff with a listing of the production times needed at all work stations through which a product must pass during the manufacturing process. By multiplying a product's labor routing by the number of units to be produced, the production planning staff can tell how much direct labor and machining time is needed to complete a production run. A labor routing accuracy level of 95% is considered the minimum acceptable level to plan production properly.

Formula: Summarize the total number of correct machining times and machine codes in each labor routing, and divide by the total number of line items in the routing. When calculating this measurement, a line item should be considered incorrect if *either* the machining time *or* the machine code (which identifies the correct work station to be used) is incorrect. Having one or the other correct does not mean that the entire line should be listed as correct for the purposes of the calculation. The formula is:

$$\frac{\text{Number of correct machining times and machine codes}}{\text{Total number of routing line items}}$$

Example: The Burly Barbeque Grille Company manufactures the beefiest grill on the planet. It requires a number of production steps to complete, as outlined in the following labor routing.

The production-scheduling staff finds that the paint shop is consistently overburdened with a lengthy queue of grills. Further investigation reveals that the 120 minutes of time listed for the paint shop in step 8 is too low by 40 minutes. The labor routing accuracy for this product is therefore measured at 90% (9 of 10 items being correct), and the time for the paint shop is adjusted up to 160 minutes, which immediately eliminates the bottleneck problem at the paint shop.

Step Number	Work Station	Minutes
1	Kitting	25
2	Hole punch	15
3	Riveting	40
4	Quality station	10
5	Burnishing	60
6	Label station	5
7	Electrical	20
8	Paint shop	120
9	Quality station	10
10	Boxing	5

Cautions: The level of precision required for a labor routing is especially important when very short processing times are required for each production station, since a small error in an already-small number can have a major impact when multiplied by a large production run. For example, there is little cause for concern if a three-hour production time is off by a minute, but there is if a four-second production time is incorrect by a second (which is 25% off of the actual production time). Consequently, the calculation of labor routing accuracy should be based on getting the estimated time correct to within a certain percentage of the actual time. A common figure is to assume that the estimated routing time is correct if it is plus or minus 5% of the actual time.

PERCENTAGE OF NEW PRODUCTS INTRODUCED

Description: The percentage of new products introduced is of great importance in high-fashion consumer markets, where existing products may last for only a few months before being replaced. However, it may be of little consequence in more staid industries where new products only appear every few years. Thus, the applicability of this measure will depend on the competitive situation in which a company finds itself.

Formula: Divide the number of new products introduced in the measurement period by the total number of new products available at the beginning of the period. The formula is:

$$\frac{\text{Number of new products introduced in the period}}{\text{Number of products available at the beginning of the period}}$$

Example: The VibroMatic Massage Company has been producing the same massage chair for the past decade. Its new president wants to shake up the industry by releasing a series of designer-model massage chairs in a range of price points. Accordingly, the president bases the bonus plan for the engineering manager on the percentage of new products introduced. At the end of the measurement period, the percentage of completion for the various product designs is shown in Table 10.2.

Table 10.2

Design	Status
Micro massage chair	In production
Massage stool	In tooling
Mongo deluxe massage	Design approved
Foot massage bolster	In design
Office massage chair	In design

The company had a total of five production models at the beginning of the measurement period. Based on the table, the president can pay a bonus based on the one model that has made it into production, or the two that have at least reached the tooling stage, or the three that have at least reached the design stage. The president reviews the engineering manager's job description and concludes that those job responsibilities end at the design stage, after which other people are responsible for tooling and production. For bonus payment purposes, the products are measured as having been completed once their designs have been approved, which means that three new products were completed during the period for measurement purposes. This results in the following percentage of new products introduced:

$$\frac{\text{3 New products introduced in the period}}{\text{5 Products available at the beginning of the period}} = 60\%$$

Cautions: The design team being measured may attempt to define minor product variations as new products. Since incremental product changes may be released with great regularity, this would yield a very high new product performance measurement. To keep this from happening, specify that only those products using an entirely new product platform, or which use a minimum percentage of entirely new parts, will be considered new products.

PERCENTAGE OF SALES FROM NEW PRODUCTS

Description: The preceding measurement can force an engineering department into the wholesale production of new products, but will not necessarily result in well-targeted products that bring in a significant amount of new revenue. This problem can be avoided by using the percentage of sales from new products measurement, which focuses management attention on the practical *results* of new product development.

Formula: Divide total sales from new products by total sales. A variation is to use in the numerator the sales from any products developed within a predefined number of years; for example, one consumer products company measures the percentage of new sales generated by products that have been developed within the past three years. By using this slightly longer time frame, the highs and lows caused by individual product launches can be smoothed out. The basic formula is:

$$\frac{\text{Sales from new products}}{\text{Total sales}}$$

Example: The Tuff Man Exercise Equipment Company is engaged in rapidly broadening its lineup of weight lifting machines for the home market. Its controller wants to determine the percentage of sales from new products, based on Table 10.3.

Table 10.3

Equipment Name	New/Existing	Sales
Squat rack	New	$138,000
Bench press	New	$208,000
Preacher bench	New	$54,000
Lat pulldown	Existing	$192,000
Quad extension	Existing	$147,000
Total	—	$739,000

Based on the information in the table, the controller calculates the percentage of sales from new products as follows:

$$\frac{\text{Sales from new products}}{\text{Total sales}} =$$

$$\frac{\$400{,}000 \text{ New product sales}}{\$739{,}000 \text{ Total sales}} =$$

54% Sales from new products

Cautions: The key problem with this measurement is the definition of a new product. For example, should a product be included that only varies from the old product line in that it has a new color, a change in packaging, or some slight functional improvement? There needs to be a definition of a new product that will keep these slightly improved products from being included in the numerator of the measurement. For example, specify that only those products containing at least 25% new parts can be designated new products or only those that use an entirely new design platform.

PERCENTAGE OF NEW PARTS USED IN NEW PRODUCTS

Description: A continuing problem for a company's logistics staff is the volume of new parts that the engineering department specifies for each new product. This can result in an extraordinary number of parts to keep track of, which entails additional purchasing and materials-handling costs. From the perspective of saving costs for the entire company, it makes a great deal of sense to encourage engineers to design products that share components with existing products. This approach leverages new products from the existing work load of the purchasing and materials-handling staffs, and has the added benefit of avoiding an investment in inventory for new parts. For these reasons, the percentage of new parts used in new products is an excellent choice of performance measurement.

Formula: Divide the number of *new* parts in a bill of materials by the *total* number of parts in a bill of materials. Many companies do not include fittings and fasteners in the bill of materials, since they keep large quantities of these items on hand at all times and charge them off to current expenses. If so, there are fewer parts to include in the calculation, making the measurement much easier to complete. The formula is:

$$\frac{\text{Number of new parts in bill of materials}}{\text{Total number of parts in bill of materials}}$$

Example: The logistics manager of the Illuminato Flashlight Company has not achieved a bonus target for inventory reduction in five years. The manager complains to the president that the fault does not lie with him but rather with the engineering department, which persists in issuing flashlights whose components are entirely new, resulting in rampant increases in the number of components kept in stock. To see if design changes can reduce inventory levels, the president includes the percentage of new parts used in new products in the engineering manager's performance compensation plan for the next year. The bill of materials for one of the company's new flashlight models can be seen in Table 10.4.

Based on the information in the table, the performance measure for this single product would be:

$$\frac{\text{3 New parts in bill of materials}}{\text{10 Parts in bill of materials}} = 30\% \text{ New parts used in new products}$$

Cautions: Engineers may argue against the use of this measurement on the grounds that it provides a disincentive for them to locate more reliable and/or less expensive parts with which to replace existing components. Although this measure can act as a block to such beneficial activities, a measurement system can avoid this problem by focusing on long-term declines in the cost of products or

Table 10.4

Component	Unit of Measure	Quantity	New/Used
Casing	Each	1	Old
Tie ring	Each	1	New
Lanyard	Each	1	Old
Cone	Each	1	Old
Quartz lens	Each	1	Old
Bulb	Each	1	Old
Spring	Each	1	Old
Contact end	Each	2	Old
Label	Each	1	New
Box	Each	1	New

increases in the level of quality. A combined set of these measurements can be an effective way to focus on the most appropriate design initiatives by the engineering department.

PERCENTAGE OF EXISTING PARTS REUSED IN NEW PRODUCTS

Description: The inverse of the preceding measurement can be used to determine the proportion of existing parts that are used in new products. However, as the formula reveals, this measurement is slightly different from an inverse measurement. This variation is used by companies that have compiled an approved list of parts that are to be used in new product designs, which is a subset of all existing parts. By concentrating on the use of an *approved* parts list in new products, a company can incorporate high-quality, low-cost components for its products.

Formula: Divide the number of approved parts in a new product's bill of materials by the total number of parts in the bill. If there is no approved components list, then the only alternative is to use the set of all existing components from which to select items for the numerator, which will likely result in a higher percentage. The formula is:

$$\frac{\text{Number of approved parts in bill of materials}}{\text{Total number of parts in bill of materials}}$$

Example: The Sticky Thought Tape Dispenser Company has just issued a new executive style tape dispenser. Its bill of materials contains 20 parts, of which 18 are existing components and 12 are on the approved parts list. What is the engineering department's performance in using existing parts? The answer is:

$$\frac{12 \text{ Approved parts in bill of materials}}{20 \text{ Parts in bill of materials}} = 60\% \text{ Existing parts reused in new products}$$

Cautions: Since a complex product will probably contain one or more subassemblies rather than individual components, verify that selected subassemblies are also on the approved parts list; otherwise, subassemblies will be rejected for the purposes of this measurement.

AVERAGE NUMBER OF DISTINCT PRODUCTS PER DESIGN PLATFORM

Description: A major problem for car companies has been the proliferation of car models, few of which share the same underlying design platform. By fostering such a plethora of models, the companies have run into difficulties with too many

production lines, each of which is tooled to only manufacture one model. Another problem that arises is a vast array of components needed to assemble the many models, plus a great deal of engineering design time to create each model "from scratch" rather than starting with a common base of platform designs. This measurement is designed to bring this problem to the attention of management.

Formula: Divide the total number of distinct products by the total number of design platforms. The formula is:

$$\frac{\text{Total number of distinct products}}{\text{Total number of design platforms}}$$

Example: Tongan Motors, the massive automobile manufacturer who conveniently ships to anywhere on the Pacific Rim from its Pacific island base, is suffering from an overabundance of design platforms. It currently has 42 auto models that are based on 36 design platforms, which results in a very poor ratio of products to platforms of 1.2 products per platform. It plans to cancel 20 platforms outright and issue enough new designs to increase its ratio of models to platforms to 3.0:1.

Cautions: The key issue is in deciding what variations on a product are termed distinct products. For example, the same product in 10 different colors is still just one product, while the basic and deluxe models of a product both probably start with the same essential product design, and so can be termed a single product. This issue can be of more than academic interest, since anyone wanting to show good results under this measurement will be inclined to reclassify everything as a new product and add it to the numerator of the formula.

PERCENTAGE OF PRODUCTS REACHING MARKET BEFORE COMPETITION

Description: A common problem is for the engineering department to be so proud of its new products that it fails to release its designs until they become works of art. Though this may result in great designer satisfaction, it also means that other companies can bring their less-perfect products to market much sooner, thereby grabbing market share. The percentage of products reaching market before the competition can be measured to see if this is a problem.

Formula: Divide the number of products released before those of the competition by the total number of products that a company releases. The formula is:

$$\frac{\text{Number of products released before competition}}{\text{Total number of products released}}$$

Table 10.5

Product Name	Scheduled Release Date	Actual Release Date
Hercule Poirot Shoe	February 15	February 13
Stompin' Shoe	April 15	April 18
Clean n' Jerk Shoe	June 15	June 25
Press Shoe	August 15	August 29
Slip Not Shoe	October 15	November 5

It may be difficult to determine the precise dates on which competing products are released, or there may be no discernible competing products. If so, an easier measurement is to focus on the number of products released on or before their targeted dates. The formula is:

$$\frac{\text{Number of products released on schedule}}{\text{Total number of products released}}$$

Example: The managers of the Hercules Shoe Company, makers of shoes for weight lifters, want to pursue an aggressive schedule of new product releases during the upcoming year, which will require a great deal of effort by their shoe design teams. They set up Table 10.5, a design release schedule, including the dates on which releases are actually completed.

Based on the table, the design team must have been spending too much time in the gym, since they only made one of the five release dates. This results in a performance measure of 20%, which is calculated as:

$$\frac{\text{One product released on schedule}}{\text{Five Products Released}} = 20\%$$

Cautions: Having a product reach the market before its competition is not just up to the engineering staff. There may be problems in procuring parts, which is the responsibility of the purchasing staff; manufacturing flaws that must be resolved by the production staff; and delivery issues for which the distribution employees are responsible. Consequently, many of the reasons for a late product launch can be traced to other departments than engineering. To avoid this problem, the second of the two formulas, which focuses on meeting a designated design release date, focuses attention squarely on the efforts of the engineering staff.

RATIO OF ACTUAL TO TARGET COST

Description: In a target-costing environment, the marketing and engineering teams jointly determine the features that a new product should have, as well as the

market price it must have to achieve commercial success, and then back into the maximum target cost for the product to attain reasonable margins. The key focus of the product design teams then becomes the construction of a product that meets the predetermined target cost. This measurement is used to determine their success in doing so.

Formula: Divide the total of actual expected product costs by the total amount of targeted costs. A footnote should accompany this measurement, stating the expected production volume at which the costs are stated. The reason for this extra wording is that component costs can change drastically if assumed volumes vary. For example, if a target cost is based on an expected unit volume of 50,000, but the actual expected costs are based on a revised unit volume of only 10,000, then it is quite likely that the cost of components will increase dramatically. The formula is:

$$\frac{\text{Total of actual product costs}}{\text{Total of target costs}}$$

Example: The engineering manager for a copier design team is conducting a postdesign review of the team's performance. The team did not meet its target cost goal, and the manager is wondering what could have given an earlier warning of the costing problem. The manager has obtained the information in Table 10.6 about design costs over the term of the project.

The measurements in the table show that the design team was on track at the first design milestone by keeping actual expected costs at a level 25% higher than the final target cost. However, the team slipped significantly at the second milestone and was never able to reduce costs thereafter, resulting in a final design that was 11% more expensive than the target. More active management of the design process after the second milestone might have prevented this problem from arising.

Cautions: The element missing from this measurement is the quality of the resulting products. A design team can achieve a target cost and issue a completed product design, but if its associated warranty and scrap costs are too high, the lifetime cost of the product to the company will exceed the initial target cost. Consequently, this measure must be coupled with a set of minimum quality specifications; lifetime target costs, rather than initial target product costs, can be tracked to quantify the cost of quality.

Table 10.6

	Milestone 1	Milestone 2	Milestone 3	Approval
Actual cost	$2,050	$1,970	$1,880	$1,820
Target cost	$1,640	$1,640	$1,640	$1,640
Ratio of actual to target cost	125%	120%	115%	111%
Expected ratio	125%	112%	108%	100%

Another issue, as noted in the Formula section, is that the individual component costs used to compile the total target cost can vary greatly, depending on the assumed volume of production; this is because components that are purchased in bulk are typically less expensive than when they are bought in small quantities.

Another issue is that a design team is usually required to meet increasingly stringent costing targets as it moves closer to the final approval of its product design. As it passes each design milestone, its actual cost should come a bit closer to the target cost. Consequently, it makes sense to calculate this measurement at every milestone and compare it to the target cost at that point, rather than waiting until completion of the entire project to see if the costing goal was attained. By measuring on this trend line, management can spot design cost problems early and correct them.

WARRANTY CLAIMS PERCENTAGE

Description: The reasons why a product may be returned under warranty can be traced to a number of causes, such as poor production methods and low-quality materials, that have nothing to do with the engineering department. However, they may also be due to design flaws that are directly attributable to the engineering staff. If a significant proportion of warranty claims are caused by this problem, then the warranty claims percentage should become part of the measurement package for this department.

Formula: Divide the total number of warranty claims received by the total number of products sold. A variation on this calculation is to categorize warranty claims by underlying cause, so only those warranty problems arising from engineering issues are included in the numerator. The formula is:

$$\frac{\text{Total number of warranty claims received}}{\text{Total number of products sold}}$$

Example: The engineering manager of the Lullaby Swing Company is trying to determine the warranty claims percentage for its Baby Care Swing product. The company manufactured this product during the six months leading up to the summer selling season, after which it stopped production, and it does not plan to begin again until the end of the year. A rash of warranty claims were filed toward the end of the summer that appear to be caused by a structural defect in the swing joint that causes collapse after heavy usage. The total number of units produced was 183,000, and the number of claims filed thus far is 1,897. The calculation is:

$$\frac{\text{Total number of warranty claims received}}{\text{Total number of products sold}} =$$

$$\frac{\text{1,897 Warranty claims filed}}{\text{183,000 Units produced}} =$$

1% Warranty claims percentage

This is a common situation involving the calculation of warranty claims as a measurement, and is deserving of continued review over several years to see if problems continue to arise with this product. The production manager should consider marking the product differently in each successive year, so that returned products can be easily associated with a specific production year.

Cautions: There can be a significant time lag between the point when a product is sold and when it is returned under warranty. To obtain a measurement that properly relates the amount of units sold and the number of warranty claims, the measurement period should comprise several months.

TIME FROM DESIGN INCEPTION TO PRODUCTION

Description: Engineering design teams can take an inordinate amount of time to design a new product, especially if the process suffers from a great deal of design iteration, that is, designs constantly being revised to deal with problems encountered in the industrial design or tooling phases. This is a particularly useful measure when there is a large backlog of design projects, and management is keen on reducing design times to accommodate them all.

Formula: Subtract the design start date from the completed design sign-off date. This measure can also be subdivided into the design intervals for the product itself, the required tooling, and the production process design. The basic formula is:

Completed design sign-off date – Design start date

Example: The Svelte Equipment Company, maker of fine weight-lifting equipment, is working on a new set of chrome-plated exercise equipment for the home. There are many separate workout stations in the prospective product line, and the president wants to make sure that they are all completed on time. The relevant information is in Table 10.7, which sets a design time budget for each item of equipment and compares it to the actual time from design inception to completion.

By using this format, the president can see that the design times for the first three projects end up being close to their budgets, while the last two projects require substantially more design time.

Cautions: The design process may require approvals by departments outside the engineering area, which means that the completion date is outside the engineering

Table 10.7

Equipment	Design Inception Date	Design Completion Date	Actual Design Days	Budgeted Design Days
Universal machine	May 8	July 14	67	65
Lat pulldown	July 15	September 12	59	55
Quad stretch	September 13	November 24	72	65
Squat stack	November 25	February 11	77	60
Tricep stack	February 12	May 2	79	55

manager's control to some extent. Also, some products are revised so frequently that there is little separation between the initial design completion date and the immediate commencement of work on product upgrades and replacements.

PERCENTAGE OF FLOOR SPACE UTILIZATION

Description: The industrial engineering staff is responsible for creating a production process that makes the most efficient use of available floor space so that a company can squeeze the maximum amount of production out of its expensive existing facilities. The percentage of floor space utilization is a useful measure for determining its success in these design efforts.

Formula: Add together the amount of floor space used by machinery (including the space around it that is required for safe operations, direct labor personnel, and movement paths for logistical reasons), and divide the sum by the total amount of floor space in the production area. Of the three items listed in the numerator, the one that sparks the most argument is the amount of space required for materials movement; a company can potentially eliminate much of the space currently occupied by all types of inventory, which can be a very large proportion of all production floor space. Some companies may want to run a second utilization percentage that reveals what the utilization would be if inventory levels were optimized. By comparing the existing and optimal figures, the industrial engineering staff can determine whether it should embark on just-in-time systemic changes to achieve the indicated space savings. The formula is:

$$\frac{\text{Amount of floor space used for machinery, operator, and materials movement}}{\text{Total floor space}}$$

Example: The industrial engineering manager of the Katana Sword Company, makers of fine Japanese blades, believes that the company can eliminate a great deal of production floor space by rearranging its production equipment in a more

Table 10.8

	Current	Theoretical
Space used by machinery	12,000	8,000
Space used by operators	2,500	2,500
Space used for materials	7,500	2,500
Total floor space	25,000	25,000
Percentage of floor space utilization	88%	52%

compact manner. He derives Table 10.8 regarding information about floor space utilization.

According to the table, the manager is certainly correct in wanting to pursue the rearrangement of equipment on the shop floor, since it will save 4,000 square feet of floor space. However, the manager should also mention the potential savings of 5,000 square feet in materials storage space to the logistics department, so that they can work on this area of improvement, as well.

Cautions: It is not always efficient to cram production facilities into the smallest possible amount of floor space, since this may interfere with proper logistical flow lines through the facility, resulting in longer travel times for materials. Also, some companies may want more open facilities for marketing reasons, since this configuration looks better when taking customers through the plant.

Another consideration is whether any floor space can be sold off or subleased if a company uses this measurement as a catalyst to increase its floor space utilization. If a company's production area is highly specialized or incapable of being segregated for other uses, it may not make sense to pursue a consolidation of floor space.

11

Measurements for the Logistics Department

The logistics function is composed of production scheduling, purchasing, materials handling, and distribution. These areas are all central to the smooth functioning of a company's production processes. A failure in any of these areas can severely impact or even halt production, so this is a prime area in which to set up and maintain a rigorous system of measurement tracking. The 26 measurements described in this chapter are intended to address the key operational aspects of logistics and should be measured on a trend line to ensure that management can spot operational difficulties as soon as they arise. The measurements discussed are:

- Production Schedule Accuracy
- Economic Order Quantity
- Number of Orders to Place in a Period
- Economic Production Run Size
- Raw Material Inventory Turns
- Raw Material Content
- Finished Goods Inventory Turns
- Obsolete Inventory Percentage
- Percentage of Inventory > XX Days Old
- Percentage of Returnable Inventory
- Inventory Accuracy
- Percentage of Certified Suppliers
- Electronic Data Interchange Supplier Percentage
- On-Time Parts Delivery Percentage
- Purchased Component Defect Rate
- Incoming Components Correct Quantity Percentage
- Percentage of Actual Payments Varying from Purchase Order Price
- Percentage of Purchase Orders Issued below Minimum Dollar Level
- Proportion of Corporate Credit Card Usage
- Percentage of Receipts Authorized by Purchase Orders
- Freight Audit Recovery Ratio
- Picking Accuracy for Assembled Products
- Average Time to Ship

On-Time Delivery Percentage
Percentage of Products Damaged in Transit
Percentage of Sales through Distributors

PRODUCTION SCHEDULE ACCURACY

Description: Without a production schedule that is carefully followed, the production department will find itself in a state of bedlam, with material shortages, irate customers, and projects being rushed through the production facility. To avoid this, the logistics staff must ensure that the jobs listed on the production schedule are completed in an orderly manner and in the scheduled sequence and quantities. The production schedule accuracy measurement is a useful tool for tracking this.

Formula: Divide the number of scheduled jobs completed during the measurement period by the total number of jobs scheduled for completion. However, if there are large jobs that cross over multiple periods, they will fall outside of this measurement, which only tracks *completed* jobs. In such cases, it may be more accurate to divide the number of completed production tasks within each scheduled job by the total number of scheduled tasks for all jobs. The basic formula is:

$$\frac{\text{Number of scheduled jobs completed}}{\text{Number of jobs scheduled for completion}}$$

Example: The Wilkerson Supercomputer Company produces the largest computers in the world, which are used by many physics and weather-reporting laboratories. Each computer takes roughly three months to build when its production schedule is precisely followed. However, each one tends to take much longer, because the product manager for each job interferes in the production process to leapfrog the job ahead in the work queue. The logistics manager has recently put a stop to this behavior by denying all nonproduction personnel access to the manufacturing facility, and now needs to prove the point by showing the before-and-after monthly production schedule accuracy. The manager prepares the information found in Table 11.1.

Table 11.1

	Before	After
Total scheduled production tasks completed	29	43
Total production tasks scheduled	67	59
Production schedule accuracy	43%	73%

The table shows a decisive improvement in schedule accuracy, which the logistics manager uses to permanently block the product managers from interfering with the production process.

Cautions: Despite the obvious production efficiencies associated with creating a production plan and then precisely following that plan, there are times when last-minute changes are required by customers, which can throw some portion of the schedule into disarray. Though some provision can be made for such changes within the schedule, these intrusions will occur, and they will impact the schedule's accuracy.

ECONOMIC ORDER QUANTITY

Description: If a company does not use a material requirements planning system or just-in-time system to control its inflow of raw materials, then a reasonable alternative is the economic order quantity. Under this calculation, the point at which the carrying cost of inventory equals its ordering cost can be derived. Theoretically, this is the ideal quantity that should be ordered. Note the problems with this approach in the Cautions section.

Formula: Multiply the total usage of a component by two, and then multiply the result by the cost per order. Then divide this result by the carrying cost per unit, and calculate the root of the result. Of particular importance is the variety of costs that can be included in the carrying cost per unit, which includes incremental materials handling costs, the cost of extra warehouse space and storage racks to contain it, damage caused by storage, insurance fees, and property taxes. The formula is:

The root of ((2 × Total usage in units × Cost per order)/Carrying cost per unit)

Example: The Billings Pool Table Company buys a variety of slate table tops for its various models. The slate is quite expensive and is subject to breakage during materials handling, so the logistics staff tries to keep as little of it in stock as possible. The economic order quantity (EOQ) calculation for the slate top for the top-of-the-line Grande model is based on the following information:

Annual usage in units	125
Ordering cost per order	$25
Insurance cost per unit	$35
Storage cost per unit	$80
Interest cost per unit	$85

The EOQ formula is:

The root of ((2 × Total usage in units ×
Cost per order) / Carrying cost per unit) =

The root of ((2 × 125 Units usage ×
$25 per order) / $200 Carrying cost per unit) =

5.6 Units

Cautions: It is important to calculate all the incremental carrying costs associated with an inventory item, since they can be so large that the resulting economic order quantity ends up being small. Also, actual order quantities allowed by suppliers may be so different from the calculated EOQ that the logistics staff has no choice by to diverge from the calculated best purchase quantity. For example, the EOQ may indicate that a purchase of 38 units is best, but the supplier only sells in quantities of 50. Also, a material requirements planning system may reveal that a component has no required use in the production schedule, in which case no additional order is required, no matter how low the existing inventory levels may drop—an issue that is not included in the basic EOQ formula at all. For these reasons, EOQ should be treated as a general guideline for purchasing quantities, rather than a strictly followed calculation.

NUMBER OF ORDERS TO PLACE IN A PERIOD

Description: The purchasing manager needs to have a general idea of the number of orders that the purchasing staff will be placing within a given time period, so that the departmental headcount can be adjusted to match purchasing needs. The EOQ formula can be modified slightly to derive this information.

Formula: Divide the total usage in units for a selected time period by the economic order quantity, as shown in the preceding section. The formula is:

$$\frac{\text{Total usage in units}}{\text{EOQ}}$$

Example: The ViewBright Company, maker of rear view mirrors for the auto industry, has one major component—glass. Its purchasing manager is reviewing vacation requests from the staff and wants to know when the largest number of purchase orders are expected to be placed in the coming year. The manager assembles the information in Table 11.2 by quarter.

Based on the information in the table, the purchasing manager can see that the six months in the middle of the year will require the most purchasing effort. Consequently, the manager decides to limit the number of vacation hours that will be allowed through that time period.

Table 11.2

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Usage in units	120,000	158,000	143,000	117,000
EOQ	275	275	275	275
Number of orders to place	436	575	520	425

Cautions: This measurement assumes that the effort required to place any order is the same. In reality, the cost of order placement varies widely, depending on the number of purchasing steps required for items of different costs (more steps for high-dollar orders), the uniqueness of the items ordered, and the need for documentation for international orders. Consequently, it is better to run this calculation for different types of orders, to gain a more accurate understanding of the total projected amount of time required to place them.

ECONOMIC PRODUCTION RUN SIZE

Description: The economic production run size is similar to the economic order quantity that was described in the Economic Order Quantity Section, except that it applies to the scheduling of production run quantities rather than purchasing quantities. This is a useful tool for the production scheduling staff, which needs to know the most cost-effective size for which production runs should be scheduled. Please review the issues related to this measurement in the Cautions section.

Formula: Multiply the total unit demand of a product by two, and then multiply the result by the run setup cost. Then divide the result by the carrying cost per unit, and calculate the root of the result. Of particular importance is the variety of costs that can be included in the carrying cost per unit, which includes incremental materials handling costs, the cost of extra warehouse space and storage racks to contain it, damage caused by storage, insurance fees, and property taxes. The formula is:

$$\text{The root of } ((2 \times \text{Total unit demand} \times \text{Run setup cost}) / \text{Carrying cost per unit})$$

Example: The Hi-Tech Washing Machine Company makes very large quantities of its revolutionary microwave washing machine for the consumer market. Its production scheduling manager wants to determine the optimal production run size for this product. The microwave model has total annual demand of 150,000 units, a setup cost of $425,000, and a carrying cost per unit of $32. Its economic production run size is as follows:

The root of ((2 × Total unit demand × Run setup cost) / Carrying cost per unit) =

The root of ((2 × 150,000 × $425,000 Setup cost) / $32 Cost per unit) =

63,122 Units

Cautions: This measurement applies only to situations where production runs are being made to stock, rather than to fill orders. If specific orders are being filled, then production runs must match the size of the orders so that specific customer delivery dates are met.

Also, the theory of the economic production run size has been challenged by the just-in-time (JIT) manufacturing concept, which holds that the ideal run size is a single unit, which can be achieved by lowering the setup time to a minimal amount.

RAW MATERIAL INVENTORY TURNS

Description: One of the key performance measures of a logistics manager is the ability to keep a company's investment in raw materials to a minimum, which requires excellent inventory tracking systems, carefully maintained production planning systems, and good relations with high-quality suppliers. The end result of these systems is a very high number of raw material inventory turns.

Formula: Divide the dollar volume of raw materials consumed during the measurement period by the total dollar value of inventory on hand at the end of the period, and multiply the result by 12. The inventory value at the end of the period can be arbitrarily high in relation to average inventory levels throughout the measurement period, so an average value can be used instead. The formula is:

(Raw material dollars consumed/Raw material inventory dollars on hand) × 12

Example: The Cod Fishnet Company assembles its high-end amateur fishing nets from the finest spun cotton and teak handles. Since its sales tend to be highly variable in size and timing, it is very important for the logistics manager to keep low volumes on hand to avoid large investments in raw materials; as an incentive, the manager is paid a bonus in every month where raw material turns of at least 12 are achieved. For the most recent month, the amount of raw material dollars consumed was $138,500, whereas the beginning inventory balance was $159,900 and the ending balance was $123,425. Based on this information, the company's raw materials inventory turns for the period were:

(Raw material dollars consumed / Raw material inventory dollars on hand) × 12 =

$$\frac{\text{\$138,500 Raw materials consumed}}{\text{(\$159,900 Beginning inventory + \$123,425 Ending inventory) / 2}} \times 12 =$$

11.7 Raw material inventory turns

The measurement indicates that the logistics manager has not achieved inventory turnover of at least 12 and therefore will not be paid a bonus. However, if the ending inventory value had been used in the measurement instead of the average value, the calculation would have yielded a turnover rate of 13.5, which would have earned the logistics manager a bonus. Because of this difference, the Cod Fishnet Company's president should codify the exact nature of the calculation used to determine whether the bonus is paid.

Cautions: This is a good measurement for tracking logistics performance. However, the use of high-cost air freight services to bring in inventory at the last minute can lead a logistics manager to increase freight costs in order to achieve a high level of raw materials turnover, even though the total cost to the company is increased by doing so. This problem can be avoided by measuring changes in freight costs alongside the turnover measurement.

RAW MATERIAL CONTENT

Description: It is useful to determine the proportion of raw material costs included in a typical sale so that management can determine if the company is adding a sufficient amount of value to the product to yield a required level of profit. Otherwise, a company is essentially a reseller. Also, the measurement can be tracked on a trend line to see if the proportion of raw material to sales is rising, which indicates that raw material costs are increasing without a corresponding increase in sales.

Formula: Summarize the total amount of raw material dollars sold, and divide it by sales. The amount of raw materials can be collected from the bills of material associated with each product sold, though this only summarizes the standard amount of raw materials used (which may not reflect actual scrap levels or the most current raw material costs). An alternative is to obtain the information by adding the most recent period's raw material costs to the beginning raw material inventory balance, and then subtracting the ending raw material balance. The measurement can also be subdivided and tracked for individual products so that the purchasing staff can see which product margins are suffering from raw material cost increases. The formula is:

$$\frac{\text{Raw material dollars sold}}{\text{Sales}}$$

Example: The Underhill Plastics Company has a standard policy of passing along to its customers the amount of any increases in the price of its resin raw materials. This is the responsibility of the logistics manager; however, the president has noticed that this task tends to be delayed by several months, resulting in a higher proportion of raw material costs to sales in the meantime as well as reduced profits.

Table 11.3

	January	February	March	April	May
Sales	$350,000	$375,000	$320,000	$335,000	$352,000
Raw materials cost	$210,000	$221,250	$195,200	$234,500	$246,400
Raw material content	60%	59%	61%	70%	70%

Consequently, the president asks the accounting staff for a monthly calculation of raw material content, which will indicate any increases in raw material costs for which pass-through price increases have not yet occurred. The president obtains information for the past five months which can be seen in Table 11.3.

The raw material content calculation in the table reveals that the content percentage jumped in April and stayed high, indicating that there has been a jump in resin prices that the logistics manager has not yet passed through to the company's customers. The president heads for the logistics department for a loud discussion with its manager.

Cautions: A change in the level of raw material content can also be caused by a change in the price of a product by the marketing staff or by giving away free product samples, because both actions will reduce the sales figure in the denominator, resulting in a higher ratio even if the amount of raw material dollars does not change. These types of activities are beyond the control of the logistics staff, although this department is generally considered to be responsible for the calculation's results.

The ratio can also change if the mix of products differs from period to period and if the raw material content percentage is different for each of the products sold.

FINISHED GOODS INVENTORY TURNS

Description: A company may have an excellent overall inventory turnover rate but a poor finished goods turnover rate. This may be caused by the continuation of production into a slow part of the sales cycle, which will use up the remaining raw materials and convert them over to finished goods, which, in turn, will then sit until the sales cycle picks up again. This manufacturing strategy is used by companies that level-load their work forces year-round and by companies that are attempting to increase their loan borrowing bases by pumping up the value of their inventories by converting them to higher-value finished goods. Given the latter reason, a lender may be interested in reviewing this measurement on a trend line to see if it increases in concert with the company's borrowing base.

Formula: Divide the amount of finished goods dollars sold during the measurement period by the finished goods dollar amount on hand, and multiply the result

Table 11.4

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Annualized canoe sales	$3,500,000	$3,500,000	$3,500,000	$3,500,000
Finished goods inventory on hand	$305,000	$95,000	$410,000	$850,000
Finished goods inventory turns	11.5	36.8	8.5	4.1

by 12. In cases where there are highly seasonal sales, it is better to use an average annualized sales figure than the annualized sales for the month in which the measurement is made. The formula is:

(Finished goods dollars consumed/Finished goods inventory dollars on hand) × 12

Example: The Barstow Canoe Company sells most of its fiberglass canoes in the spring and summer. Rather than lay off its experienced production team for the rest of the year, it continues to employ them through the fall and winter seasons, building finished goods inventories for the next selling season. A prominent business school is developing a case study on Barstow's production system and wants to include in their report the amount of the finished goods inventory turns at the end of each quarter. They compile the information shown in Table 11.4.

The measurement clearly shows the wide variability in inventory turnover that is caused by a combination of the company's seasonal sales and its steady rate of production through all parts of the year.

Cautions: The amount of finished goods turnover can change if the amount of direct labor or overhead charged to a product is altered, which can be done through modifications to a labor routing document or the overhead allocation methodology. Thus, the measurement can yield different results even when there is no change in the number of finished goods units on hand.

OBSOLETE INVENTORY PERCENTAGE

Description: A company needs to know the proportion of its inventory that is obsolete for several reasons. First, external auditors will require that an obsolescence reserve be set up against these items, which will lower the inventory value and create a charge against current earnings. Second, constantly monitoring the level of obsolescence allows a company to work on eliminating the inventory through such means as returns to suppliers, taxable donations, and reduced-price sales to customers. Finally, obsolete inventory takes up valuable warehouse space that could otherwise be put to other uses; monitoring it with the obsolete inventory percentage allows management to eliminate these items to reduce space requirements.

Formula: Summarize the cost of all inventory items having no recent use, and divide by the total inventory valuation. The amount used in the numerator is subject to some interpretation, since there may be an occasional use that will eventually use up the amount left in stock, despite the fact that it has not been used for some time. An alternative summarization method for the numerator that avoids this problem is to include only those inventory items that do not appear on any bill of material for a currently produced item. The formula is:

$$\frac{\text{Cost of inventory items with no recent usage}}{\text{Total inventory cost}}$$

Example: The logistics manager of the Terrific Truck Supply Company is new to the job and wants to see if the inventory has an obsolescence problem. Truck replacement parts have a long shelf life, so the manager calls up a parts usage report and decides that anything for which not more than 10% of the on-hand volume has been sold in the past year will be defined as obsolete. A query command in the company's online inventory reporting system shows that the value of the inventory in the specified range is $248,000. The total inventory value is $2,090,000, which therefore yields an obsolete inventory percentage of 11.9%. The manager contacts several suppliers and earns the company $50,000 in credits by returning many of these obsolete items.

Cautions: A large amount of obsolete inventory does not reflect well on the logistics manager, who is responsible for maintaining a high level of inventory turnover. It is possible that the logistics manager will attempt to alter the amount listed in the numerator, either by defining *recent usage* as anything within a very long time period, or by ensuring that all inventory items are included on some sort of bill of material, which is generally considered evidence that they may eventually be used. To avoid this problem, the calculation should be given to someone outside of the logistics department.

PERCENTAGE OF INVENTORY > XX DAYS OLD

Description: A company may not have any obsolete inventory, but it may have enough older inventory that raise concern about the possibility of obsolescence at some point in the future. By determining the amount of inventory that is older than a certain fixed date, the logistics staff can determine which items should be returned to suppliers (see the next measurement) or which items should be sold off at a reduced price.

Formula: Settle on a number of days after which inventory is considered to be old enough to require liquidation action. Then determine the dollar value of all items whose age exceeds this number of days. Divide that total by the total dollar value

of inventory. The measurement should be accompanied by a report that lists the detailed amounts and locations of each inventory item in the numerator so that the logistics staff can review them in detail. The formula is:

$$\frac{\text{Dollars of inventory} > \text{XX days old}}{\text{Total dollars of inventory}}$$

Example: The Medieval Illumination Company makes candles that are specially tailored to each major holiday. Its Christmas candles use a red wax that degrades after 120 days and must be melted down after that time for reuse as new candles. The marketing manager requests a report that itemizes the dollar value of candles that have been in stock more than 60 days, which still leaves up to 60 more days in which to sell them off. The results of the report show $12,500 of candles that are at least 60 days old, out of a total candle inventory of $320,000. The percentage of inventory over 60 days old is therefore 3.9% ($12,500 divided by $320,000).

Cautions: The measurement can give some idea of the total amount of inventory that may require liquidation, but it does not show the raw material usage requirements of the production schedule, which may be scheduled to use these items during an upcoming production run. This can only be found by comparing the old inventory list to the production requirements report.

Using this report to determine the proportion of old finished goods yields a better idea of what products may need to be sold off. However, knowledge is needed of the timing of the sales season for each product on the list. For example, an article of clothing may appear to be old, but if its prime selling season is just starting, then it would make sense to leave it alone through much of the season, to see if it can be sold at its full retail price before considering any type of price discounting.

PERCENTAGE OF RETURNABLE INVENTORY

Description: Over time, a company will tend to accumulate either more inventory than it can use or inventory that is no longer used at all. These overaccumulations may be caused by an excessively large purchase, scaling back of production needs below original expectations, or perhaps a change in a product design that leaves some components completely unnecessary. Whatever the reason, it is useful to review the inventory occasionally to determine what proportion of it can be returned to suppliers for cash or credit.

Formula: Summarize all inventory items for which suppliers have indicated that they will accept a return in exchange for cash or credit. For these items, use in the numerator either the listed book value of returnable items or the net amount of cash that can be realized by returning them (which will usually include a restocking fee charged by suppliers). The first variation is used when a company is more interested

in the amount of total inventory that it can eliminate from its accounting records, whereas the second approach is used when a company is more interested in the amount of cash that can be realized through the transaction. The denominator is the book value of the entire inventory. The formula is:

$$\frac{\text{Dollars of returnable inventory}}{\text{Total dollars of inventory}}$$

Example: The Holystone System, Inc., producer of a teeth-whitening system for dental patients, is rolling out a new system that does not use several of the components stored in its warehouse. Accordingly, it contacts it suppliers and finds that they will accept returns for inventory items that have a book value of $230,000, but for which they will charge a restocking fee of 20%. The total inventory valuation is $1,475,000. Holystone is in cash flow difficulties, and so is most interested in measuring the amount of cash it can realize by returning inventory to suppliers. The percentage of returnable inventory is:

$$\frac{\text{Dollars of returnable inventory} \times (1 - \text{restocking fee})}{\text{Total dollars of inventory}} =$$

$$\frac{\$230{,}000 \times (1 - .20)}{\$1{,}475{,}000} =$$

12.5% of Returnable inventory

Cautions: Even though a large proportion of the inventory may initially appear to be returnable, consider that near-term production needs may entail the repurchase of some of those items, resulting in additional freight charges to bring them back to the warehouse. Consequently, the underlying details of the measurement should be reviewed in order to ascertain not only which items can be returned, but more specifically which ones can be returned that will not be needed in the near term. This involves the judgment of the logistics staff, perhaps aided by a reorder quantity calculation (see Economic Order Quantity Section), to see if it is cost justifiable to return goods to a supplier that will eventually be needed again. A reduced version of the measurement that avoids this problem is to include in the numerator only those inventory items for which there is no production need whatsoever, irrespective of the timeline involved.

INVENTORY ACCURACY

Description: If a company's inventory records are inaccurate, timely production of its products becomes a near-impossibility. For example, if a key part is not located at the spot in the warehouse where its record indicates it should be, or its indicated quantity is incorrect, then the materials-handling staff must frantically

search for it and probably issue a rush order to a supplier for more of it, while the production line remains idle, waiting for the key raw materials. To avoid this problem, the company must ensure that not only the quantity and location of a raw material is correct, but also that its units of measure and part number are accurate. If any of these four items are wrong, there is a strong chance that the production process will be negatively impacted. Thus, inventory accuracy is one of the most important materials-handling measurements.

Formula: Divide the number of accurate test items sampled by the total number of items sampled. The definition of an accurate test item is one whose actual quantity, unit of measure, description, and location match those indicated in the warehouse records. If any one of these items is incorrect, then the test item should be considered inaccurate. The formula is:

$$\frac{\text{Number of accurate test items}}{\text{Total number of items sampled}}$$

Example: An internal auditor for the Meridian and Baseline Company, maker of surveying instruments, is conducting an inventory accuracy review in the company's warehouse. The auditor records the incorrect information for a sample count of eight items (see Table 11.5).

The warehouse manager has spent a great deal of time ensuring that the inventory record accuracy in the warehouse is perfect. The manager is astounded when the auditor's measurement reveals an accuracy level of zero, despite perfect quantity accuracy; the manager has completely ignored the record accuracy of part descriptions, locations, and units of measure, and as a result has had multiple incorrect components of the measurement for some inventory items. The manager informs the staff that they will be correcting records over the weekend.

Cautions: It is extremely important to conduct this measurement using all four of the criteria noted in the formula derivation. The quantity, unit of measure,

Table 11.5

	Audited Description	Audited Location	Audited Quantity	Audited Unit of Measure
Aneroid barometer	No	No		
Battery pack	No			
Connection jack		No		
GPS casing	No	No		
GPS circuit board		No		
Heavy duty tripod	No			No
Plumb line				No
Sextant frame				No

description, and location must match the inventory record. If this is not the case, then the reason for using it—ensuring that the correct amount of inventory is on hand for production needs—will be invalidated. For example, even if the inventory is available in the correct quantity, if its location code is wrong, then no one will be able to find it to use it in the production process. Similarly, the quantity recorded may exactly match the amount located in the warehouse, but will still lead to an incorrect quantity if the unit of measure in the inventory record is something different, such as dozens instead of eaches.

PERCENTAGE OF CERTIFIED SUPPLIERS

Description: The logistics department certifies a supplier when the supplier's internal production systems are considered to be sufficient to ensure that any shipments sent to the company will contain the correct quantities of the correct components and will have a quality level that meets the company's minimum standards. By issuing this certification, the logistics staff has essentially shifted its receiving review function into the supplier's factory, so that there is no need to review its goods when they arrive at the receiving dock. In its most advanced form, this means that certified suppliers can deliver their components directly into the company's production line without being reviewed by any company personnel. This represents a considerable time savings, as well as a major reduction of the materials-processing flow. Consequently, logistics department members who wish to achieve a highly efficient materials flow should track the percentage of certified suppliers.

Formula: Divide the number of certified production suppliers by the total number of production suppliers. Since certification is a very time-consuming and expensive process, it is likely that not all suppliers will ever go through the certification process, resulting in a performance measurement that is always less than 100%. An alternative approach that will allow for 100% results is to create a list of suppliers who should eventually be certified and only use them in the denominator. The formula is:

$$\frac{\text{Number of certified production suppliers}}{\text{Total number of production suppliers}}$$

Example: The American Defense Company produces a complex sonar system for Navy submarines. This requires the assembly of extremely delicate electronic components that are produced by 20 component suppliers. The company has had an ongoing problem with damage to these circuits during delivery to the company's production facility, which is caused both by inadequately robust design of the product and inadequate use of shipping materials. American's logistics staff decides to create a certification program for all 20 suppliers that focuses on their ability to design and produce more robust components as well as better packaging

designs. After six months of effort, it certifies 11 of the 20 suppliers, which is a 55% certification level. The process has been so arduous at the remaining suppliers that the company elects to shift its business away from them and to the 11 certified suppliers.

Cautions: Achieving a high level of certification completion is not a one-time measurement result. On the contrary, supplier performance must be constantly reevaluated, either because its capabilities may decline over time, or because the company's certification standards have risen. Consequently, the measurement should really determine the percentage of suppliers who have been recertified within the past year (or some other appropriate measurement period).

ELECTRONIC DATA INTERCHANGE SUPPLIER PERCENTAGE

Description: It is much easier to manage the incoming flow of materials from suppliers, as well as pay them in a more orderly manner, if there is an electronic data interchange (EDI) linkage between the company and its suppliers. In its most advanced form, this system allows suppliers to receive listings of scheduled production needs directly from the buying company's manufacturing planning system, as well as automated purchase orders, while the buying company can receive immediate feedback from suppliers regarding delivery amounts and dates. The system can also be used to reconcile invoices and pay suppliers in concert with automated clearing house (ACH) banking transactions.

Formula: Summarize the number of suppliers with EDI linkages to the company by the total number of suppliers being regularly used by the company. Only those suppliers who are conducting all available transactions through EDI should be included in the numerator, which will place increased emphasis on suppliers who have installed the system but are not using it to its maximum effect. Also, the number of suppliers listed in the denominator should not include all incidental suppliers having minimal business with the company (since this can be a formidably large number), but rather the group of ongoing suppliers who regularly transact business with it. The formula is:

$$\frac{\text{Number of suppliers with EDI linkages}}{\text{Total number of suppliers}}$$

Example: The Musical Heritage Company, restorer of damaged antique musical instruments, conducts a great deal of business with a set of auction houses around the world that feed its restoration craftsmen an unending stream of old instruments. It needs to control the incoming flow of instruments, since its inventory damage insurance policy will only cover the company for those instruments currently in the restoration process; all other instruments, many of them quite expensive, are at risk while being stored. The answer is an EDI notification system for

the suppliers, who are electronically told when to ship the next set of instruments, and who can automatically confirm with Musical Heritage that the instruments have been shipped. The company has the eight auction houses as clients, all of whom send it sufficient volume to warrant EDI installations. Of this group, three are using both the shipment authorization and confirmation EDI features, one house is not using it at all, and the remaining four are only using the shipment authorization function.

If Musical Heritage is most concerned about limiting its liability under the insurance policy, then the measurement should be targeted at the shipment authorization function, which has achieved an 87.5% success rate (seven of eight auction houses are using it). If Musical Heritage is also concerned about the shipment confirmation EDI feature, which is useful for scheduling the work flow of its artisans, then the success rate is only 37.5% (three of eight auction houses are using it).

Cautions: Achieving an EDI supplier percentage of well below 100% is quite acceptable. The reason is that installing an EDI system at each supplier is a time-consuming process, because of the travel between locations for setup meetings and the cost of software and related equipment. Consequently, there will be some suppliers whose transaction volumes are so low that installing an EDI system will never make sense. This problem can be avoided by carefully pruning the number of suppliers listed in the numerator, so only those suppliers are included that are most likely to install EDI. If this approach is used, then a 100% EDI supplier percentage is possible.

ON-TIME PARTS DELIVERY PERCENTAGE

Description: One of the key performance measures for rating a supplier is its ability to deliver ordered parts on time, since a late delivery can shut down a production line. Furthermore, a long-standing ability to always deliver on time gives a company the ability to reduce the level of safety stock kept on hand to cover potential parts shortages, which represents a clear reduction in working capital requirements. Consequently, the on-time parts delivery percentage is crucial to the logistics function.

Formula: Subtract the requested arrival date from the actual arrival date. If the intent is to develop a measurement that covers multiple deliveries, then an average can be created by summarizing this comparison for all the deliveries and then dividing by the total number of deliveries. Also, if an order arrives prior to the requested arrival date, the resulting negative number should be converted to a zero for measurement purposes; otherwise, it will offset any late deliveries when there is no benefit to the company of having an early delivery. Because a company must pay for these early deliveries sooner than expected, they can even be treated as positive variances by stripping away the minus sign. Any of these variations are

possible, depending upon a company's perception of the importance of not have early deliveries. The basic formula is:

Actual arrival date – Requested arrival date

Example: The Rawlins Power Boat Company is measuring the on-time parts delivery percentage of its teak parts manufacturer. Teak fittings are extremely expensive, so the company does not like to have much safety stock on hand. However, this means that Rawlins must rely on the supplier's ability to deliver on time, which has not been a strong point of late. Its delivery performance for the last five deliveries is shown in Table 11.6.

By simply summarizing the days variance for all five deliveries, the on-time parts delivery percentage becomes 1.8 days. However, this includes the negative variances caused by two deliveries being received too early. There is no benefit to Rawlins from having early deliveries, since it must store the parts somewhere as well as pay for them sooner than expected. Consequently, by resetting these negative variances to zero, the calculation is:

(6 + 4 + 0 + 5 + 0)/5 Deliveries = 3.0 Days on-time parts delivery percentage

Also, the accounts payable staff does not like having to pay the teak supplier early for the deliveries that arrive prior to their due dates. Since this viewpoint gives a negative connotation to early deliveries, the logistics manager elects not to reset them to zero for the calculation, but rather to strip away their negative sign, turning them into positive variances. Under this approach, the formula is:

(6 + 4 + 2 + 5 + 4)/5 Deliveries = 3.8 Days on-time parts delivery percentage

Thus, the treatment of variances caused by early deliveries can have a considerable impact on the reported amount of a supplier's on-time parts delivery percentage. The type of measurement used in this example caused the result to vary from a low of 1.8 days to a high of 3.8 days, which represents more than a doubling of the high value over the low value.

Cautions: This is an excellent measurement, but it does not address other key aspects of supplier performance, such as the quality of the goods delivered (see the

Table 11.6

Delivery Number	Requested Date	Delivery Date	Days Variance
1	2/09	2/15	6
2	2/27	3/03	4
3	3/14	3/12	–2
4	3/26	3/31	5
5	4/03	3/31	–4

next measurement) or its cost. These additional features can be measured alongside the on-time delivery percentage or melded into an overall rating score for each supplier.

PURCHASED COMPONENT DEFECT RATE

Description: The purchasing staff should be interested in the proportion of components purchased from outside suppliers that are defective. Any defect requires expensive time to document and return and may even interfere with the timely completion of the production schedule. Consequently, this is one of the most important measures of supplier performance. It should be measured both by supplier and by each component provided by each supplier, in case there are problems with only some portion of a supplier's total deliveries to a company. Also, it should be measured on a trend line, so that gradual increases can be easily spotted and dealt with.

Formula: Summarize all rejected components and divide them by the total number of components received. As just noted, this measurement should at least be summarized by supplier, if not by specific component types delivered by individual suppliers. The formula is:

$$\frac{\text{Number of rejected components}}{\text{Total number of components received}}$$

Example: The Tango Mural Company, manufacturer of flame-retardant Spanish tiles, has been having trouble with the receipt of chemicals from a key supplier. The company operates a lean inventory system that does not allow it to go for more than two days without inventory replenishment. Consequently, the rejection of chemicals from its orders has thrown it into an expedited ordering mode in recent months to keep its tile-baking facility operational. The purchasing staff accumulates the information in Table 11.7 to present to its chemical supplier.

The reject rate in month three has jumped drastically over that of the preceding two months, denoting some type of quality problems at the supplier. The purchasing manager decides to take this table into a meeting with the supplier, with the intention to demand immediate improvement in the rejection rate.

Table 11.7

	Month 1	Month 2	Month 3
Barrels ordered	512	431	602
Barrels rejected	31	30	72
Purchased component defect rate	6%	7%	12%

Cautions: If a company's computerized receiving system allows one to itemize different types of reasons for a rejected component, it is possible to include more than one rejection reason when a part is rejected. If so, the compilation of the information needed for the numerator of this measurement may result in some double counting. This will result in an apparent number of rejected components that is higher than the actual amount. To avoid this problem, the summarization should be by number of units rejected, rather than the total number of rejection reasons.

An increased rejection rate can be caused by a change in the receiving procedures at the company or by a change in the specifications that the company is imposing on its purchased components. In either case, a change in the resulting measurement will have little to do with altered performance by suppliers, since the changes are internal to the company.

Also, rejected components may be only one of several key values that a company places on a supplier—other reasons are low pricing and on-time deliveries. If this is the case, the purchased component defect rate can be combined with measurements for these other factors to arrive at a supplier "report card" rating system.

INCOMING COMPONENTS CORRECT QUANTITY PERCENTAGE

Description: Another key item that the receiving staff is concerned about is the quantity of items received in comparison to the amount ordered. If the amount is too low, the company may be faced with a parts shortage in its production operation. If the quantity is too high, then it may find itself with more inventory than it can use. Also, if an odd lot size is received, it may be difficult for the receiving staff to find a location in the warehouse in which to store it. For these reasons, the incoming components correct quantity percentage is very commonly used.

Formula: Divide the number of orders to suppliers for which the correct quantity is delivered by the total quantity of orders delivered. This measurement is commonly applied to each supplier, so that the performance of each one can be measured. A variation on the formula is to include in the numerator only those orders received for which the entire order amount is shipped; this approach is used by companies that do not want to deal with multiple partial orders from their suppliers, because of the increased cost of receiving and related paperwork. The basic formula is:

$$\frac{\text{Quantity of orders with correct parts quantity delivered}}{\text{Total quantity of orders delivered}}$$

Example: The internal auditing staff of the Wilco Aircraft Radio Company has brought a potential fraud situation to the notice of its logistics manager. Staff members are concerned that the quantities of amplifiers received from a key supplier are always slightly lower than the ordered amount, but always within the 5% counting tolerance established by the warehouse staff. This results in full payment

Table 11.8

	October	November	December
Incoming components correct quantity percentage using 5% counting tolerance	100%	100%	100%
Incoming components correct quantity percentage using 4% counting tolerance	0%	0%	0%

by Wilco for the ordered amount, even though the actual amount received is always less. The auditors' evidence is listed in the Table 11.8.

The table indicates that virtually all orders received from the supplier are considered accurate if the measurement allows for a variation of 5% in the quantity received, while none of the orders would qualify if the tolerance were reduced by just 1%. The logistics manager concludes that the supplier must have learned about the company's counting tolerance and is deliberately sending deliveries that barely achieve the minimum count threshold. Further investigation reveals that the supplier is splitting its profits with the company's warehouse manager, who is responsible for setting the counting tolerance level.

Cautions: The formula can result in a very low correct quantity percentage if the quantity received is only off by one unit. This may seem harsh if, for example, an order of 10,000 units is incorrect by one unit. Consequently, it is common for companies to consider an order quantity to be accurate if the quantity received is within a few percent of the ordered amount. The exact percentage used will vary based on the need for precision and the cost of the components received, although 5% is generally considered to be the maximum allowable variance.

PERCENTAGE OF ACTUAL PAYMENTS VARYING FROM PURCHASE ORDER PRICE

Description: When a company issues a purchase order to a supplier, the company has no obligation to pay the supplier anything but the price per unit that is listed on the purchase order, no matter what amount may appear on the resulting invoice issued by the supplier. Nonetheless, an accounts payable staff person is usually required to reconcile any pricing differences between the two documents, which can take a great deal of accounting staff time. There may also be cases where an inattentive accounting staff does not compare the purchase order to the invoice, and instead just pay the invoice amount, possibly costing the company money. For this reason, it is useful to determine which suppliers are in the habit of ignoring the prices at which they are supposed to be billing the company.

Formula: Divide the total dollars of excess billings over the amount listed on purchase orders by the total amount listed on all purchase orders for which payments

Table 11.9

	Total Invoice Price Paid	Purchase Order Price Authorized	Variance from Purchase Order
Spring Loaded, Inc.	$217,000	$209,000	+3.8%
Velvet Linings Corp.	$193,000	$184,000	+4.8%
Foam & Sons	$73,000	$69,000	+5.8%
Footpads for Hire	$69,000	$65,500	+5.3%
Totals	$552,000	$527,500	+4.6%

have been made to suppliers. This measurement reveals the most information if it is organized by individual supplier and accompanied by a detailed listing of exactly which invoices were overbilled. The measurement is:

$$\frac{\text{Dollar total of excess costs over purchase order costs}}{\text{Total of all purchase order costs}}$$

Example: The Loafer Lounge Company, maker of exceedingly plush living room chairs for the discriminating television viewer, may have a problem with excessively high materials costs. Its accounting staff pays for supplier invoices only after confirming that the related quantities have been received and approved by the warehouse staff—there is no matching of invoice prices to purchase order prices. The logistics manager wants to prove that this extra matching step can save a great deal of money. To prove this point, the manager collects the information in Table 11.9 for the month of February.

The table reveals that suppliers are consistently taking advantage of the company by overcharging on their invoices. The net overpayment made in just one month is $24,500, which would nearly pay the annual salary of an accounts payable clerk who could match invoices to purchase orders and eliminate this problem.

Cautions: An overbilling can be legitimate if there is a valid reason for charging an extra fee, such as a rush service or delivery charge that is caused by an exceedingly short delivery date, as required by the company, or a change in the order specifications that occurred after the related purchase order was issued. These special variances should be noted in the accounts payable computer records, so they can be printed out when the measurement is calculated.

PERCENTAGE OF PURCHASE ORDERS ISSUED BELOW MINIMUM DOLLAR LEVEL

Description: Issuing purchase orders can be expensive, because the buyer must investigate pricing, possibly issue bid notifications, review bids, and make a selection before issuing the purchase order. This can cost anywhere from $100 to

several thousand dollars to complete. To make the purchasing process cost-effective, most organizations prohibit the use of purchase orders for small orders, preferring instead to use corporate purchasing cards or petty cash. By tracking the percentage of purchase orders issued below a minimum dollar level, the logistics manager can see if this is a problem area.

Formula: Determine a minimum dollar level below which purchase orders should not be used; this amount will vary by company and will be based on both the volume of orders at different dollar levels and the cost of creating each purchase order. Then count all purchase orders issued during the measurement period for amounts less than the threshold level, and divide it by the total number of purchase orders issued during the same period. The formula is:

$$\frac{\text{Number of purchase orders issued below minimum dollar level}}{\text{Total number of purchase orders issued}}$$

Example: The Windy Electric Utility, which specializes in wind-turbine electricity generation, has a large purchasing staff that is required to issue purchase orders for virtually all purchases made by the company. The logistics manager thinks that this level of control has been taken too far and wants to prove the point by itemizing the cost of small orders. The logistics manager compiles Table 11.10, which shows the volume of purchase orders placed at various dollar levels.

The table shows that the company's purchasing policies are increasingly strict as the size of an order increases, going from $65 for the smallest order to $1,350 for the largest one. Given the large volume of small orders, it is apparent that the company is using a large amount of resources to process orders in areas where there is a minimal risk of significant loss. Since the average buyer is paid $45,000 per year, the logistics manager believes that more than five positions can be eliminated simply by stopping the purchase order requirement for orders below $100, and a total of 13 positions can be eliminated if the prohibition is increased to cover all orders below $500.

Cautions: A fraud-minded employee who can influence the point below which purchase orders are not allowed can set it so that a large quantity of unauthorized

Table 11.10

Order Size	No. of Orders Placed	Cost per Order	Total Ordering Cost
$500,000+	20	$1,350	$27,000
$2,501–$499,999	55	$650	$35,750
$501–$2,500	350	$225	$78,750
$101–$500	2,800	$120	$336,000
$100 or less	4,000	$65	$260,000
Total			**$737,500**

purchases (e.g., at high prices or from unapproved suppliers) can be made with impunity. This problem can be avoided by occasionally auditing the orders placed below the purchase order threshold, looking for appropriate pricing, quantity, and quality levels.

PROPORTION OF CORPORATE CREDIT CARD USAGE

Description: A logical adjunct calculation to the preceding measure is to measure the proportion of total purchase transactions that are being accomplished through the use of corporate purchasing cards. Using credit cards reduces the amount of paperwork required of the purchasing staff, though the control over the types, quantities, and costs of purchases will decline. A typical goal is nearly 100% card usage for all purchasing transactions under $100, with some companies using a much higher cutoff, such as $2,500.

Formula: Divide the number of credit card purchasing transactions by the total number of purchasing transactions. This measurement is usually restricted to all purchasing transactions below a corporate-mandated level, such as $100. It may also be measured for each department or credit card holder, to see where credit card usage is minimal. The formula is:

$$\frac{\text{Number of credit card purchase transactions}}{\text{Total number of purchase transactions}}$$

Example: The Anderson Boat Company is forcing its employees to use company-issued credit cards to purchase all items costing $500 or less, thereby reducing the work load of its accounting staff. Acceptance of the new policy has been spotty. The logistics manager has decided to highlight departments where credit cards are not being used. The relevant information is in Table 11.11.

Predictably, the materials management group, which is supervised by the logistics manager, has a near-perfect 95% credit card usage level. However, the

Table 11.11

	Number of Credit Card Transactions Under $500	Total Number of Purchasing Transactions Under $500	Proportion of Corporate Credit Card Use
Administration	328	729	45%
Materials management	2,042	2,149	95%
Boat design	143	650	22%
Boat testing	298	1,987	15%
Boat sales	503	613	82%

engineers in the boat design and testing groups appear to be somewhat less enamored with the concept. Therefore, the logistics manager schedules meetings with the managers of both departments to see what steps can be taken to increase the usage level.

Cautions: Though 100% usage of purchasing cards for all transactions below a specific dollar limit is a laudable goal for reducing purchasing labor costs, it is subject to abuse. For example, an employee can make multiple credit card purchases at a level just below the maximum limit to buy something that is much more expensive, which would normally have been subject to a great deal of purchasing scrutiny. Furthermore, purchasing cards can be used to make personal acquisitions, or to buy inappropriate items or services. All of these problems can be mitigated through internal audit reviews, limitations on the types of purchases allowed through corporate credit cards, and periodic maximum purchasing limits. However, all these controls should be put in place before a company can determine whether a high proportion of corporate credit card use has actually reduced its total purchasing costs.

PERCENTAGE OF RECEIPTS AUTHORIZED BY PURCHASE ORDERS

Description: One of the most difficult tasks for the receiving staff is to decide what to do with orders that are received with no accompanying purchase order. Since the orders are not authorized, the staff could simply reject them. However, they run the risk of rejecting some item that may have been bought on a priority basis and will cause undue trouble for the logistics manager when projects in other parts of the company are held up. Accordingly, these orders are frequently set to one side for a few hours or days, while the receiving staff tries to find out who ordered them. This can be a significant waste of receiving time, and it is worth measuring on a trend line to see if the problem is worsening.

Formula: The receiving department should maintain a receiving log, on each line of which is recorded the receipt of a single product within an order. Using the line items in the receiving log that correspond to the dates within the measurement period, summarize the number of receipt line items authorized by open purchase orders by the total number of receipt line items in the log. The formula is:

$$\frac{\text{Receipt line items authorized by open purchase orders}}{\text{Total receipt line items}}$$

Example: The Hoboken Highlanders, makers of Scottish clothing for New Jersey residents (an admittedly small niche), has eliminated several of its purchasing controls to increase its level of purchasing efficiency. To counteract this deliberate weakening of controls, the logistics manager has insisted upon the use of purchase orders for 100% of all purchases made by the company. The primary

Table 11.12

	April	May	June
Authorized receipt line items	842	1,373	1,458
Total receipt line items	1,639	1,604	1,695
Percent of authorized receipts	51%	86%	89%

method for measuring the success of this initiative is to track the percentage of receipts authorized by purchase orders. The measurement was less than 20% at the beginning of the campaign to use this control and has gradually trended upward since then. The logistics manager has authorized an assistant to track the measurement every month and report when the measure stops improving. The trend line for the past three months is shown in Table 11.12.

The assistant sees that the rate of improvement is declining, with only a 3% month-to-month increase since May. Though only 11% of all receipts are no longer being authorized in advance by purchase orders, the measurement does not reveal the dollar amount of these unauthorized purchases, which may be considerable. Accordingly, the assistant decides to review further the dollar volume of these transactions before bringing them to the attention of the logistics manager.

Cautions: This is an excellent measurement, since the use of purchase orders is one of the best controls over unauthorized buying, and the measurement clearly shows the extent of control problems in this area. However, it does not include other types of purchases that never run through the receiving area, such as services, subscriptions, or recurring lease payments. These other types of costs can constitute the majority of all nonpayroll costs in services industries; consequently, the measurement is most useful in businesses dealing in tangible goods.

FREIGHT AUDIT RECOVERY RATIO

Description: Many auditing firms specialize in comparing the freight bills paid by a company to the standard rate schedules published by their shippers, to find overbilling situations. If they find any, the auditors earn a percentage of the total amount recovered. Given the amount of funds that can be collected by using freight auditors, it behooves the logistics manager to track their achieved recovery ratio to see if they are effective in earning money for the company.

Formula: Divide the total refund received from a company's freight carriers by the total amount of freight billings for the period for which the freight billing audit was conducted. If more than one auditing firm is being used at the same time, then this measure should be calculated separately for each one. Also, the percentage fee received by the freight auditing firm can be deducted from the total refund, to

derive the net recovery rate experienced by the company as a result of the auditors' efforts. The basic formula is:

$$\frac{\text{Total freight billings refund}}{\text{Total freight billings}}$$

Example: The Redfern Ski Company ships its super lightweight plastic skis to a variety of military and rescue organizations throughout the world, which depot them in remote locations for emergency rescue operations. Its per-unit freight bills sometimes exceed the cost of the skis being shipped, so the company regularly brings in freight auditors to ensure that the lowest possible freight charges are being paid. This year, the Robertson Auditing Company is reviewing billings for Redfern. It charges 35% for all refunds collected, which is higher than the 30% charged by last year's auditors, who achieved a 5% freight audit recovery rate, net of their fee. Of the $1,250,000 of freight billings that Robertson reviews, it finds that 8.5% should be refunded to the company. The calculation of its freight audit recovery ratio is:

$$\frac{\text{Total freight billings refund} - \text{Auditor fee}}{\text{Total freight billings}} =$$

$$\frac{(\$1{,}250{,}000 \times 0.085) - (\$1{,}250{,}000 \times 0.085 \times 0.35)}{\$1{,}250{,}000} =$$

5.525% Recovery rate

Since Robertson achieved a higher recovery rate, net of their fee, than the previous year's auditors, Redfern may consider retaining this higher-performing audit firm for the following year.

Cautions: Most organizations do not have a sufficient volume of freight bills to warrant using freight-auditing firms on a year-round basis (if they did, they would be justified in bringing the work in-house). If freight auditors are brought in too frequently, they may end up reviewing freight invoices that were already reviewed during the last audit. Picking over the same invoices in this manner will inevitably result in a decline in the freight audit recovery ratio, which is not the fault of the freight auditors, but rather of the company that scheduled them to begin work too soon.

PICKING ACCURACY FOR ASSEMBLED PRODUCTS

Description: When a company ships disassembled products to customers, it is important that the kits shipped out have exactly the correct number of the right

parts. If the number is too high, then the company will be increasing its materials costs more than necessary. If the number is too low, then the company faces a significant customer relations problem, as well as added costs to locate and ship missing parts to customers. For these reasons, the picking accuracy of assembled products is important for companies that ship kits.

Formula: Conduct an audit of a sample of completed kits, counting as an error every kit where the quantity of parts is incorrect as well as for every kit where the quantity is correct, but the types of parts included are incorrect. Once a kit is considered incorrect for either reason, it cannot be counted as an error again (thereby avoiding double counting). Then divide the total number of errors by the total number of product kits sampled. Finally, subtract the resulting percentage from 100%. The formula is:

$$100\% - \frac{\text{Number of quantity errors} + \text{Number of part errors}}{\text{Total number of product kits sampled}}$$

Example: The Swiss Furniture Company ships disassembled kits of Swiss furniture to customers throughout the world. It has recently received a rash of complaints about missing parts in its stereo cabinet product. To determine the extent of the problem, the company's internal audit team pulls 20 completed cabinet kits from the finished goods storage area and discovers that three units have incorrect parts and five units have too few parts. One of the kits with an incorrect part is also one of the kits with a parts shortfall.

Based on this information, the picking accuracy for the stereo cabinet is derived as:

$$100\% - \frac{5 \text{ Quantity errors} + 3 \text{ Part errors} - 1 \text{ Duplicate error}}{20 \text{ Product kits sampled}} =$$

65% Picking accuracy for assembled products

Cautions: If the company managers think that the key issue is avoiding customer complaints, then they may be justified in not bothering to count a part overage as an error. This is especially common when counting fittings and fasteners, which are usually the least expensive parts of a product kit.

AVERAGE TIME TO SHIP

Description: After a product has been manufactured, it may be assumed that it will be shipped a few moments later. Though this may be the case for shipping departments having minor backlogs or products with simple packaging requirements, it is not at all true for companies with the reverse problems. In particular,

it is quite common for large custom-made products to require one or more days of work before a properly configured shipping container can be built for it. Measuring the average delivery time can determine if this constitutes a significant portion of the time period required to make a product and deliver it to the customer.

Formula: For each shipment in a sample group being reviewed, subtract the actual delivery date from the date when the order was sent to the shipping area. The delivery date can be taken from the shipping log or the bill of lading, while the date of movement to the shipping area can be taken either from production records (if products have just been produced) or from materials-handling records (if they have been taken from finished goods inventory). The formula is:

Delivery date – Date order was sent to shipping area

Example: The Magellanic Company, maker of custom sea-going rowboats for the fishing industry, typically spends several days constructing shipping containers for each of its rowboats. The logistics manager wants to determine whether the standard time of two days is adhered to in all cases; otherwise, a larger handling fee should be charged on certain types of boats. The manager derives the information in Table 11.13 from deliveries made in the past month.

The logistics manager notes that boats longer than 13.5 inches take an extra day to construct; further investigation reveals that this is caused by the standard wooden box frame of 13.5 inches being exceeded, requiring considerable extra time to lengthen. Accordingly, the manager recommends a price increase for all boats over 13.5 inches to account for this packaging problem.

Function: It may not be the fault of the shipping department if the average delivery time is extended because of a credit-related stoppage in shipping. This happens when the collections staff decides that a customer is not paying for existing invoices in a timely manner and requires the shipping staff to stop shipping products to the customer until overdue payments are received. If products related to these customers have already arrived in the shipping department, then they may sit there for weeks before payment is received, thereby increasing the size of the measurement. The problem can be avoided by having the shipping department immediately return these items to the warehouse for storage.

Table 11.13

Order Number	Boat Dimensions (inches)	Average Delivery Time
307	5 × 12	2
318	6 × 15	3
312	6.5 × 15	3
310	5.5 × 14	2
315	6 × 13.5	2

ON-TIME DELIVERY PERCENTAGE

Description: Many customers need to integrate a company's products into their own products, which are scheduled for production on a specific date. This means that a company must ensure that its products arrive at the customer site by a specific date to avoid serious inconvenience to the customer (which may even involve penalties or the outright rejection of the order if the arrival date is missed). In these situations, one of the top performance measures is the on-time delivery percentage.

Formula: For a selected sample of deliveries, subtract the actual order delivery date from the required delivery date, resulting in an average variance for the group. The required delivery date is easily obtained from the customer order, and the actual delivery date can be obtained from either the third-party shipper or the company's own in-house delivery service. The formula is:

Required delivery date – Actual delivery date

Example: The Tic-Tac Dough Company's marketing staff wants to reposition its premier bagel product lines as the freshest in the marketplace by ensuring that only bagels cooked within the past four hours are delivered to its numerous supermarket outlets. Because of this strategy, the on-time delivery percentage becomes its most crucial performance measure. On the previous day, it achieved the delivery results shown in Table 11.14.

Of the five deliveries made, only batch number 146 arrived later than the designated time. This results in an on-time delivery percentage of 80%, which is derived by dividing the four on-time deliveries by the five deliveries sent out.

Cautions: This is an excellent measurement. However, a company can achieve high rankings by simply delivering all products early, which the customer may not want, since these deliveries must be stored in valuable customer warehouse space until needed. Consequently, the measurement can be modified to count a delivery as being on-time only if it arrives within a certain number of days (or hours) of the customer-specified time. A high measurement result can also be achieved by using

Table 11.14

Batch Number	Time Left Bakery	Time Arrived Store	Elapsed Time
143	3:50 AM	7:00 AM	3:10
144	3:55 AM	6:42 AM	2:47
145	4:00 AM	7:15 AM	3:15
146	4:05 AM	8:11 AM	4:06
147	4:10 AM	8:05 AM	3:55

rush delivery services, which are quite expensive. This problem can be spotted by tracking freight costs alongside this measurement.

PERCENTAGE OF PRODUCTS DAMAGED IN TRANSIT

Description: Some types of products are fragile by nature and require special packaging to ensure that they arrive at the customer in good order. If they do not, then a company must deal with unhappy customers, replacement parts, and rush deliveries to replace the damaged items. For these reasons, tracking the percentage of products damaged in transit is an important measurement.

Formula: Divide the number of damage-related customer complaints by the total number of orders shipped. The measure can be separated by freight carrier, since some have more difficulty in moving fragile items than others. Another variation is to measure it by individual customer, since some perceive a product to be damaged and in need of replacement when others would only see minor surface damage on a product that is still usable. The formula is:

$$\frac{\text{Damage-related customer complaints}}{\text{Number of orders shipped}}$$

Example: The Crystal Ball Corporation, maker of various crystal gifts for children, has had a long-term problem with product breakage during transit. It has created the best possible packaging, but the problem persists. It is now focusing its efforts on the delivery companies that transport its shipments. It has combined its bill of lading and customer complaint databases to arrive at the information for the past year shown in Table 11.15.

Based on the product damage calculation in the table, there is a clear problem with DunRight Shippers, which is damaging more than double the amount of orders of any other shipper. If the International Air Freight Company does domestic deliveries, then its 1% damage rate should qualify it to take over much of DunRight's business.

Table 11.15

Freight Company	Number of Complaints	Total Orders Shipped	Percentage Damaged in Transit
ABC Freight	11	549	2%
Danville Shippers	42	1,042	4%
DunRight Shippers	152	1,693	9%
International Air Freight	8	841	1%

Cautions: There can be a time delay between the point when a customer complaint is received and the date when the related product was shipped, so that the time period covering the numerator in the calculation is somewhat earlier than the time period covering the denominator. This can result in an inaccurate measurement if the volume of orders changes significantly from period to period. The problem can be mitigated by using larger time periods for the measurement, such as quarterly instead of monthly.

PERCENTAGE OF SALES THROUGH DISTRIBUTORS

Description: A company may use a number of sales channels to move its products to customers, such as direct retail, direct catalog, distributors, retail chains, and so on. Each channel should be measured to see where the bulk of company business is being generated. The header for this measurement is the percentage of sales through distributors, but it can be easily modified to determine the proportion of sales through any sales channel. This measurement is listed in the logistics chapter instead of the sales chapter because the type of distribution channel has a profound impact on the cost structure of the logistics department's shipping costs. For example, sales to a distributor are generally in bulk, which reduces freight costs, while sales directly to consumers require much higher packaging and delivery costs. Also, customer support is sometimes handled by distributors, whereas direct sales require a company to handle this function itself.

Formula: Divide the total dollars of sales to distributors by the total dollars of sales by the company. This measure can be used for any other sales channel, and can also be separated into sales by different product lines or geographic regions. The formula is:

$$\frac{\text{Total dollars of sales to distributors}}{\text{Total dollars of sales}}$$

Example: The Shenandoah Golf Company manufactures titanium golf clubs. It began by selling through golf course pro shops in the Virginia area and has since used a variety of sales channels to increase its sales throughout North America. Lately, the sales and logistics department costs have become so large that the president decides to review all of the sales channels to see if some can be eliminated, thereby allowing the company to drop those employees who were dedicated to specific sales channels. The president collects the information shown in Table 11.16.

By splitting sales into sales channels and then taking the extra step of determining net margins on each channel, the president can see that the catalog sales channel should be eliminated, given its net losses. Also, sales to retail chains are not resulting in excessively high margins, though they are positive; this may be an area requiring additional review.

Table 11.16

Sales Channel	Sales by Channel	Total Sales	Percent Sales by Channel	Margin After Support Costs
Catalog	$450,000	$15,595,000	3%	–15%
Distributors	$3,800,000	$15,595,000	24%	12%
Pro shops	$6,250,000	$15,595,000	40%	11%
Retail chains	$5,095,000	$15,595,000	33%	6%

Cautions: Though the measurement of sales volume by channel is important, it is even better if the accounting system can be designed to yield gross margins or (better yet) net margins by sales channel. This is usually difficult to achieve and requires some manual revision of the numbers stored in the general ledger. If this is done, a company sometimes finds that the net profits resulting from direct sales to customers are lower than if sales are made through intermediaries, such as distributors, because of the many expenses involved with direct sales. If only the gross margin associated with the various sales channels is incorporated into the calculation, then the reverse conclusion may be reached, since this measure will only show the reduced prices that are typically granted to distributors.

12

Measurements for the Production Department

Production measures are unique in that they involve very few financial inputs. Instead, most of the information from which they are derived is obtained from other sources, such as tracking systems for units of production, machinery utilization time, and scrap tracking. These systems may not be as tightly controlled as financial systems, so the data used for these measurements should be tested to ensure that it is of a sufficient quality to yield accurate information.

The measurements described in this chapter fall into several categories: the utilization of key production constraints, also known as bottleneck operations; overall productivity and effectiveness; asset usage; and overhead expense utilization. The measurements discussed in this chapter include:

- Constraint Productivity
- Constraint Rework Percentage
- Constraint Schedule Attainment
- Constraint Utilization
- Degree of Unbalance
- Throughput Effectiveness
- Break-Even Plant Capacity
- Manufacturing Effectiveness
- Productivity Index
- Unit Output per Direct Labor Hour
- Average Equipment Setup Time
- Unscheduled Machine Downtime Percentage
- Acceptable Product Completion Percentage
- Work-in-Process Turnover
- Scrap Percentage
- Warranty Claims Percentage
- Maintenance Expense to Fixed Assets Ratio
- Indirect Expense Index
- Reorder Point
- On-Time Delivery Ratio

CONSTRAINT PRODUCTIVITY

Description: An efficient management team wants to increase the productivity of its bottleneck operation, since increasing the amount of throughput at this location will enhance the company's overall ability to generate a larger profit. If the efficiency of some other operations were to be enhanced, the bottleneck would still exist, and so overall manufacturing output would not improve.

Formula: Divide the total number of units produced per hour by the number of hours worked at the bottleneck operation. If several different products are being continually run through the bottleneck operation, all requiring different processing times, then the measure should be separately calculated for each product so that productivity can be more precisely determined. The measurement should be tracked on a trend line in order to spot changes in the level of productivity. The formula is:

$$\frac{\text{Number of units produced per hour}}{\text{Number of hours worked}}$$

Example: The Aboriginal Paintwork Company runs all of its hand-thrown ceramic products through a kiln, which is the bottleneck in its single-shift operation. The plant manager wants to see if an ongoing effort to reduce setup, baking, and retrieval times has yielded a greater degree of efficiency at this operation. The manager collects information over a three-month period that includes several company holidays that is shown in Table 12.1.

The table shows that the increased number of work days occurring during the three-month period has created the appearance of greater efficiency at the kiln, even though the actual level of productivity has gradually declined on a per-hour basis throughout the period.

Cautions: This measurement can yield misleading results if the mix of units produced carries a lower profit margin than some other mix that might require the production of fewer units, resulting in a high level of productivity to create a smaller profit than might otherwise be attained. Consequently, this measure should be used in conjunction with a review of the total gross margin being generated by the bottleneck operation.

Table 12.1

	May	June	July
Number of units produced	6,400	6,552	6,688
Number of work days	20	21	22
Number of available hours	160	168	176
Constraint productivity	40/hr	39/hr	38/hr

CONSTRAINT REWORK PERCENTAGE

Description: A bottleneck operation limits the total amount of production work that can be completed by a manufacturing facility, so the volume of work passing through it must be maximized. This objective can be severely impinged upon when production rework must be passed through the bottleneck for refinishing work, since the bottleneck operation must duplicate previously completed work which infringes upon its ability to complete new work that would otherwise have created additional profits. Consequently, the production manager should closely track the amount of rework time at the bottleneck operation.

Formula: Divide the total rework hours used in a constraint operation by the total number of hours available at the constraint. For example, if a constraint operation can be used 24 hours a day, then this should be used in the denominator. The formula is:

$$\frac{\text{Rework hours used in constraint operation}}{\text{Total hours of constraint}}$$

Example: The Premium Woodworking Company runs nearly all of its furniture products through a belt-sanding operation, which is its production bottleneck. A number of sanding problems have been recognized downstream from this operation, necessitating rework that must pass through the belt sander a second time. It is also possible to sand the flaws by hand, though this takes much more labor to complete. The belt-sanding operation runs 24 hours a day, 365 days a year. Should the constraint rework measurement be used in this situation, and if so, how should it be measured?

The measurement should be used, because the bottleneck belt sanding operation is operating at its absolute capacity with no room for rework tasks. If sanding flaws can be corrected by hand, then this option should be pursued instead of using any capacity in the bottleneck for the same task. The measurement should only include any rework that is actually run through the belt-sanding operation, since this reflects the production manager's inability to shift rework away from the bottleneck. For example, if three hours of rework were required for manual sanding and two hours for belt sanding in a 24-hour day, then only the two hours used for belt sanding should be divided by the 24 hours of available capacity to arrive at a constraint rework percentage of 2/24, or 8.3%.

Cautions: Rework that can be shifted to other machines than the bottleneck operation should be excluded from the calculation, but only if it is in fact shifted elsewhere. Also, this measurement is less valid in situations in which companies use their bottleneck operations for less than a 24-hour day, since they can simply schedule some overtime work to handle excess work requirements.

CONSTRAINT SCHEDULE ATTAINMENT

Description: A bottleneck operation is being used most efficiently when the exact amount of production scheduled to pass through it actually does so. If the wrong items or a reduced number of items pass through it, then a company will not realize the maximum amount of profits from its operation. This measurement is used to determine a production manager's efficiency in producing in accordance with the production plan.

Formula: Divide the number of part hours actually produced by the number of part hours scheduled at the constraint operation. This measure can be used for all operations within a manufacturing facility, but the key measurement is on the constraint operation, since shortfalls here will have the largest impact on overall output. If there is rework needed to complete the production schedule, then this should be added to the numerator in the formula. Also, the number of hours of work itemized in the production schedule is based on the standard estimate of hours required; if the work is completed with a variance from the standard, then this variance should be included in the numerator in the formula. The basic formula is:

$$\frac{\text{Part hours produced}}{\text{Part hours scheduled}}$$

Example: The Acme Roadrunner Tire Company produces 20 tires of various sizes. During the current month, its 10 tire lamination machines are scheduled to produce tires for a total of 7,200 hours, which constitutes full production for 24 hours a day for all of the machines. During this time period, the production team completes 6,980 hours of production on regularly scheduled jobs. In addition, because of engineering improvements, they saved 100 hours from the standard production time estimated for completion of the job, due to better monitoring of the tire lamination times. Also, several batches of tires were found to be faulty, resulting in 250 hours of rework. To determine the constraint schedule attainment ratio, the production manager uses the following calculation:

$$\frac{\text{Part hours produced} + \text{Rework hours} - \text{Reduction in actual hours from standard}}{\text{Part hours scheduled}} =$$

$$\frac{\text{6,980 Production hours} + \text{250 Rework hours} - \text{100 Hours variance from standard hours}}{\text{7,200 Parts hours scheduled}} =$$

$$\frac{7{,}130}{7{,}200} =$$

99% Schedule attainment

Cautions: The number of part hours produced may not encompass the parts itemized in the production schedule, so the underlying data should be cross-checked against the production schedule from time to time to ensure that the exact part types and quantities dictated by the schedule are being followed. Also, the resulting measurement may seem to indicate that the production schedule was precisely met, but can still be incorrect if the sequence in which production orders was completed is different from the schedule. For example, if a production job is scheduled to be run and completed on the first day of the month, but is actually run on the last day, then a measurement encompassing the entire month will still indicate that the production schedule was successfully met, even though the customer had to wait much longer than promised to receive the product. To avoid this issue, the constraint schedule attainment measurement should be run for very short time periods so that the timing of jobs within the schedule cannot be shifted while still appearing to meet the schedule.

CONSTRAINT UTILIZATION

Description: If there is no production schedule in place, then there is no need for the preceding constraint schedule attainment measure. Instead, simply measure the amount of usage of the bottleneck operation, irrespective of what types of work are passed through it. This measure does not tell one if the highest-profit goods are being prioritized in the constraint operation, as would be the case if a production schedule were used, so it is a less precise measure.

Formula: Divide the actual hours during which the constraint operation is used by the total number of constraint hours available. The formula is:

$$\frac{\text{Actual hours used in constraint operation}}{\text{Total constraint hours available}}$$

Example: The Medic First Response Corporation assembles first aid kits in an assembly line. The shrink wrapper at the end of the line is the production constraint. This machine runs at approximately one third of the speed of the assembly line, so it must operate on all three shifts in order to keep up with the output from the assembly line. Accordingly, the production manager is quite interested in maintaining the highest degree of shrink wrapper utilization. During the preceding five-day work week, the machine was in operation for 110.5 hours. To determine the constraint utilization, the manager runs the following calculation:

$$\frac{\text{Actual hours used in constraint operation}}{\text{Total constraint hours available}} =$$

$$\frac{\text{110.5 Actual hours of shrink wrapper usage}}{\text{120 Total shrink wrapper hours available}} =$$

92% Constraint utilization

Cautions: As noted in the Description section, this measure can look good as long as any sort of work is constantly being run through the constraint operation. Since this may exclude highly profitable production from being placed first in the work queue, the measure does not relate well to the amount of profits being generated. Consequently, if this measure is used, it should be combined with a summary review of profits being generated by the operation, preferably on a trend line.

DEGREE OF UNBALANCE

Description: The degree of unbalance refers to the amount of productive capacity in a production cell that cannot be utilized because of the presence of a production bottleneck. This measure is used by the industrial engineering staff and production manager to determine which bottleneck operations within cells should be improved or supplemented so that the degree of unbalance is reduced. By doing so, the productive flow within a manufacturing cell becomes much smoother and can achieve a higher rate of output.

Formula: Measure the capacity change between the bottleneck operation and the capacity of the next most restrictive operation within a manufacturing cell. A variation on this approach is to determine the average capacity of all other machines in the work cell and use this amount in the denominator. A ratio close to 100% reveals a minimum degree of imbalance. The formula is:

$$\frac{\text{Maximum Capacity of the Work Cell Bottleneck Operation}}{\text{Maximum Capacity of the Next Most Restrictive Work Cell Operation}}$$

Example: The production manager of the McGraw Rifle Company is concerned about the size of a prospective order from the Army for a new military submachine gun called the P-16. The work center that produces this weapon is composed of a series of lathes, metal shears, and stamping machines. The three lathes in this work center are the capacity constraint, followed by the metal shears, and then the stamping machines. The production manager wants to determine the degree of imbalance within the work center, so that more bottleneck equipment can be ordered, which will increase the work center's capacity to deal with the large incoming military order. The manager accumulates capacity information which is shown in Table 12.2.

Divide the weekly capacity of the lathes, at 875 units, by the weekly capacity of the shears to arrive at a degree of imbalance measurement of 78%. There is a difference of 250 units of productive capacity between the lathes and shears, which is somewhat less than the 292-unit weekly capacity of a single lathe; therefore, the manager must purchase one additional lathe in order to eliminate the imbalance between lathes and shears.

Table 12.2

	Capacity per Week
Lathes	875
Shears	1,125
Stamping machines	2,500

Cautions: The measurement variation that uses the average capacity of all non-bottleneck operations in a work cell as the denominator can result in a misleading measurement. For example, if the industrial engineering staff finds that the degree of unbalance is an excessive 50% by using this measurement, it may find, after doubling the capacity of the bottleneck, that the degree of unbalance has only improved to 60%. The reason is that the averaging technique used to derive the denominator has masked the capacity problem presented by the next most restrictive work station, which is much worse than the average.

The degree of unbalance may not be a very useful number for work cells that rarely reach their maximum levels of production capacity. It is most useful in situations where production equipment is being fully utilized over all three shifts and is having difficulty keeping pace with the level of demand.

THROUGHPUT EFFECTIVENESS

Description: This measure reveals the trade-off between maximizing throughput and other operating expenses. For example, if a production manager is strictly focused on increasing the amount of throughput (revenue less variable expenses) at the constraint operation, the price may be spending inordinate amounts on improving logistics at the constraint operation, improving its setup time, offloading work to other operations, and so on. Comparing throughput to these other operating expenses can help to determine the point at which the ratio can no longer be maximized which implies that additional operating expenses should not be incurred from that point. In essence, this measure allows incremental analyses to be performed of the trade-off between incurring extra operational expenses and improving throughput. If the measure results in a ratio of anything greater than 1:1, then a prospective increase in operating costs that can be tied to an increase in gross margins should be accepted.

Formula: Subtract all variable production expenses from gross revenues, and divide the result by operating production expenses. In the strictest sense, variable production expenses can be construed as only direct materials, with all other production expenses falling into the category of *operating* production expenses. Also, when compiling operating expenses to use in the denominator, be sure to exclude all expenses that have no bearing on the production function, such as sales, general, and administrative expenses. The formula is:

$$\frac{\text{Gross revenue} - \text{Variable expenses}}{\text{Operating production expenses}}$$

Example: A production manager is interested in adding a quality control person to a constraint operation in order to manually review 100% of the materials coming into the machine. The machine becomes clogged by low-quality parts whose dimensions are fractionally incorrect, resulting in one hour of downtime to clear the machine. On average, these clogs occur 1.5 times per day during a 360-day production year. The amount of revenue that could have been produced while these clogs are cleared averages $800 per hour. The average variable cost required for each dollar of revenue is $0.78. The quality control person will cost $32,000 per year, including payroll taxes and related benefits. Using the throughput effectiveness measurement, is it cost-effective to incrementally make this addition to the production operation? The production manager uses the following formula:

$$\frac{\text{Gross revenue} - \text{Variable expenses}}{\text{Operating production expenses}} =$$

$$\frac{(1.5 \text{ Clogs} \times 360 \text{ Days} \times \$800 \text{ Revenue/hour}) - \text{Variable expenses}}{\$32{,}000 \text{ Incremental quality control expense}} =$$

$$\frac{\$432{,}000 \text{ Revenue} - (1.5 \text{ Clogs} \times 360 \text{ Days} \times (\$800 \text{ Revenue} \times 0.78 \text{ Variable cost})}{\$32{,}000 \text{ Incremental quality control expense}} =$$

$$\frac{\$432{,}000 \text{ Revenue} - \$336{,}960 \text{ Variable cost}}{\$32{,}000 \text{ Incremental quality control expense}} =$$

$$3{:}1$$

The ratio of 3:1 indicates that the addition of an inspector to the constraint operation will result in an increase in the gross margin that exceeds the incremental cost by a factor of three. Therefore, the production manager should hire the quality control person.

Cautions: This is an excellent measurement to use, but it requires detailed analysis to ensure that actual cost changes are in line with the amounts used in the measurement so that decisions based on this ratio will result in real incremental improvements in the effectiveness of a company's throughput.

BREAK-EVEN PLANT CAPACITY

Description: The break-even plant capacity measurement reveals the point at which a facility's output exactly equals the expense associated with running it. It is particularly useful when making decisions regarding the replacement of labor-

intensive activities requiring a variable labor rate with automated equipment requiring an additional fixed cost.

Formula: Multiply the current plant utilization level by the total amount of fixed costs currently incurred by the plant. Then divide into the result the net amount of sales minus all variable expenses. There may be varying points of view regarding which costs are listed in the denominator as variable, and which are listed in the numerator as fixed—no matter how the issue is settled, be sure to include *all* costs somewhere in the formula, with no exclusions (except for extraordinary costs). This formula can be used effectively for individual product lines within a facility. The formula is:

$$\frac{\text{Current utilization level} \times \text{Total fixed costs}}{\text{Sales} - \text{Variable expenses}}$$

Example: The Archly Investment Company is considering the purchase of the Sinclair Aircraft Company. A key consideration is the ability of the acquiree to earn money in an expanding private aircraft market. The director of Archly is keenly interested in the break-even plant capacity to see if there is much upside potential, or if the break-even point is so high that the facility would be unable to turn a significant profit even if the market increased considerably. The director finds that the facility is currently operating at 40% capacity, that its sales are $46,500,000, its variable expenses are $20,925,000, and its fixed costs are $15,425,000. The calculation is:

$$\frac{\text{Current utilization level} \times \text{Total fixed costs}}{\text{Sales} - \text{Variable expenses}} =$$

$$\frac{(40\% \text{ Current capacity level}) \times (\$25{,}425{,}000 \text{ Fixed costs})}{(\$46{,}500{,}000 \text{ Sales}) - (\$30{,}925{,}000 \text{ Variable expenses})} =$$

$$\frac{\$10{,}170{,}000}{\$15{,}575{,}000} =$$

65% Plant break-even capacity

Given the 65% plant break-even capacity level, there appears to be room for additional profits if sales increase.

The Archly director would also like to determine the theoretical maximum amount of profits if capacity utilization were to reach 100%. The facility uses 40% of its capacity to generate $46.5 million of sales; by dividing the 40% utilization figure into existing sales level, the director estimates that total sales at a 100% utilization level would be $116,250,000. Also, the existing gross margin is 33% (based on sales of $46.5 million, less variable costs of $30.925 million, divided by sales). These figures allow the director to estimate total theoretical profits as shown in Table 12.3.

Table 12.3

	Income Statement	Calculation
Revenue	$116,250,000	$46,500,000 existing sales/ 40% current capacity utilization
Gross margin percentage	33%	($46,500,000 existing sales – $30,925,000 existing variable expenses)/existing sales
Gross margin dollars	$38,362,500	Calculated
Fixed expenses	$25,425,000	Existing level of fixed expenses
Profits	$12,937,500	Gross margin—fixed expenses

Although a large amount of profits appears to be possible if sales increase, the director understands that production costs tend to rise exponentially as production capacity approaches 100% utilization, because of excessive machine usage and consequent equipment breakdowns, overtime costs, and logistics difficulties.

Cautions: The current utilization level may vary considerably from the long-run rate of utilization, so one may wish to run the calculation based on both short-term and long-term capacity utilization levels to obtain a better perspective on the full range of possible break-even points. It is important to ensure that *all* plant costs are included in either the variable cost or fixed cost elements of the equation, since the breakeven point will otherwise be lower than the real level required to cover all costs. However, there should be no allocated corporate costs in the calculation, since these costs are not directly related to the facility.

MANUFACTURING EFFECTIVENESS

Description: Even if the utilization level at a constraint operation is quite high, this does not necessarily mean that the hours being used at the operation are being effectively translated into more shipments to customers. For example, the hours used might be for rework, for production that is later scrapped, or for testing or setup. If a significant proportion of the production hours used at a constraint operation are used in these activities, then the number of throughput hours used to create products that are actually shipped to customers will be reduced, resulting in lower profits. The manufacturing effectiveness measurement is intended to reveal the proportion of constraint hours consumed that eventually result in shipments to customers.

Formula: Divide the total throughput hours shipped in the reporting period by the total number of constraint hours consumed. The formula is:

$$\frac{\text{Throughput hours shipped}}{\text{Constraint hours consumed}}$$

Example: The production manager of a kayak manufacturing plant is concerned about the manufacturing effectiveness of the facility's constraint operation, which is a blow-molding machine that creates the kayak shells. The operation runs during all three shifts, seven days a week, so there is no way to increase its total output without purchasing an additional blow molding machine. However, the manager suspects that some of the output of this equipment is not being shipped to customers. The manager compiles the following information:

Total hours of constraint usage/week	168 Hours
Hours used for production run setups	38 Hours
Hours used on shells that are scrapped	12 Hours

Based on this information, the manager finds that manufacturing effectiveness of the operation is only 70%, which is derived as:

$$\frac{\text{168 Total throughput hours} - \text{38 Setup hours} - \text{12 Scrap hours}}{\text{168 Total constraint hours consumed}} =$$

$$\frac{\text{118 Throughput hours shipped}}{\text{168 Constraint hours consumed}} =$$

70% Manufacturing effectiveness

To increase the manufacturing effectiveness of the blow-molding operation, the director hires the most experienced setup engineers available, hoping to reduce the amount of setup hours required to switch over to new production jobs.

Cautions: There can be a significant time lag between the shipment of products to customers and the point at which constraint hours were consumed, especially if the constraint operation is early in the production process and many days are required before shipment occurs. If so, the measurement of constraint hours consumed will fall into one reporting period, while the measurement of throughput hours shipped may fall into another, making it difficult to compile the information needed for the measurement. To avoid this problem, manually measure the types of throughput hours consumed at the constraint operation, though this can be subject to error (especially if the person tracking the information is also the subject of the resulting measurement).

PRODUCTIVITY INDEX

Description: The productivity index can be used to measure a variety of activities within a production operation that lead to changes in the volume of units manufactured. For example, if the total amount of maintenance hours spent on a work cell is increased, there may be a resulting increase in the total number of

units of production from that cell, since it is assumed that the increased maintenance efforts will result in more functional equipment. Similarly, if more direct labor dollars are spent in an assembly line, there should be a corresponding increase in the volume of units produced. The productivity index is used to measure the incremental change in output that results from these changes in productive inputs.

Formula: Divide the total change in output quantities by the total change in input quantities. This formula is structured in a deliberately vague manner so that it can be used for a number of applications. For example, the change in scrapped units can be compared to a change in additional hours spent on training machine operators. Alternatively, the change in production line output can be compared to a change in the number of production line personnel added to the production process. The formula is:

$$\frac{\text{Total change in output quantities}}{\text{Total change in input quantities}}$$

Example: A punch press operation is producing an excessive quantity of scrap, due to poorly positioning parts on the presses. The production manager chooses to provide extensive additional training to the press operators in hopes that this will cure the problem. As a result of spending 312 hours of both operator and trainer time, the scrap rate drops from 15% to 8%. The production manager would like to create a productivity index to measure this change, but thinks that a comparison of the existing numbers would be a comparison of "apples to oranges." Accordingly, the manager converts the inputs and outputs into dollars. The 312 hours of staff time spent on training was at an hourly cost of $19.50, which is a total input of $6,084. The manager multiples the incremental improvement in the scrap rate of 7% by the direct material cost per unit of $4.25 and by the monthly unit production volume of 10,000 units, which results in an incremental change in output of $2,975. This results in a productivity index of $2,975/$6,084, or 49% in just one production period. When the comparison is extended over several periods, the ongoing improvement in scrap levels will yield a very high productivity index.

Cautions: When using this measurement, be careful to isolate the change in input, so that it can be clearly identified as a cause of the change in output. For example, if five separate changes are made to the production process, it is impossible to determine what proportion of the resulting change in production outputs was caused by each one. Instead, to make this measure work properly, one change should be made at a time, so that it can be more precisely related to changes in the units of output.

It is also possible that there is no direct causal relationship between an input and an output, in which case the comparison should not be made at all.

UNIT OUTPUT PER DIRECT LABOR HOUR

Description: This measurement is most useful in those increasingly rare situations where the primary form of value added to a product is direct labor. In most situations, direct labor composes only a small proportion of the value added, so there is only a poor causal relationship between the amount of unit output and the number of direct labor hours worked. However, where the proportion of hours worked is high, this measure can have some value.

Formula: Add together the total number of units completed during the production period and the total number of unit equivalents, less the total number of unit equivalents recorded at the end of the preceding reporting period. Then divide the result by the total number of direct labor hours in the reporting period. A *unit equivalent* is defined as that completed proportion of an incomplete unit of production on which work has been finished. For example, if a product is 40% complete, then it is 0.40 unit equivalents. If another product were 20% complete, then it would be 0.20 unit equivalents. When combined, the two units would be 0.60 unit equivalents. The formula is:

$$\frac{\text{Total units completed} + \text{Total unit equivalents} - \text{Total carryforward unit equivalents}}{\text{Total number of direct labor hours}}$$

Example: There are three major jobs running through the production shop of the Overhead Hoist Company. At the end of the preceding period, Job A was 30% complete, Job B was 49% complete, and Job C was 83% complete. When combined, this amounted to a unit equivalent of 1.62 units of production (30% + 49% + 83%). At the end of the current reporting period, Job C was completed and shipped. Job A was 85% complete, Job C was 98% complete, and Job D was 32% complete. The number of direct labor hours worked in the shop in the current period was 2,418. The calculation of unit output per direct labor hour is:

$$\frac{\text{Total units completed} + \text{Total unit equivalents} - \text{Total carryforward unit equivalents}}{\text{Total number of direct labor hours}} =$$

$$\frac{\text{1 Unit completed} + (.85 + .98 + .32)\text{ Equivalent units} - (\text{1.62 Carryforward units})}{\text{2,418 Direct labor hours}} =$$

$$\frac{\text{1 Unit completed} + \text{2.15 Equivalent units} - \text{1.62 Carryforward units}}{\text{2,418 Direct labor hours}} =$$

$$\frac{\text{1.53 Equivalent units}}{\text{2,418 Direct labor hours}} =$$

.00063 Units per direct labor hour

Cautions: When compiling data for this measurement, be careful about the method used to derive equivalent units. If handled in a nonquantitative manner, the number of unit equivalents can be severely skewed. A good approach is to determine the number of actual hours already spent on a product, per the job tracking system, and compare this to the standard number of hours recorded on the labor routing to determine the percentage of completion. For example, if a product requires a standard amount of 17 hours of labor, and 12 hours of actual work have thus far been completed, then it can be assumed to be 70% (12 actual hours divided by 17 standard hours) complete. However, verify the accuracy of the standard hours listed in the labor routings to ensure their accuracy. It may also be necessary to set up controls over who is charging time to jobs so that actual hours charged are not improperly charged.

AVERAGE EQUIPMENT SETUP TIME

Description: This measurement is useful in situations where equipment is being run at maximum capacity, so it is critical to have the smallest possible amount of equipment down time between production runs. It is also useful in just-in-time production environments, where equipment setups occur frequently and can take up a large part of the time in a production process.

Formula: Subtract the stop time for the preceding production run from the start time for the next production run. This approach works best where an automated machine usage tracking system has been installed. However, it assumes that there are jobs continually following each other that require continual shifts to new jobs, with no downtime in between. The measure will not work if there are no jobs immediately preceding an equipment setup, since there will be no start time. If this is the case, the start and stop times can be manually tracked, though this tends to be inaccurate (especially when the person doing the time tracking is also responsible for the setup). The formula is:

Start time for new production run – Stop time for last production run

Example: A transmission assembly plant builds three types of transmissions, each involving very long production runs that can last for a quarter of a year. Because a considerable degree of retooling is required to switch machinery over to a different transmission, the equipment setup time can take over a week to complete. The factory is making no money during this interval, so the equipment setup procedures are of great concern to management—anything to shorten the setup time

will save them money. They use videotaped practice setups to determine what steps can be eliminated or shortened, finding that half of the setup time can be eliminated simply through the prepositioning of parts, using different types of lockdown bolts, and requiring the setup staffs to use a formal setup checklist. As a result, the total setup interval drops from seven days to three days. During the four days of saved setup time, the factory is able to produce an additional 582 transmissions, each with a gross profit of $225 dollars. The management team finds that its setup reduction efforts have resulted in an increase in profits of $130,950 (582 transmissions × $225 gross profit).

Cautions: When this measure is being reported manually by equipment setup teams, they will have an incentive to report a short setup time if they have any sort of performance incentive to keep setups short. In such cases, their efforts should be spot-checked by an independent observer from time to time. A much better approach is to use an automated machine usage tracking system that automatically sends information to a central location; however, these systems are expensive.

UNSCHEDULED MACHINE DOWNTIME PERCENTAGE

Description: A well-organized factory has a schedule of planned maintenance for all of its key equipment, around which the production schedule is organized. When equipment fails outside of this schedule, the production planning staff must quickly reorganize the production schedule around the capacity of whatever equipment is no longer available for use. This can wreak havoc with a factory's productive capacity in the short term, with particular problems arising for the promised delivery dates of products that must be processed on the equipment that has failed. The unscheduled machine downtime percentage is most useful for tracking a company's ability to minimize this problem.

Formula: Divide the total minutes of unscheduled machine downtime by the total minutes of machine time. This calculation can be summarized for all machines or individually for each one. Another approach is to calculate the measurement only for the equipment that represents a production bottleneck, since this has the greatest impact on a company's production capabilities. The formula is:

$$\frac{\text{Total minutes of unscheduled downtime}}{\text{Total minutes of machine time}}$$

A variation on the ratio is to divide the total minutes of unscheduled downtime by the total minutes of *scheduled* downtime; this measurement gives a better idea of the maintenance staff's ability to spot upcoming equipment problems and properly schedule them for repair in concert with the production schedule, rather than spending all of its time repairing equipment on a rush basis. The ideal measurement should be as close to zero as possible. The formula is:

Table 12.4

	Press No. 1	Press No. 2	Press No. 3
Hours of unscheduled downtime	29	14	101
Total hours of machine time	720	720	720
Unscheduled machine downtime percentage	4%	2%	14%

$$\frac{\text{Total minutes of unscheduled downtime}}{\text{Total minutes of scheduled downtime}}$$

Example: The Ajax Machining Company produces a number of lawn shear models, all of which must be completed by April in order to be in stores for the crucial summer selling season. It had difficulty meeting this target the previous year because of a number of unscheduled machine maintenance problems that delayed the production process. The production manager wishes to avoid this problem in the upcoming production season and chooses to use the unscheduled machine downtime percentage to track the progress in fixing the problem. The manager compiles the information in Table 12.4 for the last month for a set of presses that have had persistent maintenance problems.

The table shows that Press Number 3 is causing the most unscheduled maintenance downtime. Further investigation reveals that it has a continual history of maintenance problems and is also the oldest press owned by the company. Accordingly, the manager schedules the press for replacement.

Cautions: Calculation of this measurement requires access to machine time-tracking equipment that is directly linked to the equipment to monitor ongoing processing; this equipment is quite expensive. The alternative is manual record keeping of machine time, which tends to be inaccurate through lack of operator attention.

ACCEPTABLE PRODUCT COMPLETION PERCENTAGE

Description: In an ideal situation, 100% of all products produced are acceptable to customers and can be shipped to them. In reality, some units will be flawed for a variety of reasons and must be scrapped or reworked. If the number is significant, then a company is wasting a large amount of direct materials and processing time. The acceptable product completion percentage can be used to give management an idea of the extent of this problem.

Formula: Subtract the number of products in a production run by the number of rejected products, and divide the result by the number of products in a production

run. An alternative is to use the same formula for a production time period, such as a month; this is more useful when a company has extremely long production runs that may cross several reporting periods and needs rejection feedback information sooner than the end of the runs. The formula is:

$$\frac{\text{(Number of products in production run)} - \text{(Number of rejected products)}}{\text{Number of products in production run}}$$

Example: The Ultra Hose Clamp Company manufactures several sizes of hose clamp. The basic product requires three manufacturing steps, which are slot punching, band slicing, and clamp insertion. The production manager wishes to determine the acceptable production completion percentage for all hose clamps manufactured in June, not only in total but also for each manufacturing step. The manager compiles the information in Table 12.5.

In the table, the total production quantity for each step in the process continually declines, because a quantity of product has been rejected at each step in the production process. For example, the initial production quantity was 42,500 units, but 429 units were rejected during the initial slot-punching process, thereby leaving only 42,071 units to be run through the band-slicing process. The total calculation on the right side of the table uses the *initial* total production quantity as the denominator, since that calculation is concerned with the number of rejections arising from the *entire* production process, which assumes the use of the initial production run quantity. Based on the information in the table, it appears that management attention should focus on the clamp insertion process, where the bulk of all rejections are arising.

Cautions: The key issue with this measurement is how to determine if a product is rejected. At its most strictly defined level, it can be interpreted as only those products that have gone through the entire production process and then been rejected. However, there may be a number of points earlier in the process where rejections can also occur; the sum total of these earlier rejections should also be included in the measurement. In addition, unacceptable products may escape detection by the quality control system and be shipped to customers, who then return them for refunds or warranty claims. These later rejections should also be included in the total rejection rate.

Table 12.5

	Slot Punching	Band Slicing	Clamp Insertion	Total
Reject quantity	429	114	1,843	2,386
Total production quantity	42,500	42,071	41,957	42,500
Acceptable product completion percentage	99.0%	99.7%	95.6%	94.4%

WORK-IN-PROCESS TURNOVER

Description: The only part of inventory that is under the direct control of the production manager is work-in-process. Measuring its turnover can give one a reasonable idea of the efficiency of the production operation in maintaining high production levels with minimal inventory stockpiles between the production operations.

Formula: Divide the annual cost of goods sold into the total amount of work-in-process currently on hand. If a large ramp-up in sales (and therefore the cost of goods sold) is budgeted for later in the year, it may be better to derive the annual cost of goods sold figure used in the denominator by using the last twelve months of cost of goods sold; by doing so, possibly unlikely budget data can be replaced with actual data. The formula is:

$$\frac{\text{Annual cost of goods sold}}{\text{Total work-in-process}}$$

Example: The Flyaway Bike Company has recently installed a manufacturing resources planning (MRP II) system with advanced shop floor reporting and production scheduling capabilities. It should result in much better control over the production process, and reduce the amount of work-in-process inventory needed. The production manager wants to affirm that the company is receiving the full benefit of this system by measuring the work-in-process turnover. He collects the information in Table 12.6 for a four-month period; the MRP II system was installed mid-way through the measured period.

The turnover trend line in the table confirms that the MRP II system appears to be gradually increasing the work-in-process turnover rate. The production manager decides to continue monitoring this measure over time since there appears to be a declining trend line that may continue into the future.

Cautions: The exact amount of work-in-process currently in use can be an extremely difficult number to determine. If a company uses a manual system for tracking all of its inventory transfers in and out of production, then the amount of effort needed to compile this information will probably not be worth the effort. A

Table 12.6

	April	May	June	July
Work-in-process inventory	185,000	190,000	182,000	170,000
Annual cost of goods sold	$1,450,000	$1,450,000	$1,450,000	$1,450,000
Work-in-process turnover	7.8	7.6	8.0	8.5

better approach is to use a manufacturing resources planning (MRP II) computer system to track work-in-process, resulting in a simple automated report to obtain the required information.

Also, this measure is not useful in a just-in-time (JIT) production environment, since there should theoretically be so little work-in-process inventory that the measure would be meaningless. Also, JIT systems are designed for minimal reporting systems in the production process, so it is unlikely that the needed information would be available.

SCRAP PERCENTAGE

Description: The amount of scrap generated by a production operation is of great concern to the production manager, for it can be indicative of a number of problems—poor training of the direct labor work force, improper machine setup, materials handling problems, or even the ordering of substandard raw materials. Another reason for keeping a close watch over the scrap percentage is that inordinate amounts of scrap may require extensive revisions to the production schedule in order to produce extra goods, which in turn will require short-term changes to the purchasing schedule in order to bring in the required raw materials. For these reasons, the scrap percentage is one of the most closely watched performance measurements in the factory.

Formula: The amount of scrap that a company produces is difficult to measure because it can be produced in many parts of a facility, and in many cases it is not accumulated for measurement purposes. If this is the case, the best approach is to subtract the standard cost of goods sold from the actual cost of goods sold, and divide the result by the standard cost of goods sold. By using this approach, the aggregate cost of what was produced can be compared to what should have been produced, without having to resort to a detailed count of each item scrapped. The formula is:

$$\frac{\text{Actual cost of goods sold} - \text{Standard cost of goods sold}}{\text{Standard cost of goods sold}}$$

A variation on this formula is to track only the scrap generated by the bottleneck production operation. This is especially important because the scrap lost through this operation must be manufactured again, which may interfere with the production of other goods that must pass through the same operation, thereby possibly reducing the total amount of gross margin generated by the factory.

Example: The production manager of the Pelican Lawn Products Company wants to calculate the scrap percentage of his manufacturing facility, and therefore accumulates the following information:

Actual direct labor	$145,000
Actual direct materials	580,000
Actual overhead	870,000
Standard direct labor	142,000
Standard direct materials	542,000
Standard overhead	745,000
Standard scrap	12,000

The production manager wants to exclude overhead costs from the calculation in order to concentrate on just those costs most directly related to scrap. There is some standard scrap built into the standard direct materials costs; the production manager wants to determine the total amount of scrap being produced, so this item is eliminated from the standard cost of goods sold. The resulting calculation is:

$$\frac{\text{(Actual direct labor + Actual direct material) – (Standard direct labor + Standard direct materials – Standard scrap)}}{\text{(Standard direct labor + Standard direct materials – Standard scrap)}} =$$

$$\frac{(\$145{,}000 + \$580{,}000) - (\$142{,}000 + \$542{,}000 - \$12{,}000)}{(\$142{,}000 + \$542{,}000 - \$12{,}000)} =$$

$$\frac{\$745{,}000 - \$672{,}000}{\$672{,}000} =$$

10.8% Scrap percentage

Cautions: There are several problems with comparing the actual cost of goods sold to the standard amount and assuming that the difference is scrap. One problem is that there may be a standard scrap value already included in the bills of material that comprise the standard cost of goods sold, so these values must be extracted from the standard in order to determine the actual amount of scrap. A third problem is that there may be other variances contained within the actual cost of goods sold, such as a price variance on raw materials purchased. These variances must be calculated and removed from the actual cost of goods sold before the amount of scrap can be determined. Another problem is that many of the costs that make up the cost of goods sold are related to overhead, rather than the direct cost associated with scrap. To avoid this problem, include in the cost of goods sold only the direct labor and direct materials costs associated with production, removing all overhead costs. Finally, the inherent assumption in this formula is that standard costs are reasonably accurate; if not, the resulting scrap calculation will be incorrect.

WARRANTY CLAIMS PERCENTAGE

Description: Warranty claims can be caused by a poor product design, the use of raw materials having inadequate specifications, or improper production. Therefore it can be used to rate the performance of the engineering, logistics, and production departments. When warranty claims are high, this becomes a valuable tool for judging the quality of a company's products.

Formula: Divide the total number of warranty claims received by the total number of products sold. Since there may be a significant time lag between the date when a warranty claim is received and the date of production, it is best to accumulate this information over a number of months on a rolling basis, so that there is a reasonable basis of comparison between the two numbers. The formula is:

$$\frac{\text{Total number of warranty claims received}}{\text{Total number of products sold}}$$

Example: The production manager of the Lullaby Swing Company is trying to determine the warranty claims percentage for its Baby Care Swing product. The company manufactured this product through the six months leading up to the summer selling season, after which it stopped production and does not plan to begin again until the end of the year. A rash of warranty claims were filed toward the end of the summer that appear to be caused by a structural defect in the swing joint that causes collapse after heavy usage. The total number of units produced was 183,000, and the number of claims filed thus far is 1,897. The calculation is:

$$\frac{\text{Total number of warranty claims received}}{\text{Total number of products sold}} =$$

$$\frac{\text{1,897 Warranty claims filed}}{\text{183,000 Units produced}} =$$

1% Warranty claims percentage

This is a common situation involving the calculation of warranty claims as a measurement and is deserving of continued review over several years to see if problems continue to arise with this product. The production manager should consider marking the product differently in each successive year so that returned products can be easily associated with a specific production year.

Cautions: As noted in the Description section for this measurement, warranty problems can be caused by the production, engineering, and logistics departments, so using this measure to judge the performance of just the production department may be ignoring the true problem-causing departments. Also, when a company

sells its products through intermediaries, such as large retail chains or distributors, these entities may sometimes use the warranty claims process as an excuse for returning unsold products that have no defects at all. For both of these reasons, incoming warranty items should be carefully reviewed to determine the true cause of problems, before calculating the warranty claims percentage.

MAINTENANCE EXPENSE TO FIXED ASSETS RATIO

Description: The ability of the production function to operate at its maximum levels of productivity are strongly influenced by the amount of investment that a company is willing to make in the ongoing repair and maintenance of its fixed assets, most of which tend to be concentrated in the production area. Accordingly, a high ratio of maintenance expense to fixed assets, especially on an increasing trend line or in relation to the industry average, is evidence of this commitment.

Formula: Divide the total amount of maintenance and repair expense by the total gross amount of fixed assets. It would be useful to more precisely determine the amount of repairs and maintenance that are devoted just to the production function, but this is not normally broken out in the chart of accounts; the total amount of production equipment is typically listed separately in the general ledger, so the denominator could be restricted to just the amount of fixed assets related to production. The formula is:

$$\frac{\text{Maintenance and repair expense}}{\text{Total gross fixed assets}}$$

Example: A production manager wishes to determine that portion of the maintenance expense to fixed assets ratio that pertains just to his department. Here is the relevant information from the accounting department:

Building maintenance expense	$98,000
Production maintenance expense	$312,000
Engineering maintenance expense	$14,000
Other maintenance expense	$29,000
Furniture & fixtures assets	$201,000
Land assets	$300,000
Hardware & software assets	$193,000
Machinery assets	$2,087,000

Of the listed expenses, the production manager is responsible for the building and the production department but only wants to measure maintenance activity in the production area, consequently, the production manager uses only the produc-

tion maintenance expense in the numerator of the calculation. Of the assets, all the machinery assets are assumed to belong in the production department. The resulting ratio is:

$$\frac{\text{Maintenance and repair expense}}{\text{Total gross fixed assets}} =$$

$$\frac{\$312,000}{\$2,087,000} =$$

15% Maintenance expense to fixed assets ratio

Cautions: This can be a misleading measurement if not also used in conjunction with some measure of fixed asset replacement, because the amount of maintenance and repair costs will also be high if the underlying base of fixed assets has not been replaced on a regular basis. If there is no information available about fixed asset replacement, then an alternative approach is to split the amount of maintenance and repair expenses into its labor and materials components. A high components portion (especially if it is increasing on a trend line) is a reasonable indication of equipment failures on old equipment that require significant replacement work.

Another issue is that some repairs are of a singular nature and will not recur for some time. For example, a roof replacement may only be required once every decade. If there are sudden spikes in the trend line of maintenance and expense repairs, they may be indicators of these unusual items, which can then be excluded from the ratio.

INDIRECT EXPENSE INDEX

Description: In companies that have established a steady market share and have predictable and repeatable expenses (as is found in mature markets), the indirect expense index is a useful tool for spotting changes in indirect expenses as they relate to the overall level of production. In established markets, there is usually a consistent relationship between the amount of indirect expenses incurred and the volume of production. When there is a change in this relationship, the indirect expense index can be used to bring it to the attention of management.

Formula: Divide the total of all indirect production expenses in period two by the number of units produced in the same period. Then divide the total of all indirect production expenses in period one by the number of units produced in the same period, and divide this into the calculation for period two. By comparing the results for two consecutive periods, it can be easily seen if the relationship between indirect expenses and units of production is rising or falling; any number greater than one represents an increase in per-unit indirect costs over the prior period. The formula is:

Table 12.7

	September	October	November
Total indirect expenses	$157,000	$153,000	$150,000
Total units produced	2,250,000	2,100,000	2,025,000
Ratio of indirect expenses to units produced	$.070/unit	$.073/unit	$.074/unit
Indirect expense ratio	—	1.04	1.01

$$\frac{\text{Indirect production cost in period two/units produced in period two}}{\text{Indirect production cost in period one/units produced in period one}}$$

Example: The new production manager of InCase Manufacturing, which manufactures injection-molded CD cases, needs to find out what areas to review following the firing of the previous manager for not controlling spiraling costs. The relevant production and unit information for the last three months is shown in Table 12.7.

The indirect expense ratio reveals at least part of the problem; the former production manager had not reduced indirect expenses in proportion to the drop in production units manufactured, resulting in a gradual increase in the amount of indirect expenses to units produced.

Cautions: Many indirect expenses, such as production supervisor salaries, do not vary from period to period, whereas production volumes can vary considerably—especially in seasonal selling situations. For example, a manufacturer of Christmas ornaments may experience extremely high production volumes in the months preceding Christmas, but nothing directly thereafter. In these cases, the periods being compared in the indirect expense index should be the latest month and the same month in the previous year, which should presumably have experienced the same ratio of indirect expenses to units of production.

REORDER POINT

Description: The reorder point can be used as a valid measurement by the production or logistics department. It shows the point at which an order for more parts should be placed, assuming that some reserve of parts is kept on hand as a safety stock.

Formula: Multiply the average usage per time period by the ordering lead time, and then add a predetermined amount for safety stock. The formula is:

$$(\text{Average usage per time period} \times \text{Lead time}) + \text{Safety stock}$$

Table 12.8

Month	Kick Plate Usage
January	1,258
February	542
March	1,602
April	770
May	894
June	1,195
Average usage	1,044

Example: The Open Sesame Door Company purchases large quantities of door kick plates from a brass supplier. The production manager's performance rating has suffered from the lack of this item in the past, since running out of it has brought production to a complete halt. The production manager needs a reorder point that ensures that the company never runs out of kick plates again. The relevant information for the last six months of production is shown in Table 12.8.

If the production manager simply orders the average amount of usage of 1,044 kick plates in each month, then there would not have been enough of them on hand to meet production requirements in January, March, and June. To avoid this problem, the manager must add safety stock to the average usage figure. To ensure that production needs are met, a safety stock figure must be added that is the difference between the average usage and the maximum usage. In this case, the maximum usage was in March, when 1,602 kick plates were needed. The difference between the maximum of 1,602 and the average usage of 1,044 is 558, which becomes the safety stock. Thus far, it appears that the safety stock should be 1,602 units, which is also the maximum amount of usage that can be expected during the year.

However, the production manager does not wish to invest so heavily in raw materials. The average lead time for purchases of kick plates is five business days, or one-quarter of a month. With this information, the manager realizes that orders can be placed four times a month, thereby reducing the amount of kick plates kept on hand; also, she only needs one quarter of the safety stock. Accordingly, the manager modifies the calculation for the short lead time in the following manner:

$$\frac{\text{(Average usage per time period} \times \text{Lead time)} + \text{Safety stock}}{\text{(1,044 Units of average usage} \times \text{¼ Month lead time)} + \text{(558 Units of safety stock} \times \text{¼ Month lead time)}} =$$

$$(1{,}044 \times ¼) + (558 \times ¼) = (261 + 140) =$$

401 Unit reorder point

Cautions: This measurement is based solely on the concept of purchasing with historical usage information. The concept is fine as long as the amount of product manufactured is always the same. However, it will jeopardize the production

process if there is a sudden surge in the volume of required production, since this will overwhelm the amount of inventory left on hand as safety stock and will then bring production to a halt for lack of materials. To avoid this problem, use a more precise order planning system, such as a manufacturing resources planning (MRP II) system.

Another issue is that the reorder point is based on the assumption of continuing usage of a part but does not account for the termination of a part. For example, the engineering staff may be planning to replace a part with a different, less expensive item. Unless someone manually eliminates the reorder point calculation for this part, the system will recommend placing an order that will keep the company fully stocked with the part, even though it is no longer needed. Again, a fully functional MRP II system will eliminate this problem by accounting for the planned obsolescence of parts.

Yet another problem is that the lead time may vary based on the supplier used as well as the time of year (since suppliers may suffer from surges in orders at high-volume times of the year). Consequently, the reorder point cannot be used blindly, but rather in concert with an ongoing effort to verify lead times with suppliers.

ON-TIME DELIVERY RATIO

Description: Though on-time delivery can be considered a logistics function, a product cannot be delivered until the production department has manufactured it. Consequently, this is a reasonable measurement to use for the production department. This is a key determinant of customer satisfaction and should be used by any company that ships products to customers. Those that provide services will probably not need it.

Formula: Divide the number of orders shipped on or before the customers' required due dates by the total number of orders shipped. A less restrictive measure is to use the *adjusted* customer-required due dates; these are typically dates that the company has persuaded customers to adopt, given the company's availability of materials and productive capacity. A more restrictive variation is to use as a customer due date the date of delivery that will ensure the customer receives the product by its mandated due date. The basic formula is:

$$\frac{\text{Number of orders shipped by due date}}{\text{Total number of orders shipped}}$$

A variation on the measurement is to divide the dollar value of orders shipped on or before the customers' due date by the total dollar value of orders shipped. However, this measure can be strongly skewed by the presence of a few large orders, so that a company appears to have an excellent on-time delivery ratio, despite shipping many smaller orders late. The formula is:

$$\frac{\text{Dollar value of orders shipped by due date}}{\text{Total dollar value of orders shipped}}$$

Example: The entire production staff of the Del Ray Scuba Company is paid a bonus when it achieves an 85% on-time delivery ratio at the end of each month. This manufacturer of aluminum and steel dive tanks ships tanks to dive shops all over the world, which can involve long shipping times. The on-time delivery ratio calculation subtracts the transit time from the required customer due date in order to determine the date by which orders must be shipped. In May, the production department recorded the performance shown in Table 12.9.

According to the table, the production department missed a delivery date for a shipment to Undersea Adventures in Palau. This order required a long eight-day delivery time, due to the customer's location in the western Pacific Ocean. Consequently, five of the six orders were shipped on time, which is an on-time delivery percentage of 83%. The production department will not be paid a bonus for its May deliveries.

Cautions: This measure is commonly used as a key measure of performance, and so can be a determinant of bonuses paid to the production and logistics staffs. For this reason, there is a high probability that the underlying customer order information will be altered to ensure that an acceptable ratio is achieved. This can be done by accessing customer order records and altering the due date. This problem can be avoided by restricting access to the order date with password protection. Also, if the measurement is set up to record a shipment date that is a few days before the actual customer due date (in order to account for transit time), the production staff may take a liberal view of the amount of transit time required. For example, to give itself more time to manufacture a product, the production staff may assume that a shipment will only require one day to reach the customer, even though it is located thousands of miles away. To avoid this problem, there should be a standard policy dictating the number of assumed transit days for different distances at which customers are located from the production facility, and which are used to determine the required shipment date. This issue can also give rise to the use of expensive overnight delivery services in order to shrink the transit time and get products to customers by their required due dates.

Table 12.9

Customer Name	Location	Required Due Date	Transit Time	Net Ship Date	Actual Ship Date
Coral Divers	Belize	5/14/03	4	5/10/03	5/08/03
Palancar Drift Dives	Cozumel	5/18/03	4	5/14/03	5/12/03
Nemo & Sons	Red Sea	5/23/03	6	5/17/03	5/17/03
Stingray City Tours	Saba	5/25/03	4	5/21/03	5/19/03
Undersea Adventures	Palau	5/29/03	8	5/21/03	5/22/03
Battleship Scuba Shop	Truk	5/31/03	8	5/23/03	5/24/03

13

Measurements for the Sales and Marketing Department

The sales function is the engine that supplies the rest of a company with enough revenue to create profitability and positive cash flow. Since it is so crucial to overall operations and financial viability, its performance should be tracked with several types of ratios and formulas. The measures selected should address not only the sales effectiveness of individual sales staff, but also sales trends by product line, overall market share, and the ability of the company to retain existing customers. The measurements presented in this chapter are

- Market Share
- Customer Turnover
- Browse to Buy Conversion Ratio
- Recency
- Direct Mail Effectiveness Ratio
- Inbound Telemarketing Retention Ratio
- Quote to Close Ratio
- Sales per Salesperson
- Sales Productivity
- Sales Effectiveness
- Sales Trend Percentage by Product Line
- Product Demand Elasticity
- Days of Backlog

MARKET SHARE

Description: Company managers may think that the company's sales volume is rising, and yet it may not be keeping pace with the overall sales increases within the market. This is a common occurrence in cases where market size is rapidly changing. Consequently, a periodic measurement of market share yields an approximate view of a company's sales performance in relation to the market as a whole.

Table 13.1

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Company sales	$35,000,000	$40,000,000	$45,000,000	$50,000,000
Market size	$292,000,000	$364,000,000	$450,000,000	$556,000,000
Market share	12%	11%	10%	9%

Formula: Summarize the dollar volume of all unit sales within a market, and divide it by the total dollar volume of industry shipments. This ratio may also be calculated based on unit volumes shipped, rather than dollars. The formula is:

$$\frac{\text{Dollar volume of company shipments}}{\text{Dollar volume of industry shipments}}$$

Example: The Speedy Semiconductor Company has been experiencing exceedingly rapid sales growth for the past few quarters. Its president wants to ensure that this rate of growth is consistent with the growth of its market, or if the company is losing pace in comparison to its competitors. The market share data from the Semiconductor Industry Trade Organization and Speedy's sales data for the same period are shown in Table 13.1.

The market share ratio shown at the bottom of the table should concern the president of Speedy, for the company's sales growth is not matching the overall size of the market. A reasonable follow-up question for the president would be to determine what other companies in the industry are gaining in market share, since these companies are essentially taking sales away from Speedy.

Cautions: A company can artificially increase its market share by stuffing sales into its distribution pipeline by offering special pricing arrangements to its distributors; this will artificially increase its market share until the next reporting period, when sales are likely to plunge below their earlier levels (since the distributors are still selling off their extra stocks from the last period), appearing to indicate a sudden reduction in market share. To avoid this problem, the market share calculation can be averaged over several reporting periods.

Another problem is that the dollar volume of industry shipments can be quite hard to compile and may be inaccurate even when this chore is completed.

CUSTOMER TURNOVER

Description: This measure is extremely useful for determining the impact of customer service on a company's customers. A very low turnover rate is important in situations where the cost of acquiring new customers is high.

Formula: The calculation of this formula is subject to some interpretation; the key issue is how long to wait before a customer is assumed to have stopped buying from the company. In some cases, this may be anyone who has not placed an order within the past month and in other cases within the past year. The correct formulation will depend upon the nature of the business. With this in mind, the formula is to subtract from the total customer list those that have been invoiced (or sold to on a cash basis) within the appropriate time period and then divide the remainder by the total number of customers on the customer list:

$$\frac{\text{Total number of customers} - \text{Invoiced customers}}{\text{Total number of customers}}$$

Example: The customer service department of the Indonesian Linens Company is being inundated with requests from the president to reduce the company's high rate of customer turnover, which is currently 30% per year. The department manager does not have enough staff available to contact all customers regularly, and so asks the controller for assistance in finding out which customers are most important, so that the department can focus on them. Mr. Noteworthy, the controller, conducts an activity-based costing analysis of all customers and determines which 50 customers produce the largest amount of gross margin dollars for the company. The customer service manager gratefully shifts the department's focus to these key customers. A few months later, Mr. Noteworthy calculates customer turnover both in total and for this smaller group of key customers, using the information in Table 13.2.

The table shows that, although overall customer turnover has not changed, the increased focus on high-profit customers has resulted in greatly reduced turnover in this key area.

Cautions: There may be some customers who only purchase small amounts each year; one may not want to include these customers in the turnover calculation, focusing instead on those that provide a significant level of sales volume. Another variation on the ratio is to determine the top customers who provide the company with the bulk of its profits and only measure the turnover rate among that group. By subdividing customers in this manner, a company can focus its customer retention strategy on those who have the largest financial impact on the company.

Table 13.2

	Total Customer Base	Key Customer Base
Total number of customers	450	50
Customers not placing order in the last three months	135	5
Customer turnover	30%	10%

BROWSE TO BUY CONVERSION RATIO

Description: In most retail establishments, it is impossible to determine how many people browse through the store, and so there is no way to determine the ratio of potential customers to those who actually make a purchase. However, this is a simple and effective calculation for any situation where the store is on-line, since the exact number of browsing customers can be compiled. In this situation, a company has a great deal of interest in the browse to buy conversion ratio, since it can adjust its online store presentation to encourage a higher proportion of buyers and get immediate confirmation through this ratio of the effectiveness of its changes.

Formula: Divide the number of buying customers by the number of browsing customers. This measure can be subdivided into individual pages on a Web site; for example, the measure can be used individually for the camera, television, and video camera sections of an electronics store Web site. This type of "slice and dice" measurement may yield a greater degree of accuracy in determining which parts of an on-line store are most effective in attracting customer orders. The ratio is:

$$\frac{\text{Number of buying customers}}{\text{Number of browsing customers}}$$

Example: An outside Web site developer has contacted the International Baby Supply Center, offering to redesign its Web site to attract more paying customers. The company's lead buyer, Mr. Smythe, decides to structure the deal so that the Web site developer is paid only if the browse to buy conversion ratio improves after the site changes are completed. The developer is willing to modify the Web pages depicting products, but not the home page. Accordingly, the number of browsing customers is measured at the product pages rather than at the home page. The development contract states that the developer will be paid 10% of the sales from the increased proportion of buyers for six months following installation of the new Web pages. Table 13.3 reveals the before-and-after statistics for the site.

Table 13.3

	Before Changes	After Changes
Number of buying customers	10,400	17,225
Number of browsing customers	130,000	157,000
Browse to buy conversion ratio	8%	11%
Average sale per customer	$12	$15

The developer's efforts have resulted in an improvement in the ratio of 3%. To calculate the amount to be paid to the developer, Mr. Smythe multiplies the 3% difference by the number of browsing customers after the changes are implemented, which is:

3% × 157,000 Browsing customers = 4,710 Additional buying customers

He then multiplies the increase in buying customers by the average sale per customer of $148, to find the amount payable to the developer. The calculation is:

$15 Average sale per customer × 4,710 Additional buying customers = $70,650

Cautions: The number of browsing customers used in the ratio can be subject to a considerable degree of interpretation. For example, it can be summarized from the number of potential customers who access the home page of the site, from the number who access specific product pages, or those who have placed an order but back out just prior to paying. One possibility is to measure the ratio at all of these points in order to determine where in the process the greatest proportion of potential customers drop out of the purchasing decision.

RECENCY

Description: Recency refers to the time period between visits by a customer to a company's retail location. Most stores are not equipped to track the arrival of customers at a store, except for some retail clubs that issue identification cards to their customers. However, online stores can easily determine when customers have accessed the site, and so have reasonable grounds for calculating this measure. An online store can use the measure as a target for its marketing efforts. By issuing advertisements, special deal notices, and so on, and then noting any changes in the recency measure, a company can see if its marketing efforts are changing the purchasing behavior of its customers.

Formula: Subtract the most recent date of a customer site visit from the date of the last visit date. This number can be summarized and averaged for all customers, or for select subgroups of customers.

The measure can be used for physical retail locations by measuring customer access based on the dates of their noncash purchases; however, this modification to the formula will exclude those customers who have only browsed through the store and not purchased anything.

Example: The Christmas Express Company's marketing manager wants to calculate the recency of the customers accessing its online store. The information for 10 randomly selected customers is shown in Table 13.4.

Table 13.4

Last Visit Date	Prior Visit Date	Recency
August 13	August 2	11 Days
August 12	August 4	8 Days
August 10	August 1	9 Days
August 17	August 16	1 Day
August 20	August 5	15 Days
August 9	August 3	6 Days
August 30	August 10	20 Days
August 29	August 11	18 Days
August 27	August 13	14 Days
August 23	August 7	16 Days

The average recency for the information in the far right column of the table is 11.8 days.

Cautions: It may not be that easy to trace the recency of customers at an online site, because they may be accessing the site from different online service providers, which will give them a different identification that cannot be compared to their identifications from previous site visits. The best way to avoid this problem is to require a site log-in using a company-issued identification so that there is no question about who is accessing it.

DIRECT MAIL EFFECTIVENESS RATIO

Description: Direct mail campaigns have a high product design, production, and mailing cost, so it is crucial to verify the success of these endeavors. A successful campaign usually has a low single-digit response rate and can swing between a profit or loss if the response rate varies by a fraction of a percent. Consequently, a company that engages in this form of marketing must pay close attention to the direct mail effectiveness ratio.

Formula: This ratio can be measured in two ways. Under the first approach, potential customers do not place an order at the time of the response to the direct mail campaign, and must be contacted in order to confirm a sale. To measure this type of activity, divide the number of leads generated by the direct mail activity by the number of direct mail pieces issued. The formula is:

$$\frac{\text{Number of leads generated}}{\text{Number of direct mail pieces issued}}$$

If customer orders arise straight from a direct mail campaign, then there will be orders instead of sales leads. The ratio then becomes a comparison of direct mail sales to either the number of direct mail pieces issued, or of the total direct mail expense. Another variation is to compare the gross margin on sales derived from the direct mail campaign to the total direct mail expense. This last version is the most effective for determining whether or not a profit has been achieved from this activity. The three variations are:

$$\frac{\text{Direct Mail Sales}}{\text{Number of Direct Mail Pieces Issued}}$$

$$\frac{\text{Direct Mail Sales}}{\text{Total Direct Mail Expense}}$$

$$\frac{\text{Gross Margin on Direct Mail Sales}}{\text{Total Direct Mail Expense}}$$

Example: The marketing manager of the Curious Gifts Catalog Company wants to measure the performance of her latest direct mail campaign. The relevant information is shown in Table 13.5.

With this information, the manager finds that sales per direct mail piece is $0.35 (calculated as $842,000 sales, divided by 2,400,000 pieces issued). The ratio of direct mail sales to related expenses is roughly 3:1 (calculated as $842,000 sales, divided by $284,000 direct mail expense). The most telling comparison is the ratio of gross margin to the direct mail expense of 1.33:1 (calculated as $379,000 gross margin, divided by $284,000 direct mail expense); this last measure shows that there was a reasonable profit resulting from the direct mail campaign.

Cautions: If there are multiple direct mail campaigns going on at the same time, it is easy for sales leads or orders derived from them to be mixed up so that it is impossible to tell which campaign was the most effective. To correct this problem, there should be a mailing-specific identification number on each direct mail piece delivered, which should be used to identify each sales lead or order as it is received.

Table 13.5

Measurement	Amount
Sales	$842,000
Gross margin	$379,000
Direct mail expense	$284,000
Pieces issued	2,400,000

INBOUND TELEMARKETING RETENTION RATIO

Description: This specialized measure is only useful for companies that maintain an inbound telemarketing function, and which have subscription or other recurring forms of revenue. In these cases, customers will likely contact the call center in order to notify the company that they are canceling their ongoing purchases from it. If so, the company should track the ability of the employees taking those calls to persuade customers not to cancel. The inbound telemarketing retention rate can be used to determine the effectiveness of this activity.

Formula: Divide the total number of initial customer order cancellation requests into the number of cancellations that have been successfully reversed. Depending upon the situation, this measurement can vary significantly, depending upon which employee is talking to customers; thus, the measure can be effectively used to determine differences in the retention rate between employees in the inbound telemarketing operation. The formula is:

$$\frac{\text{Number of customer order cancellations reversed}}{\text{Number of initial customer order cancellations requested}}$$

Example: The Potent Credit Company issues platinum credit cards to a set of wealthy clients. It has recently instituted a no-loss program of offering free credit to any canceling customers for three months, in an effort to drop its cancellations as close to zero as possible. It has accumulated the information about the new program shown in Table 13.6.

The table reveals that the company has certainly engineered a drastic improvement in its retention rate, but at a cost of $413 per customer retained. An additional analysis at this point would be to determine the amount of profit to be expected from each customer to see if there is a cost/benefit advantage to retaining customers at this much higher cost.

Cautions: The cost of retaining customers who want to cancel can be significant. For example, a credit card company may offer zero-interest financing on any existing credit card debt for the next few months if a customer agrees to continue

Table 13.6

	Before New Program	After New Program
Number of cancellations reversed	158	797
Total number of cancellations	1,213	1,009
Inbound telemarketing retention rate	13%	79%
Cost of retention deals	$25,800	$329,161
Retention cost per reversed cancellation	$163	$413

using the card; the cost of the interest income lost through this concession is the cost of retaining the customer. Consequently, it is useful to also track the cost of the deals used to retain customers, and then compare this information to the retention rate to see if the customer retention effort is worthwhile.

QUOTE TO CLOSE RATIO

Description: The quote to close ratio is one of the most heavily used performance measures by the sales manager. This reveals which sales personnel have the best ability to close a deal once it has been quoted. Though this measures the effectiveness of only one step in the sales funnel, it is nonetheless an important one and can reveal considerable differences between the closing abilities of the various sales staff.

Formula: Divide the dollar value of orders received by the total amount of quoted orders. An alternative is to compare the number of orders received to the number quoted, but is not recommended—the ratio can be too easily skewed by a large number of small quotes. Also, given the inordinate length of time that customers sometimes wait before approving an order, this measure needs to be spread over several months in order to effect a reasonable comparison of quoted to received orders. The formula is:

$$\frac{\text{Dollar value of orders received}}{\text{Dollar value of quoted orders}}$$

Example: The Geomorphics Software Company has had great difficulty in determining the sales effectiveness of its new sales staff. Its software is difficult for the sales staff to learn, and so requires a long time period before sales personnel can become effective sellers. The sales manager has hit upon the use of the quote to close ratio on a trend line to see if this is a better way to measure their effectiveness. Accordingly, the sales manager has compiled dollars quoted and orders received information for two new sales personnel, Mr. Brandy and Ms. Browne. Their sales results over a four month period are shown in Table 13.7.

Table 13.7

	Jan	Feb	Mar	Apr
Brandy – Quotes	$45,000	$63,000	$42,000	$53,000
Brandy – Orders	$6,750	$12,600	$10,080	$14,840
Brandy – Quote to close ratio	15%	20%	24%	28%
Browne – Quotes	$42,500	$45,000	$41,000	$43,000
Browne – Orders	$6,375	$5,400	$7,380	$6,450
Browne – Quote to close ratio	15%	12%	18%	15%

Based on the quote to close ratios for both sales trainees, it appears that Mr. Brandy is gradually improving his ability to close on sales, whereas Ms. Browne is not.

Cautions: This measure can be difficult to use for individual sales personnel, since quotes are frequently made by teams, whose composition changes for each quote. In these cases, it can only be used to measure the closing ability of an entire sales team. It is also less effective in cases where quoted sales comprise only a small fraction of total sales dollars.

SALES PER SALESPERSON

Description: Sales per salesperson is the classic measure for determining the sales effectiveness of the sales staff. This measure is commonly used to award bonuses to sales personnel, and to judge which sales staff are retained. However, as noted under the Cautions section, there are several key issues to be aware of that can make this a misleading measure.

Formula: Summarize all nonrecurring sales and divide them by the total number of full-time equivalents in the sales department. The resulting measure will only yield average sales per salesperson within the department, which will hide the poor performance of any individual sales staff within the group, so one can also calculate the ratio on an individual basis. The measure should not include any recurring sales (as occurs for subscriptions or ongoing insurance sales) since these require little sales effort. Also, the measure should include all sales support staff in the full-time equivalents number in the denominator, even though they are not actively selling—they are key to supporting the sales staff, and their absence will impact sales effectiveness, so they should be included. The formula is:

$$\frac{\text{Nonrecurring sales}}{\text{Number of FTE sales personnel}}$$

Example: The Ski & Snowboard Magazine Emporium's sales manager is concerned about the performance of its salespeople, Ms. Dunriddy and Ms. Enoch. They both have identical total sales, but one is relying on recurring magazine subscriptions for a larger proportion of her sales, which results in a much slower rate of sales growth for the company. The sales manager compiles the information shown in Table 13.8.

The information in the table suggests that Ms. Enoch is the newer of the two salespeople and is striving to increase sales much more rapidly, so she can derive a benefit in later years from the commission rate on recurring subscriptions. Alternatively, Ms. Dunriddy has already built up her recurring subscription base, and is coasting along with minimal effort to attract new sales. To provide a greater

Table 13.8

	Ms. Dunriddy	Ms. Enoch
Recurring sales	$150,000	$25,000
New sales	$100,000	$225,000
Total sales	$250,000	$250,000
Sales per salesperson	$250,000	$250,000

incentive for both salespeople, the sales manager reduces the commission on recurring subscriptions and increases it on new subscriptions.

Cautions: The primary concern is that the sales staff may alter their sales behavior so thoroughly in order to maximize their performance under this measurement that actual profits decline. For example, a salesperson may focus on selling a product with a high price, rather a lower-priced product that carries a much higher gross margin. Another example is when a salesperson gives away so many other items in order to secure a sale, such as long payment terms or free maintenance, that gross margins are driven down even when sales remain high. A third example is when the sales staff indulges in the excessive use of travel and entertainment expenses in order to secure sales, once again driving down profitability. Finally, it is common for sales personnel to secure orders from customers with a minimal ability to pay for the goods and then browbeat the in-house credit department in order to secure the extension of credit to these customers. For all of these reasons, the sales per salesperson measurement can easily result in salesperson behavior that does not maximize profits. If it is possible to measure profitability by salesperson (a sometimes complex endeavor, since the chart of accounts is rarely set up to provide this information), then this is a much better way to control the selling behavior of the sales employees.

SALES PRODUCTIVITY

Description: Part of the problem with the preceding sales by salesperson measurement is that a salesperson can focus on sales of high-cost, low-margin products in order to make the measure look good, even though the company earns only a small margin on the sales. The sales productivity measure can show better the ability of the sales force to sell those products having the highest margins with the least amount of sales expense. This is an excellent method for determining bonuses or employee retention within the sales department.

Formula: Subtract the variable cost of goods sold from new sales, and divide the result by the sales expense. This measure should be used for each of the sales staff, since sales productivity can vary considerably within the department. Also, the

Table 13.9

	Salesperson A	Salesperson B	Salesperson C
Gross revenue	$1,000,000	$800,000	$750,000
Variable cost of sales	$600,000	$400,000	$375,000
Sales expense	$150,000	$82,000	$74,000
Sales productivity	2.7:1	4.9:1	5.1:1

sales figure within the formula should only be for nonrecurring revenue (i.e., new sales), so that the sales staff does not receive credit for renewal billings for which they expended no sales effort. The sales expense used in the calculation should include the base pay, commission, travel & entertainment, and all other directly traceable costs of the sales staff. It should not include any overhead allocation, since this is not a direct cost of making a sale. The formula is:

$$\frac{\text{Gross nonrecurring revenue} - \text{Variable cost of sales}}{\text{Sales expense}}$$

Example: The manager of a sales department has been informed that one of the three sales staff must be laid off. To determine performance, the manager decides to measure their sales productivity. The manager collections information that covers the sales performance of the sales staff for the past year that is shown in Table 13.9.

The table reveals that, although Salesperson A sells the most volume, the products have a lower gross margin than those being sold by the other two sales staff. In addition, Salesperson A is spending far more money to secure sales than are the other two sales employees. This results in the worst sales productivity ratio (of 2.7:1) for Salesperson A, while Salesperson C, who has the lowest sales volume, has achieved the highest sales productivity score. Based on this information, Salesperson A should be laid off.

Cautions: Using this calculation, it is possible that an introductory-level, low-paid salesperson who achieves a modest amount of sales could theoretically achieve a higher sales productivity score than a more experienced salesperson with a higher base pay, because the sales expense portion of the calculation is so much lower. Also, this measure does not address the issue of sales being made that impact a company's bottleneck production operation; this is covered in the next measurement.

SALES EFFECTIVENESS

Description: An alternative way to measure the ability of the sales staff is to sell products that avoid use of the company's chief production constraint. If too many

products are sold that require a large proportion of constraint time, then a company will soon find itself unable to increase sales without a large investment to increase the size of the constraint. However, if the sales staff is made aware of the amount of constraint time used by each product, then this measure can be used to determine how well they avoid the constraint.

Formula: Subtract the variable cost of goods sold from gross revenue, and then divide the result by the amount of constraint time used to produce the items sold. A key factor is determining which costs within the cost of goods sold are truly variable. In many instances, only material costs are variable, with even direct labor costs being fixed in the short term. The formula is:

$$\frac{\text{Gross revenue} - \text{Variable cost of goods sold}}{\text{Constraint time used}}$$

Example: The Hard Rock Candy Company has maximized the output from its bottleneck operation, which is a candy cooker, and cannot produce a higher level of output without purchasing an additional cooker. The president instructs the salespeople to shift their efforts into product sales that require less cooker time. The president compiles Table 13.10 before-and-after information about the salespeople's performance to see if they are following his instructions.

The table reveals that the salesperson has achieved a slightly lower level of sales but has altered the gross margin mix, so the same gross margin (of $250,000) has been achieved both before and after the change in sales instructions. The primary change is that the number of hours of cooker time required by the sales has dropped from 168 hours to 153, which means that the gross margin earned per hour of constraint time has increased from $1,488 per hour to $1,634 per hour. In short, the salesperson is appropriately following the president's instructions.

Cautions: It can be difficult to accumulate the information needed to operate this measurement in an effective manner. A company must accurately determine its variable cost of goods sold and be able to efficiently trace it back to individual product sales as well as inform the sales staff of the constraint usage times for each product. This can also require a significant revamping of the sales compensation plan in order to shift salesperson efforts away from usage of the constraint.

Table 13.10

	Before	After
Gross revenue	$1,000,000	$950,000
Variable cost of goods sold	$750,000	$700,000
Constraint time used	168 hours	153 hours
Sales effectiveness	$1,488/hr	$1,634/hr

SALES TREND PERCENTAGE BY PRODUCT LINE

Description: The marketing and engineering departments need to know how the sales of each of a company's product lines are progressing, so that they can alter their marketing positioning, sales concepts, and product features in coordination with the perceived position of each product in its life cycle. For example, if sales are steady or dropping, then the engineering department should use this information to design a replacement or enhanced version of the existing product that will spur sales when introduced.

Formula: Subtract total sales dollars in the previous period from those in the current period, and divide the result by total sales in the previous period. This yields the percentage change in sales during the period. The measure can also be based on the number of units sold, but ignores the price point at which sales are made, and so yields less information. This measure is best used for an entire product line rather than for individual products, since there may be so many products and accessories within a product line, including many that are cannibalizing sales from each other, that the multitude of resulting ratios will not yield any useful information. The formula is:

$$\frac{\text{(Total sales in current period)} - \text{(Total sales in previous period)}}{\text{Total sales in previous period}}$$

Example: The Nomicon Office Seating Company has designed a deluxe office chair, the Flexomatic, that has seen skyrocketing sales for the last few years. However, competitors have brought out two comparable models, which will soon cut into the unit volume on sales of the Flexomatic. Consequently, the sales manager wants to keep close track of its sales trend to spot the point at which sales are trailing off. The relevant information for the past four months is shown in Table 13.11.

The sales trend percentage for the Flexomatic reveals a potential problem in the most recent month of April, where the rate of sales growth has dropped from the usual 50% rate to 33%. If this reduced sales trend were to continue much longer, the sales manager might consider dropping the Flexomatic price to become more competitive with the other models on the market.

Cautions: Changes in sales levels from period to period may be closely tied to promotional, seasonal, or pricing changes, and so must be reviewed with these is-

Table 13.11

	January	February	March	April
Sales	$1,000,000	$1,500,000	$2,250,000	$3,000,000
Change in sales from previous period	—	$500,000	$750,000	$750,000
Sales trend percentage	—	50%	50%	33%

sues in mind. To avoid this problem, a sales trend could be compared to the same trend calculation for the period in the previous year, along with a commentary on changes in marketing and engineering efforts in the interim that might have had an impact on sales.

PRODUCT DEMAND ELASTICITY

Description: This is useful for determining the ability of a company to maximize its profit on product sales by altering prices. However, as noted under the Cautions section, there are so many other variables impacting sales effectiveness besides price that this measurement's effectiveness is restricted.

Formula: Divide the percentage change in quantity of product sold by the percentage change in price. The product demand is considered to be inelastic if the result of the measurement is greater than 100%, and elastic if it is less than 100%. The formula is:

$$\frac{\text{Percentage change in quantity}}{\text{Percentage change in price}}$$

Example: The Meridian Vacuum Company has been selling an industrial-grade vacuum cleaner for a number of years at a price of $250 per unit. After comparing this product to the competition, Meridian's marketing team believes that it can spend only $25 to reposition the vacuum as a premium product with an aluminum casing. At a gross margin of 50%, this means that the product's price must increase by $50, to $300. In addition, due to its repositioning as a premium product, the marketing staff would like to increase its price further, to $325. A marketing test at this price point reveals that the number of units sold declines from 5,000 to 4,000 as a result of the increased price. Is this product price elastic or inelastic? Use the preceding formula to find out:

$$\frac{\text{Percentage change in quantity}}{\text{Percentage change in price}} =$$

$$\frac{(5{,}000 \text{ Units} - 4{,}000 \text{ Units}) / 5{,}000 \text{ Units}}{(\$325 - \$250) / \$250} =$$

$$\frac{20\%}{30\%} =$$

$$67\%$$

The measurement reveals that the suggested price increase will result in a smaller proportional drop in unit sales. Consequently, the new price point should be implemented.

Cautions: There are many factors that go into a consumer's decision to purchase a product besides price, all of which render the product demand elasticity measure difficult to determine. For example, a customer may pay a higher price simply because it is offered more lenient credit terms by the seller. Also, a seller that has established a high-quality brand name through extensive marketing efforts can command a premium on its product sales. Further, differences in product quality may shift the buying habits of consumers when faced with otherwise similar products. Also, if there are substitute products available, then prices will be driven down to match those of the substitute. For these reasons, it tends to be difficult to use this measurement except when large pricing changes are implemented that will overwhelm all the other factors noted here.

DAYS OF BACKLOG

Description: The days of backlog measure is extremely important for the production department, because this group can use it to determine the amount of production capacity that should be made available in the short term. It is also useful from a financial planning standpoint, since it shows likely short-term changes in sales that will impact reported financial results. It can also be used to project production outsourcing needs, when the amount of backlog exceeds a company's short-term productive capacity.

Formula: Determine the amount of annual sales, divide it by 365, and divide the result into the dollar total of all unfilled sales orders. The annual sales figure may include budgeted sales through the end of the year, which may vary considerably from actual results; to avoid an unrealistic annual sales figure, one can use the latest 12 months of sales results on a rolling basis. Also, be careful not to include any projected sales in the backlog figure for which firm orders have not yet been received from customers, since the intent of this measurement is to obtain a realistic understanding of actual orders that have not yet been filled. The formula is:

$$\frac{\text{Dollar volume of sales backlog}}{\text{Average annual sales} / 365}$$

Example: The MicroMelt Plastics Company management team is considering adding capacity to its line of 50-ton injection molding machines. It will only do this if there is a clear trend of an increasing backlog in sales that can be run through this type of machine. To see if this is the case, the controller compiles information for the last four quarters (see Table 13.12).

The days of backlog in the preceding table reveals that, though the dollar volume of the sales backlog is increasing, existing production capacity has actually been able to reduce the number of days of backlog. This may eliminate the short-

Table 13.12

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Sales backlog	$75,000	$85,000	$115,000	$120,000
Rolling 12-month sales	$1,500,000	$1,785,000	$2,645,000	$3,000,000
Days of backlog	18 Days	17 Days	16 Days	15 Days

term need for additional equipment; however, the company should review the percentage of capacity utilization on each existing machine to see if they are reaching their maximum sustainable levels of production. If so, then it still may be necessary to buy more production equipment if sales levels are expected to increase in the future.

Cautions: The backlog figure should be separated into in-house production work and product resales, because resales require no in-house production capacity. Also, this can be a misleading measurement, for it ignores the amount of sales that must pass through a company's bottleneck operation. If the mix of sales within the backlog requires a large amount of processing time at the bottleneck operation, a company may find itself unable to handle the existing backlog even if the total backlog appears to be low.

14

Measurement Analysis with an Electronic Spreadsheet*

There are several tools used to conduct financial analysis. One is a database of accounting information, in which an analyst can roam for days, tracking down the details regarding when specific transactions have taken place, why they occurred, and the likelihood of their happening again. However, analysts rarely descend straight into the depths of the accounting database without first using some more simple means for determining what problem has arisen, which yields clues regarding where in the database to search. This higher-level information is obtained by using ratio and trend analysis to pinpoint the issue. To get this information, a calculator, pencil, and paper are sufficient, but also very time consuming and prone to error. Instead, an electronic spreadsheet is the best method. In this chapter, we review how to use such a spreadsheet—in this case, the Microsoft Excel spreadsheet, version 2000.

The formulas presented in this chapter are by no means difficult. The discussion is confined to the simplest and most understandable spreadsheet commands, and avoids the use of complicated macros. The discussion focuses on using spreadsheets for five types of analysis: financial statements, project analysis, investment analysis, risk analysis, and trend analysis. In each case, it is noted how Excel can be used to solve a problem, and then a sample situation is provided.

A key issue that is noted throughout this chapter is the difference between a spreadsheet and a worksheet. In Excel, a spreadsheet can have a number of interlinked layers known as worksheets. When an entry is made in one worksheet, it can be referenced by other worksheets in the same spreadsheet. This is a preferable approach to using Excel for financial analysis, since one can separate the data being analyzed in one worksheet, ratios in another, and graphics in yet another worksheet – but with formulas linking all of them together. In the examples used in the first few sections of this chapter, nearly all of the analysis is done on one spreadsheet that contains a half-dozen worksheets.

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FINANCIAL STATEMENT PROPORTIONAL ANALYSIS

Proportional analysis is simply converting all of the numbers in an income statement and balance sheet into percentages, so that they can be compared over time to see what differences arise. By conducting this analysis, one can see if there are trends in revenues, costs, assets, or liabilities that may require further analysis or investigation.

When using Excel to conduct a proportional analysis of a financial statement, one must first input the income statement for each period into the worksheet, so that the proportional analysis calculation will appear below it or on a separate worksheet. Exhibit 14.1, a simplified income statement has been entered in the cells at the top of the worksheet. For each line item in this top section, there is a formula entered in the replicated income statement at the bottom of the screen that divides each expense line item by the revenue figure, resulting in a percentage of sales for each item. For example, the materials cost proportion for the month of January is calculated with the following formula, which is entered in cell B15:

B5 / B$4

Since the spreadsheet contains the income statement for multiple months, the resulting proportional analysis becomes very useful for finding any trends in the expenses being incurred over the course of the year.

Microsoft Excel - Exhibit-14.1.xls

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H	I
1	Proportional Income Statement Analysis								
2									
3	**Dollars**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
4	Revenue	1,200	1,250	1,300	1,250	1,350	1,400	1,450	1,400
5	Materials Cost	550	575	595	565	605	610	635	620
6	Direct Labor Cost	120	120	145	140	150	160	170	180
7	Gross Margin	530	555	560	545	595	630	645	600
8	Administrative Expenses	280	290	340	335	330	350	360	365
9	Profit Before Taxes	250	265	220	210	265	280	285	235
10	Taxes	100	106	88	84	106	112	114	94
11	Net Profit	150	159	132	126	159	168	171	141
12									
13	**Proportions**								
14	Revenue	100%	100%	100%	100%	100%	100%	100%	100%
15	Materials Cost	46%	46%	46%	45%	45%	44%	44%	44%
16	Direct Labor Cost	10%	10%	11%	11%	11%	11%	12%	13%
17	Gross Margin	44%	44%	43%	44%	44%	45%	44%	43%
18	Administrative Expenses	23%	23%	26%	27%	24%	25%	25%	26%
19	Profit Before Taxes	21%	21%	17%	17%	20%	20%	20%	17%
20	Taxes	8%	8%	7%	7%	8%	8%	8%	7%
21	Net Profit	13%	13%	10%	10%	12%	12%	12%	10%
22									
23									
24									

Sheet1 Sheet2 Sheet3

Exhibit 14.1 Proportional Analysis of an Income Statement

The income statement proportional analysis used in the preceding example would be of great use to management in determining why its profits are not increasing along with its evident sales growth. In the example, sales increase from $1,200 in January to $1,400 in August, but profits drop by $9. Why? By perusing the proportional analysis, it is an easy matter to see that the cost of materials has *dropped* as a percentage of sales, which may reflect excellent purchasing, design, or production work to lower these costs. For the answer to why profits have dropped, we must look lower in the spreadsheet. The direct labor cost as a proportion of sales has risen, so this is an obvious target area for further analysis. However, the overall gross margin percentage has only dropped by one percent over the time period being analyzed, so there must be more trouble further down in the income statement. Sure enough, the administrative expenses line item reveals a three percent jump in costs. Accordingly, anyone using this analysis would conclude that the trouble has arisen in the direct labor and administrative areas, and that the materials expense requires no further analysis.

Though this type of analysis is an excellent way to hone in on key areas, it is rarely the final analysis conducted, since it does not reveal enough information. Also, it is not sufficient if there are many operating divisions rolled into the income statement. In these cases, it is best to create a number of separate spreadsheets, one for each division, and conduct the analysis on each one, thereby yielding a greater level of detail regarding problem areas.

The same proportional analysis can be applied to the balance sheet. In Exhibit 14.2, one can manually enter a simplified version of the balance sheet at the top of the spreadsheet, which produces a set of percentages at the bottom. The asset percentages sum to the grand total of all assets, while the percentages for liabilities and equity sum to the total for those two categories.

As was the case for the proportional analysis of the income statement, the cell formula is extremely simple. In Exhibit 14.2, the percentage for accounts payable in April is calculated by dividing the total accounts payable dollars, located in cell E10, by the total of all liabilities and equity for that month, which is located in cell E14.

What does the proportional analysis of the balance sheet tell us? To use the example, there is a clear increase in the fixed asset investment, which requires the use of all cash, as well as an increased debt load, which reaches its height in May, after which cash flow from operations is used to gradually draw down the level of debt. The only other trend of note is that inventory levels are declining, which indicates either excellent logistics practices or a decline in sales that no longer requires such a large supporting base of inventory. Consequently, a great deal can be discerned by reviewing a proportional balance sheet analysis.

FINANCIAL STATEMENT RATIO ANALYSIS

Perhaps the most common use of an electronic spreadsheet is to conduct a ratio analysis of the income statement and balance sheets. Typically, a summary form of the income statement and balance sheet are located at the top of the worksheet,

Microsoft Excel - Exhibit-14.2.xls

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H	I
1	Proportional Balance Sheet Analysis								
2									
3	**Dollars**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
4	Cash	152	138	72	31	17	0	0	0
5	Accounts Receivable	375	400	410	415	425	435	442	440
6	Inventory	400	398	396	394	392	390	388	378
7	Fixed Assets	598	603	729	841	900	902	908	911
8	*Total Assets*	1,525	1,539	1,607	1,681	1,734	1,727	1,738	1,729
10	Accounts Payable	450	475	485	490	500	510	517	515
11	Accrued Liabilities	83	83	83	81	81	81	80	80
12	Debt	92	71	119	180	213	186	181	164
13	Equity	900	910	920	930	940	950	960	970
14	*Total Liabilities*	1,525	1,539	1,607	1,681	1,734	1,727	1,738	1,729
16	**Proportions**								
17	Cash	10%	9%	4%	2%	1%	0%	0%	0%
18	Accounts Receivable	25%	26%	26%	25%	25%	25%	25%	25%
19	Inventory	26%	26%	25%	23%	23%	23%	22%	22%
20	Fixed Assets	39%	39%	45%	50%	52%	52%	52%	53%
21	*Total Assets*	100%	100%	100%	100%	100%	100%	100%	100%
23	Accounts Payable	30%	31%	30%	29%	29%	30%	30%	30%
24	Accrued Liabilities	5%	5%	5%	5%	5%	5%	5%	5%
25	Debt	6%	5%	7%	11%	12%	11%	10%	9%
26	Equity	59%	59%	57%	55%	54%	55%	55%	56%
27	*Total Liabilities*	100%	100%	100%	100%	100%	100%	100%	100%
28									

Sheet1 Sheet2 Sheet3

Exhibit 14.2 Proportional Analysis of a Balance Sheet

with ratios located at the bottom that are derived from these two reports. By using this approach, one can quickly enter the summary-level financial information for the current reporting period and then see the related ratios appear at the bottom of the worksheet. In a few moments, he or she has access to a rough analysis of company operations. If there are entries for the financial results of previous months, then one can also see trend lines in ratio results that extend through to the current reporting period.

As an example of the types of ratio analysis one can use in a worksheet, we will use the income statement and balance sheet shown earlier, in Exhibits 14.1 and 14.2. A series of ratios are noted in Exhibit 14.3 that are derived from those statements.

In Exhibit 14.3, there are several tabs itemized at the bottom of the worksheet. Each one represents another spreadsheet that is clustered into the same workbook. The first tab, entitled IS, contains a spreadsheet version of the income statement. The second tab, entitled BS, contains a spreadsheet version of the balance sheet. The ratios shown in the exhibit are compiled by referencing the cell locations in these two spreadsheets and listing the result on the current Ratios spreadsheet.

The formulas behind the ratios in Exhibit 14.3 are not shown, so the same spreadsheet is laid out differently in Exhibit 14.4 to provide this information. In

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File Edit View Insert Format Tools Data Window Help

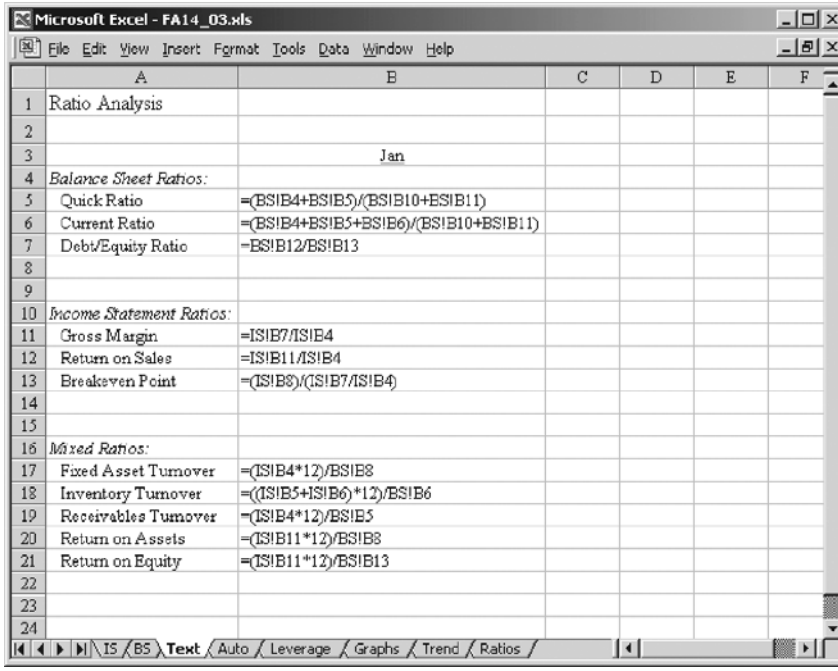
	A	B	C	D	E	F	G	H	I
1	Ratio Analysis								
2									
3		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
4	*Balance Sheet Ratios:*								
5	Quick Ratio	1.0	1.0	0.8	0.8	0.8	0.7	0.7	0.7
6	Current Ratio	1.7	1.7	1.5	1.5	1.4	1.4	1.4	1.4
7	Debt/Equity Ratio	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
8									
9									
10	Income Statement Ratios:								
11	Gross Margin	44%	44%	43%	44%	44%	45%	44%	43%
12	Return on Sales	13%	13%	10%	10%	12%	12%	12%	10%
13	Breakeven Point	$634	$653	$789	$768	$749	$778	$809	$852
14									
15									
16	*Mixed Ratios:*								
17	Fixed Asset Turnovers	79%	81%	81%	74%	78%	81%	83%	81%
18	Inventory Turnover	20	21	22	21	23	24	25	25
19	Receivables Turnover	38	38	38	36	38	39	39	38
20	Return on Assets	10%	10%	8%	7%	9%	10%	10%	8%
21	Return on Equity	17%	17%	14%	14%	17%	18%	18%	15%
22									
23									
24									

Trend | Ratios

Exhibit 14.3 Ratio Analysis Based on an Income Statement and Balance Sheet

this example, we have eliminated the formulas for all but the month of January, and then listed each formula in full. For example, the first ratio is the Quick Ratio, which compares easily liquidated assets to current liabilities. To obtain this information, the cell entry goes to the "BS" spreadsheet and adds together cells B4 and B5, which contain the cash and accounts receivable figures for the month of January. The formula then divides the sum by the accounts payable and accrued liabilities amounts, which are located on the same spreadsheet in cells B10 and B11.

Further down in the list of ratios are ones that are built upon the income statement. For example, the Return on Sales percentage is derived by referencing the profit figure for January, which is located in cell B11 in the IS spreadsheet and dividing by total sales, which is located in cell B4 in the same spreadsheet. Finally, we can mix references to both the IS and BS spreadsheets in the same ratio formula. For example, to arrive at the return on equity, the formula takes the profit for January, which is located in cell B11 in the IS spreadsheet, annualizes it by multiplying by 12, and divides it by the equity figure, which is located in cell B13 in the BS spreadsheet. Thus, we can mix cell references from a variety of spreadsheets in order to arrive at a centralized set of ratios that can be stored in a single spreadsheet location.


Microsoft Excel - FA14_03.xls

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F
1	Ratio Analysis					
2						
3		Jan				
4	*Balance Sheet Ratios:*					
5	Quick Ratio	=(BS!B4+BS!B5)/(BS!B10+BS!B11)				
6	Current Ratio	=(BS!B4+BS!B5+BS!B6)/(BS!B10+BS!B11)				
7	Debt/Equity Ratio	=BS!B12/BS!B13				
8						
9						
10	*Income Statement Ratios:*					
11	Gross Margin	=IS!B7/IS!B4				
12	Return on Sales	=IS!B11/IS!B4				
13	Breakeven Point	=(IS!B8)/(IS!B7/IS!B4)				
14						
15						
16	*Mixed Ratios:*					
17	Fixed Asset Turnover	=(IS!B4*12)/BS!E8				
18	Inventory Turnover	=((IS!B5+IS!B6)*12)/BS!B6				
19	Receivables Turnover	=(IS!B4*12)/BS!E5				
20	Return on Assets	=(IS!B11*12)/BS!B8				
21	Return on Equity	=(IS!B11*12)/BS!B13				
22						
23						
24						

IS BS Text Auto Leverage Graphs Trend Ratios

Exhibit 14.4 Formulas for Previous Ratio Analysis

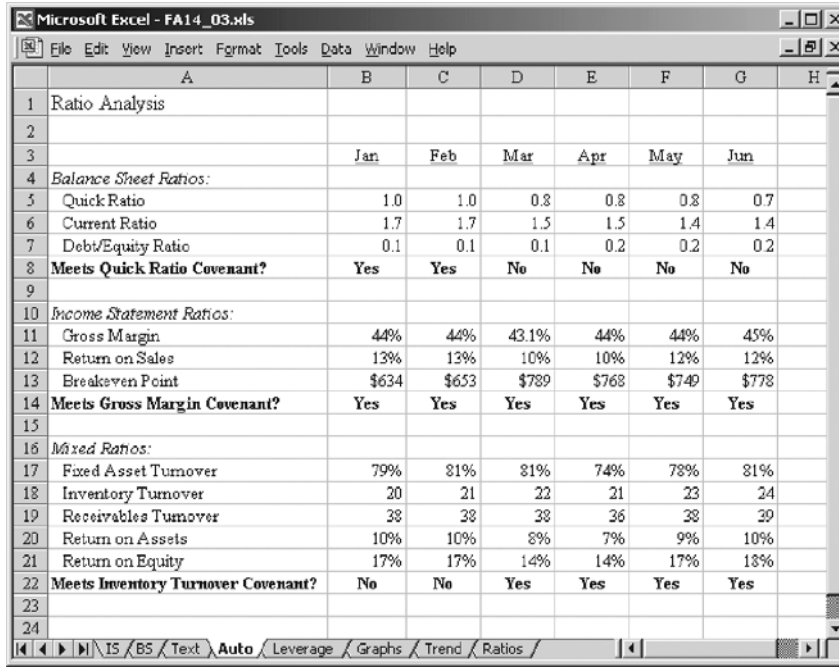
AUTOMATED RATIO RESULT ANALYSIS

If there are a great many ratios linked to a set of financial statements, one may want to save time in reviewing them by having the spreadsheet issue a warning message for those ratios that fall outside a preset parameter. Another reason for using this approach is when a lending institution places constraints on a company by requiring minimum levels for certain ratios, such as a current ratio of at least 2:1, or a debt/equity ratio of no higher than 30%. In either case, a formula that presents a YES/NO or GOOD/BAD result can save some time.

A simple IF formula will create an automated ratio result. To continue with the example used previously in Exhibit 14.4, we will add three rows to the analysis. Under the Balance Sheet Ratios section, add a row entitled Meets Quick Ratio Covenant? This is a YES/NO determination based on the quick ratio being greater than 0.9, and will appear in row 8. The formula for the month of January will be:

IF(B5>.9,"Yes","No")

Under the Income Statement Ratios section, add a row entitled Meets Gross Margin Covenant? This is a YES/NO determination based on the gross margin being greater than 43% and will appear in row 14. The formula for the month of January will be:



Microsoft Excel - FA14_03.xls

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H
1	Ratio Analysis							
2								
3		Jan	Feb	Mar	Apr	May	Jun	
4	*Balance Sheet Ratios:*							
5	Quick Ratio	1.0	1.0	0.8	0.8	0.8	0.7	
6	Current Ratio	1.7	1.7	1.5	1.5	1.4	1.4	
7	Debt/Equity Ratio	0.1	0.1	0.1	0.2	0.2	0.2	
8	**Meets Quick Ratio Covenant?**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	
9								
10	*Income Statement Ratios:*							
11	Gross Margin	44%	44%	43.1%	44%	44%	45%	
12	Return on Sales	13%	13%	10%	10%	12%	12%	
13	Breakeven Point	$634	$653	$789	$768	$749	$778	
14	**Meets Gross Margin Covenant?**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	
15								
16	*Mixed Ratios:*							
17	Fixed Asset Turnover	79%	81%	81%	74%	78%	81%	
18	Inventory Turnover	20	21	22	21	23	24	
19	Receivables Turnover	38	38	38	36	38	39	
20	Return on Assets	10%	10%	8%	7%	9%	10%	
21	Return on Equity	17%	17%	14%	14%	17%	18%	
22	**Meets Inventory Turnover Covenant?**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	
23								
24								

IS BS Text Auto Leverage Graphs Trend Ratios

Exhibit 14.5 Automated Ratio Results Analysis

IF(B11>.43,“Yes”,“No”)

Under the Mixed Ratios section, add a row entitled Meets Inventory Turnover Covenant? This is a YES/NO determination based on the inventory turnover level being greater than 21 and will appear in row 22. The formula for the month of January will be:

IF(B18>21,“Yes”,“No”)

All of these new formulations are shown in the ratios exhibit in Exhibit 14.5. In the exhibit, one can quickly skim through the various months of results to determine the occasions when covenants have been violated. Setting up the IF statements that drive these automated ratio results are quite simple, and can help to some extent in the task of sorting through large quantities of ratios.

LEVERAGE ANALYSIS

An additional concept that can be added on to the preceding discussion of ratios is leverage analysis. There are several types of leverage analysis, all of which can be converted into formulas and added to a ratio analysis, as will be shown in this section.

The first type of analysis is of *operating leverage*. Under this concept, we determine the extent to which a percentage change in sales results in a different percentage change in profits. For example, if all costs were totally variable, there would be a percentage change in profits that would exactly match the change in sales, which would result in an operating leverage ratio of 1:1. However, if the bulk of costs are fixed, and will therefore not change when there are changes in sales, then an increase in sales will result in a more rapid increase in profits. For example, if a 10% increase in sales results in a 20% increase in profits, then the operating leverage ratio is 2:1. This is a wonderful condition to have when sales are on the increase, since large profit jumps will occur. However, the inverse situation arises if sales decline, since fixed costs must still be paid even when sales drop, which results in inordinate profit decreases. Thus, a large operating leverage ratio is a two-edged sword that cuts deeply in a declining sales situation. To measure this, we can create a measurement for the degree of operating leverage, which is calculated by dividing the percentage change in profits (before interest and taxes) by the percentage change in sales. The reason for excluding interest and tax costs is that we are only determining the amount of leverage based on operations, and neither of these expenses are related to operations. This measure has been added to the ratio analysis previously shown in Exhibit 14.3, and is now listed in an expanded format in Exhibit 14.6.

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File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H
1	Ratio Analysis							
2		Jan	Feb	Mar	Apr	May	Jun	Jul
3	*Balance Sheet Ratios:*							
4	Quick Ratio	1.0	1.0	0.8	0.8	0.8	0.7	0.7
5	Current Ratio	1.7	1.7	1.5	1.5	1.4	1.4	1.4
6	Debt/Equity Ratio	0.1	0.1	0.1	0.2	0.2	0.2	0.2
7								
8	*Income Statement Ratios:*							
9	Gross Margin	44%	44%	43%	44%	44%	45%	44%
10	Return on Sales	13%	13%	10%	10%	12%	12%	12%
11	Breakeven Point	$634	$653	$789	$768	$749	$778	$809
12								
13	*Mixed Ratios:*							
14	Fixed Asset Turnover	79%	81%	81%	74%	78%	81%	83%
15	Inventory Turnover	20	21	22	21	23	24	25
16	Receivables Turnover	38	38	38	36	38	39	39
17	Return on Assets	10%	10%	8%	7%	9%	10%	10%
18	Return on Equity	17%	17%	14%	14%	17%	18%	18%
19								
20	***Leverage Ratios:***							
21	**Operating Leverage**		**1.4**	**-4.2**	**1.2**	**3.3**	**1.5**	**0.5**
22	**Financial Leverage**		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
23	**Earnings per Share (1,000)**	**0.15**	**0.16**	**0.13**	**0.13**	**0.16**	**0.17**	**0.17**
24								

IS / BS / Text / Auto / **Leverage** / Graphs / Trend / Ratios /

Exhibit 14.6 Leverage Ratios

Exhibit 14.6 also includes another ratio. This measures the same concept, but this time it is the relationship between earnings per share and profits. The measure divides the percentage change in earnings per share by the percentage change in earnings before interest and taxes. Since the earnings per share figure includes interest and taxes, as well as changes in the number of shares outstanding, while the earnings figure does not include any of these variables, any differences in the percentages of change between the two measures can only be caused by interest, taxes, or the number of shares. Since all of these items are finance-related issues, we call this the *financial leverage ratio*. In short, any leverage indicated by this ratio is caused by financial manipulation, rather than changes in a company's operational structure.

The leverage measures outlined here are only general measures, and yield no more than a high-level understanding of the reasons for changes in profitability levels. Much more detailed analysis is needed to gain a true understanding of the specific types of costs and other factors that drive operating and financial leverage.

TREND ANALYSIS

An electronic spreadsheet is one of the best tools to use for the analysis of trends, because one can enter a list of time-sequenced data in a spreadsheet and generate a graphical trend line from it in a few moments. Virtually any type of revenue or cost can be itemized and graphed on a spreadsheet, so trend analysis becomes one of the simplest functions with this tool. To continue with the income statement example shown earlier in Exhibit 14.1, we will select the sales, gross margin, and net income figures for trend analysis on three different graphs, all of which will be located on a new spreadsheet called Graphs. They are shown in Exhibit 14.7.

All of the graphs shown in Exhibit 14.7 were created using the same set of steps in Excel, which are as follows:

1. Go to the IS worksheet in the example and highlight the range of numbers to be graphed on a trend line.
2. Click on the Chart Wizard icon.
3. The Chart Type = Column.
4. Enter the name of the graph in the Chart Title field.
5. Set the Legend option to Off.

The Chart Wizard also gives the option of storing the finished graph on any worksheet within the current spreadsheet, or on a different spreadsheet entirely. It is generally best to not store the graph on the current worksheet, since printouts may inadvertently include the underlying data. In the example, all three graphs draw their data from the IS worksheet and store the finished product in the Graphs worksheet.

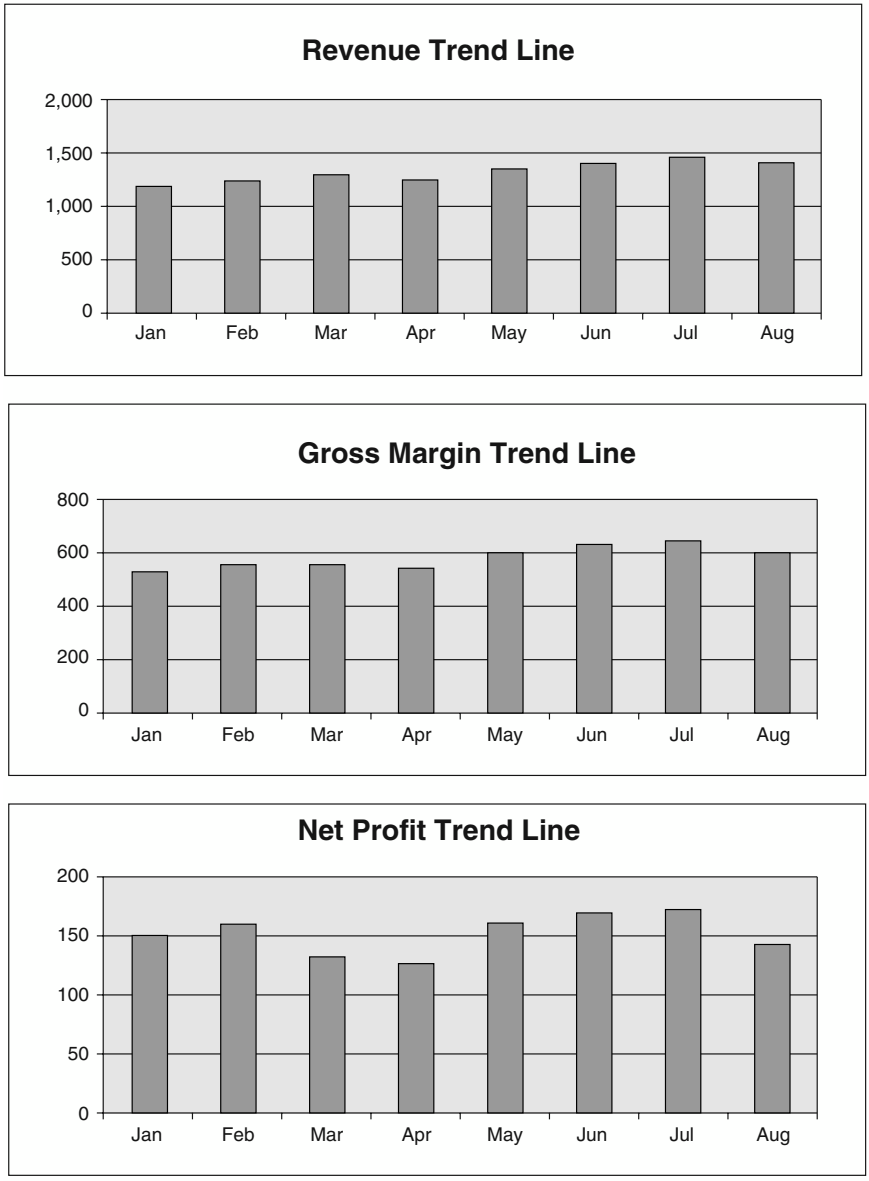


Exhibit 14.7 Graphical Presentation of Trend Lines

The Chart Wizard function is an exceptionally simple guide to creating trend analysis, and is an excellent supporting tool for one who is not only creating a trend analysis, but also presenting the information in a tasteful format for presentation purposes.

FORECASTING

One is sometimes called upon to make sales forecasts or verify those made by the sales and marketing departments. One of the better approaches for doing this is to extend the past history of sales volume forward into the periods being projected. Though this method of prediction is like trying to drive a car by looking in the rear view mirror, it is still one of the best tools available, as long as it is supplemented by detailed conversations with the sales staff to see what is really happening in the marketplace.

There are two formulas provided by Excel that result in forecast information. The first, and simplest, is the TREND command. This one superimposes a trend line on an existing set of time-sequenced data points to arrive at an expected sales level for a specified future period. To illustrate the command, we return once again to the income statement shown earlier in Exhibit 14.1. We will use a new worksheet within the same spreadsheet, called Trend, and reference in it all of the monthly sales figures from the previous income statement. This is shown in Exhibit 14.8, along with a graph that shows the added trend line.

In the worksheet in Exhibit 14.8, we already know all sales data points from January through August, and want to calculate a trend line that extends an additional month to give us a prediction for September sales. Accordingly, in the table of months and historical sales figures noted in the Trend worksheet, there is an additional cell next to the "August" sales period. In that cell we enter the following formula:

TREND(B4:B11,A4:A11,A12)

Though it looks complicated, this is a relatively simple command. The trend line is based on the data points contained in cells B4 through B11 for the date ranges contained in cells A4 through A11. The date for the period to be forecast is noted in cell A12. The formula generates a number that is the extension of the trend shown by the previous data elements and will deposit this number in the B12 cell. Another way to state the formula is to ignore the dates and just ask for the next number in sequence. The formula, based on the previous example, looks like this:

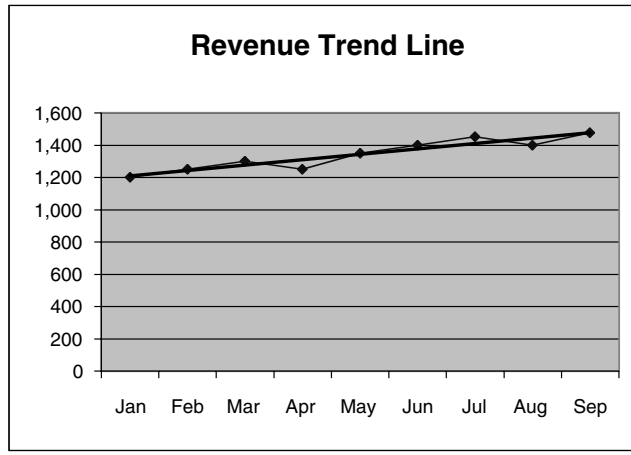
TREND(B4:B11, ,{9})

Under this variation, we are using the same set of data points, but ignoring the dates (hence the two commas in the formula with no data in between), and a number in brackets which represents the trend for the ninth number in the sequence of data elements. Since the original set of data only included eight data elements, this will be the next revenue figure after the last month of actual data. If the requested trend were for the month of December, the number in brackets would change to {12}, since this would represent the twelfth data point in the series.

In order to show this information in a graph, use the same series of steps noted for the graphs previously presented for Exhibit 14.7. However, to add a trend line overlay to the presented data, click on the completed graph, move the cursor to the

Sales Trend Analysis

Month	Revenue
Jan	1,200
Feb	1,250
Mar	1,300
Apr	1,250
May	1,350
Jun	1,400
Jul	1,450
Aug	1,400
Sep	1,475



Regression Analysis

Period	Data Item
1	43
2	79
3	12
4	18
5	59
6	114
7	3
8	82
9	55
10	31
11	94
12	14
13	87
14	51
15	82
16	23
17	21
18	94
19	11
20	79

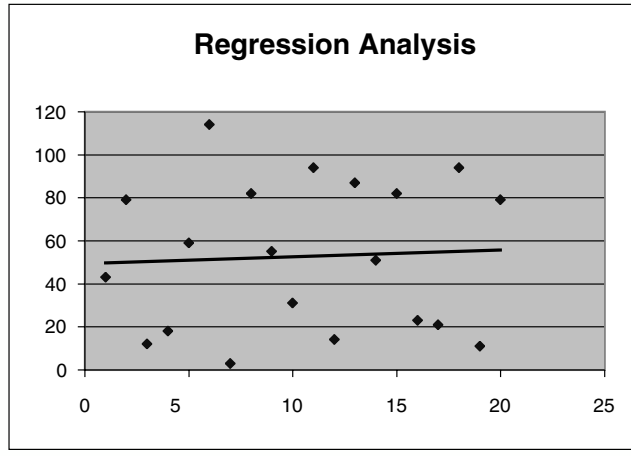


Exhibit 14.8 Trend Line Analysis

revenue line on the chart, and press the right mouse button. Then click on the Add Trendline option, and pick from six available types of trend lines that can be added to the graph.

The second type of forecasting tool provided by Excel is regression analysis. This is a powerful tool for determining the trend line that best fits a disparate set of data, and is most useful when dealing with a set of numbers that are widely scattered, and show no apparent pattern. In essence, the method determines the trend

line that minimizes the sum of all squared errors between all data points and the line. Rather than delve into the formula for this method, it is easiest to plot the data elements and proceed immediately to a graph, on which Excel will superimpose a regression trend line. In Exhibit 14.8, the second half of the presentation includes the regression analysis. In it, we have plotted twenty data items for twenty periods that are wildly different from each other, and have no apparent pattern. The first step in the analysis is to create a graph, using the same methods noted earlier for Exhibit 14.7. Then use the same steps just described for the TREND analysis to add a trend line to the chart. The result is shown in the bottom half of Exhibit 14.8, where we find that there is a slight upward trend line to the data used to compile the regression trend line.

Of the two methods presented, the TREND formula is of the most use, for one will find that most data being analyzed in the financial arena has a lengthy and steady trend line of data. Only for the most unusual analyses, involving wildly disparate data items, will the regression analysis be necessary.

The following list* shows some of the trend lines that one should consider using when measuring a company's operations:

- *Trend of amount of utilized storage space*. This trend can spotlight many contributing problems, such as obsolete inventory, returned goods, scrapped parts, and excess finished goods.
- *Trend of cost of distribution channels*. This analysis should include the net margins earned on each sales channel.
- *Trend of cost of freight*. A company may extend into new geographical regions without considering the cost of shipping product into those areas. This analysis should be conducted by region to spot such problems.
- *Trend of cost of sales calls*. In particular, one should compare the relationship between the sales received from high-volume customers and the cost of making sales calls to them. It is common to find a few high-maintenance customers who are not worth the sales effort from a cost-benefit perspective.
- *Trend of design cycle iterations required*. Increases in the number of design iterations indicate serious problems in the design process, while a drop in the trend indicates good design management (though it can also indicate that an insufficient number of product reviews are being made).
- *Trend of direct labor rates*. This can be used in comparison to a market survey to see if company pay rates are varying from those offered by other firms. After a layoff, it can change suddenly if people whose pay varies substantially from the mean have been laid off.
- *Trend of engineering change notices issued*. A jump in the number of change orders can signal the presence of quality problems, as well as a likely increase in inventory, as some components are rendered obsolete.

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*Reprinted with permission from pages 296–297 of *The Controller's Function*, by Janice M. Roehl-Anderson and Steven M. Bragg (John Wiley & Sons, 2000).

- *Trend of gross margins*. Investigate margins by both product and volume.
- *Trend of inventory, bill of material, and labor routing accuracy*. These three items require very high levels of accuracy in order to operate a production planning system. Any drop in these trends will likely result in production snafus.
- *Trend of number of product options per product family*. Changes in this trend can refer to a deliberate attempt at product proliferation as a marketing strategy (if it increases) or a rationalization of engineering tasks (if it declines).
- *Trend of overhead capitalization*. If the amount of overhead shifted into a capital account, such as inventory, is changing, this may signal a deliberate attempt by management to alter the reported level of earnings.
- *Trend of pricing*. Track the sensitivity of sales volume to changes in pricing.
- *Trend of product returns*. A sudden change in this trend can signal a quality problem in the product, or that the distribution pipeline is full.
- *Trend of ratio of overhead to production labor*. Overhead can balloon rapidly, and this is a prime early indicator of the problem.
- *Trend of return on shareholders' equity and return on assets*. A significant decline in these measures signals reduced cash flow, more difficult borrowing covenants, and a host of other problems, such as reduced margins and increased expenses.
- *Trend of sales quotas*. This trend can be compared to actual sales per salesperson to see if the quotas are unrealistically high or low.
- *Trend of sales volume*. Examine sales volume by both territory and product.
- *Trend of utilized plant capacity*. This is a good indicator of the need for additional production shifts, increased maintenance, or more facilities.

So far in this chapter, we have dealt with a variety of analyses that are used primarily for financial statement reviews or budget projections. We now move to other Excel functions that are primarily used for the evaluation of capital projects, investments, and risk analysis.

CASH FLOW ANALYSIS

When evaluating a capital asset proposal, there are many factors to review, such as expected market conditions, sales estimates, salvage values, and maintenance costs. After all of these items have been reviewed and substantiated, they must all be input into a cash flow projection model to see if the project returns an adequate amount of cash. Excel supplies a formula that makes this an easy task, once the stream of all cash flows has been entered into a spreadsheet. A sample of such an analysis is shown in Exhibit 14.9, where we have simulated a typical cash–generating project that involves a significant up-front expenditure to purchase and set up equipment, five years of progressively larger positive cash flows as more equipment capacity is used, and then additional costs at the end of the project to dismantle the equipment, which is net of salvage value.

Net Present Value Analysis

(All figures in thousands)

Period	Equipment Purchases	Equipment Installation	Testing Costs	Maintenance Costs	Personal Property Taxes	Revenue Revenue	Net Cash Flows
1	(1,200)	(400)	(250)	(50)	(48)	300	(1,648)
2				(55)	(48)	600	497
3				(60)	(48)	650	542
4				(65)	(48)	700	587
5				(70)	(48)	750	632
6	120	(75)			(48)		(3)

Cost of Capital **13%** Net Present Value **8**

Notes:
(1) Assumes a 10% salvage value at the end of the project.
(2) Assumes that positive cash flows will commence half-way into the first year.
(3) Assumes that personal property taxes will still be woned in the final year of operations, despite a projected disposal sometime during the year.

Exhibit 14.9 Net Present Value Calculation

Once this information is stored in a spreadsheet, we add the net present value formula, which is derived as follows:

NPV(Interest rate, Range of cash flow values)

The interest rate used in the formula should be the incremental cost of capital. The range of cash flow values listed in the second part of the formula represent the net cash flows for each period of the analysis. The formula then determines the current value of the expected future cash flows for each future period, using the cost of capital as the discounting factor, and summarizes all of the separate discounted cash flows into a single dollar value of all cash flows for the project. In the example, the formula uses a cost of capital of 13%, which results in the following formula:

NPV(.13,I6:I11)

The NPV formula is a powerful tool for determining the discounted cash flows of projects, but one must keep in mind that the cash flows used in these models are highly subjective in nature (depending on the extent of previous analysis work), which results in net present values that appear to be accurate to the nearest penny, but which do not have solid quantitative underpinnings, which yields inaccurate results. For example, the cash flow analysis shown earlier in Exhibit 14.9 listed a large percentage of cash inflows in the later years of the project, which contributed to the small positive cash flow anticipated for the project; unfortunately, cash flows several years into the future are more uncertain and unpredictable than those

likely to arrive in the near term, so these long-term estimates should be closely reviewed. In short, one should spend a great deal of time questioning the expected cash flows used in a net present value analysis in order to be sure of the outcome.

Cash flow assumptions are not the only factor involved in the net present value calculation. The other factor is the cost of capital used to discount the stream of cash flows. If this factor is incorrect by even a small amount, then the net present value will be incorrect, which can lead to an incorrect decision regarding the acceptance or rejection of a project. The simplest way to determine the potential severity of an error with the cost of capital is to re-calculate the net present value using a cost of capital that is incrementally higher than the original interest rate. If the net present value drops below zero, then it may be necessary to review the accuracy of the cost of capital to ensure that it is correct. A slightly more elaborate approach, as shown in Exhibit 14.10, is to plot a comparison of the net present value to the cost of capital to see at what discount rate the net present value drops to zero. Using this graphical approach, we can see that, if the cost of capital increases by just 1% from the 13% used earlier in Exhibit 14.9, the net present value will turn negative. Consequently, though the original calculation shows a positive return, it is so small that a re-examination of the cost of capital may be in order to verify that the discount rate used is the correct one.

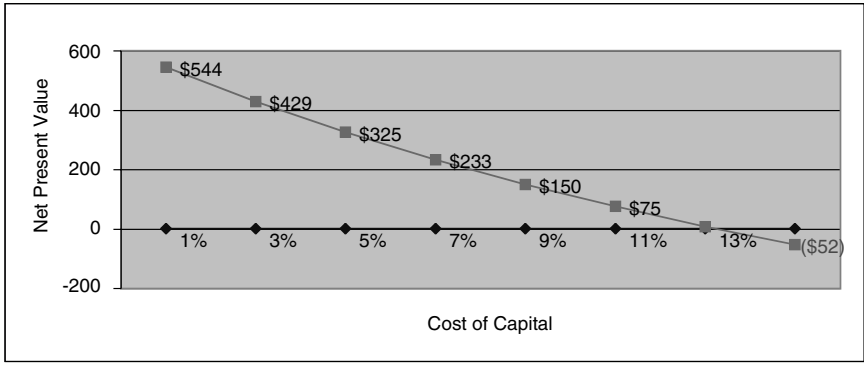
The calculations used to create the graph in Exhibit 14.10 are shown at the bottom of the exhibit, with the text of all formulas noted in the lower right corner. Each net present value formula references the cost of capital immediately to its right, while also referencing the time-sequenced series of cash flows noted on the NPV worksheet that was shown in Exhibit 14.9.

CAPITAL ASSET ANALYSIS

The preceding section dealt with the main capital asset issue with which Excel can provide assistance, which is in calculating a project's net present value. This section only deals with one additional item related to the analysis of a capital asset investment decision.

A key issue that factors into the cash flow from a project is its depreciation rate. Though depreciation does not directly involve cash flow (since it is only the amortization of the original cash outlay for the capital asset), it has an indirect impact because the depreciation expense in each period will reduce the amount of taxes paid—and that *is* a real cash outflow. There are a variety of depreciation methods available that Excel can translate into period-by-period depreciation rates that can then be inserted into a cash flow model to derive the ultimate impact on cash flows. The following list illustrates the formulas for each one, and briefly explain how each depreciation method works:

- *Double-declining balance depreciation*. This method computes depreciation at a highly accelerated rate, generally resulting in the greatest first-period depreciation of all the methods described here. The formula detail is DDB(Cost, Sal-



Cost of Capital	Net Present Value		Formula Text
1%	$544	=	NPV($C18,NPV!$H$6:NPV!$H$11)
3%	$429	=	NPV($C19,NPV!$H$6:NPV!$H$11)
5%	$325	=	NPV($C20,NPV!$H$6:NPV!$H$11)
7%	$233	=	NPV($C21,NPV!$H$6:NPV!$H$11)
9%	$150	=	NPV($C22,NPV!$H$6:NPV!$H$11)
11%	$75	=	NPV($C23,NPV!$H$6:NPV!$H$11)
13%	$8	=	NPV($C24,NPV!$H$6:NPV!$H$11)
15%	($52)	=	NPV($C25,NPV!$H$6:NPV!$H$11)

Exhibit 14.10 NPV to Discount Rate Comparison

vage, Life, Period). The Cost part of the equation is the initial cost of the asset. The Salvage part of the equation is the end-of-project salvage value (if any) of the equipment. The Life part of the equation is the number of periods during which the asset is being depreciated, which is assumed to be in years. The Period part of the equation is the period for which you want to determine the depreciation rate. For example, if you want to calculate the depreciation for 10 consecutive years, you will need to run the formula ten times, while changing the Period part of the equation each time to reflect the desired year's result.

- *Fixed-declining balance depreciation*. This method also computes depreciation at an accelerated rate. The formula detail is DB(Cost, Salvage, Life, Period). The descriptions for all of the inputs to the equation are identical to those for the double-declining balance method.
- *Straight line depreciation*. This method computes depreciation at the same rate for all periods, resulting in a smooth and easily calculated depreciation amount for all periods. However, it does not assist in accelerating cash flows by aggressively reducing taxes. The formula detail is SLN(Cost, Salvage, Life). The descriptions for all of the inputs to the equation are identical to those for the double-declining balance method. However, there is no Period entry, since the result will be the same, irrespective of the specific period for which you are calculating the depreciation.
- *Sum of the years' digits depreciation*. This method provides accelerated depreciation, though not as rapid as provided under the double-declining balance method. The formula detail is SYD(Cost, Salvage, Life, Period). Once again,

the descriptions for all of the inputs to the equation are identical to those for the double-declining balance method.

- *Variable-declining balance depreciation*. This method is essentially the same as the double-declining balance method, but you can alter the depreciation rate, as well as convert over to straight-line depreciation at the point where accelerated depreciation results in a lower depreciation expense. The formula detail is VDB(Cost, Salvage, Life, Start Period, End Period, Depreciation Factor, Switch to Straight Line). The descriptions for the first three inputs to the equation are the same as those used for the double-declining balance method. The Start Period part of the equation specifies the beginning period for which you want to calculate depreciation. The End Period part of the equation specifies the ending period for which you want to calculate depreciation. The Depreciation factor part of the equation specifies the rate at which depreciation is calculated. For example, entering a "2" results in 200% double-declining depreciation, whereas entering a 1.5 results in 150% depreciation, which is a less rapid form of accelerated depreciation. Finally, the Switch to Straight Line part of the equation allows you to enter TRUE to use declining balance depreciation for all depreciation periods, or enter FALSE to have the formula automatically switch to straight-line depreciation at the point where straight-line results in a higher depreciation expense.

It is evident that the bulk of data inputted into all of these depreciation formulas is nearly identical. Only the underlying formulas will alter the calculated depreciation expense.

The type of depreciation method used matters a great deal, for the most aggressive one, that depreciates the largest amount in the first few periods, will result in reduced taxes in the near term, which results in increased short-term cash flow. Since increased cash flow now is worth more than cash flow at the end of a project, an aggressive depreciation method will yield greater project cash flows.

COMPOUNDING ANALYSIS

One is sometimes called upon to calculate the result of a variety of payment or receipt scenarios that involve streams of cash flows over multiple periods. In this section, we review several of the most common ones, as well as how to use Excel formulas to create accurate answers for each scenario. They are:

- *Future value*. If a company is investing money at a consistent rate for a fixed time period, one may want to know how much that investment stream will be worth at a specified future date. To determine the future value of such an investment stream, use the FV formula. The details of the formula are FV(Interest Rate, Number of Periods, Payment Amount). The Interest Rate component is the expected earnings rate on the investment. The Number of Periods component is the number of periods over which a fixed amount is being invested. The

Payment Amount component is the fixed amount being paid during each period. For example, if a company were to invest $4,000 per period for 128 months at an annual interest rate of 8%, the formula would be FV(8%/12,128,-4000).

- *Interest rate on an annuity*. If a company is offered a specific set of regular payments (i.e., an annuity), it is useful to see if this results in an adequate rate of return. To determine the interest rate on such an annuity, use the RATE formula. The details of the formula are RATE(Number of Periods, Payment Amount, Present Value of Payments). The Number of Periods component specifies the number of periods over which fixed payments will be made. The Payment Amount component shows the amount of each payment. The Present Value of Payments component notes the current cash value of the investment for which payments are being made. For example, if an investor wishes to purchase a bond with a current value of $100,000 and will pay for it with monthly payments of $1,500 for 10 years, the formula would be RATE(10,–1500,100000). The resulting interest rate will be on a monthly basis, and must be multiplied by twelve to arrive at an annual interest rate.
- *Loan payment*. One of the most common calculations one makes is the determination of loan payments for a specified amount of borrowing at a set interest rate. This calculation can also be used to verify the same information that has been supplied by the lender. To determine the amount of a loan payment, use the PMT formula. The details of the formula are PMT(Interest Rate, Number of Payments, Present Value of Loan). The Interest Rate component is the interest rate per period, and is assumed not to vary. The Number of Payments component represents the number of periods over which fixed payments are to be made. The Present Value of Loan component is the original amount of the loan that must now be paid off. For example, to determine the payment amount for a loan of $355,000 at an interest rate of 7%, and which will be paid off in 120 periods (e.g., 10 years), the formula would be PMT(7%/12,120,355000).
- *Number of periods*. If there is an obligation to pay a set amount with a standard number of periodic payments, it may be necessary to determine how long those payments will last before the obligation to pay has been fulfilled. To determine the number of required payments, use the NPER formula. The details of the formula are NPER(Interest Rate, Payment Amount, Present Value). The Interest Rate component is the interest rate per period, and is assumed not to vary. The Payment Amount component is the amount paid per period, and is also assumed not to vary. Finally, the Present Value component is the current value of the obligation being paid off. For example, to determine the number of payment periods required to pay off an investment of $150,000 at an annual interest rate of 12%, and with periodic payments of $28,134, the formula is NPER(12%,–28134,150000).
- *Present value*. If a company anticipates receiving a string of payments in future periods, it may be useful to determine their present value, since this information can be used to compare the payment stream to the value of other sources of income to see which is more valuable. Such an analysis may result in the sale of

whatever investment is resulting in a payment stream that is considered to have a less-than-stellar present value. To determine an investment's present value, use the PV formula. The details of the formula are PV(Interest Rate, Number of Payment Periods, Total Payment Made per Period). The Interest Rate component is the interest rate per period, and is assumed not to vary. The Number of Payment Periods component is the number of periods during which payments are expected to arrive. The Total Payment Made per Period component is the payment made in each period, and is assumed to be the same in every period. For example, to determine the present value of a stream of $10,000 payments at a 6.5% interest rate over 20 years, the formula would be PV(6.5%,20,10000).

- *Principal payment*. A company sometimes makes a fixed payment without a clear delineation of what portion is interest and what is principal. This is especially common for capital leases, where the lessor is under no legal obligation to reveal how much of either payment component is being paid. To determine the amount of principal within such a payment, use the PPMT formula. The details of the formula are PPMT(Interest Rate, Period, Total Number of Payment Periods, Present Value). The Interest Rate component is the interest rate per period. The Period component is the specific period for which you want to determine the principal payment. The Total Number of Payment Periods component is the number of payment periods for the term of the entire loan. Finally, the Present Value component is the amount of the loan at the beginning of the transaction. For example, if you want to determine the total principal payment in the seventh year of a 12-year, $50,000 loan that bears a 9% interest rate, the formula would be PPMT(9%,7,12,50000).

Given the number of available Excel formulas, it is evident that the majority of queries that one will receive regarding the time value of money can be answered by a short formula entry in Excel.

INVESTMENT ANALYSIS

Excel contains a large number of formulas that can be used to determine the interest rate on a variety of investments. In this section, we will cover the key interest-rate formulas, including a brief explanation of each one, the components of each formula, and how the formula is used in an example. The definitions of the components of the various formulas are summarized in a set of definitions at the end of this section. The formulas are:

- *Calculate the accrued interest on a security that pays interest at maturity*. For this calculation, use the ACCRINTM formula. The details of the formula are ACCRINTM(Issue Date, Maturity Date, Annual Coupon Rate, Par Value). For example, if the issue date is 12/12/99 and the maturity date is 5/15/04 on a 9.5% coupon rate bond with a par value of $1,000, the formula would be ACCRINTM("12/12/99","5/15/04",9.5%,1000).

- *Calculate the accrued interest on a security that pays periodic interest*. This formula is used to accrue the amount of interest earned from a stream of regular interest payments from an investment. For this calculation, use the ACCRINT formula. The details of the formula are ACCRINT(Issue Date, First Interest Date, Settlement Date, Annual Coupon Rate, Par Value, No. of Payments per Year). For example, if the issue date is 3/31/01, the first interest date is 4/15/01, the settlement date is 4/10/01, the annual coupon rate is 11%, the par value is $1,000, and there are four payments per year, then the formula will be ACCRINT("3/31/01","4/15/01","4/10/01",11%,1000,4).
- *Calculate the annual yield for a discounted security*. If a company purchases a security at a discounted rate (usually because the stated interest rate is lower than the prevailing market rate), one should use the YIELDDISC formula to determine its annual yield. The details of the formula are YIELDDISC(Settlement Date, Maturity Date, Price per $100 Face Value),Redemption Value). For example, if the settlement date is 9/9/05, the maturity date is 12/31/15, the price is $101, and the redemption value is $100, then the formula will be YIELDDISC("9/9/05","12/31/15",101,100).
- *Calculate the yield for a Treasury bill*. To calculate this yield, use the TBILLYIELD formula. The details of the formula are TBILLYIELD(Settlement Date, Maturity Date, Price Per $100 Face Value). For example, if the settlement date is April 13, 2005, the maturity date is June 15, 2012, and the price per $100 face value is $94.30, then the formula will be TBILLYIELD ("4/14/05","6/15/12",94.3).
- *Calculate the yield on a security that has a short or long first period.* A security that was purchased in between its coupon payment dates will still earn the owner the full amount of the next coupon, even though the security was not held for the full period, which results in a higher than normal interest rate earned for the first period. To calculate the full-term yield with the odd-length first period, use the ODDFYIELD formula. The details of the formula are (ODDFYIELD(Settlement Date, Maturity Date, Issue Date, First Coupon Date, Annual Coupon Rate, Price per $100 Face Value, Redemption Value, No. of Payments per Year). For example, if the settlement date is May 2, 2003, the maturity date is November 11, 2008, the issue date is June 6, 2001, the first coupon date is July 7, 2003, the interest rate is 8.5%, the price is $98.25, the redemption value is $100, and four coupon payments are made per year, then the formula will be ODDFYIELD("5/2/03","11/11/08","6/6/01","7/7/03",8.5%, 98.25,100,4).
- *Calculate the yield on a security that has a short or long last period*. This is the same type of situation as just described in the preceding scenario, except that we are now selling a security prior to the next scheduled coupon date. The formula now changes to ODDLYIELD, for which the formula detail is ODDLYIELD(Settlement Date, Maturity Date, Last Coupon Date, Annual Coupon Rate, Price per $100 Face Value, Redemption Value, No. of Payments per Year). To use part of the preceding example, if the settlement date is May 2,

2003, the maturity date is November 11, 2008, the last coupon date is August 11, 2008, the interest rate is 8.5%, the price is $98.25, the redemption value is $100, and four coupon payments are made per year, then the formula will be ODDFYIELD("5/2/03","11/11/08","8/11/08",8.5%,98.25,100,4).

- *Calculate the yield on a security that pays interest at maturity*. Some securities pay all interest at the redemption date, rather than as regular coupon payments. To calculate the yield on these types of securities, use the YIELDMAT formula. The detail for this formula is YIELDMAT(Settlement Date, Maturity Date, Issue Date, Annual Coupon Rate, Price per $100 Face Value). For example, if the settlement date is February 15, 2002, the maturity date is April 15, 2011, the issue date is October 5, 2001, the interest rate is 8.2%, and the price is $101.125, then the formula will be YIELDMAT("2/15/02","4/15/11", "10/5/01",8.2%,101.125).
- *Calculate the yield on a security that pays periodic interest*. This is the standard formula for a basic bond purchase that has no unusual variations in terms of purchase or sale dates, and for which coupon payments are made in standard amounts and on regularly scheduled dates. For this situation, use the YIELD formula. The detail of the formula is YIELD(Settlement Date, Maturity Date, Annual Coupon Rate, Price per $100 Face Value, Redemption Value, No. of Payments per Year). For example, if the settlement date is January 8, 2001, the maturity date is May 15, 2007, the annual coupon rate is 7.5%, the price is $100.50, the redemption value is $100, and there are two coupon payments per year, then the formula will be YIELD("1/8/01","5/15/07",7.5%,100.50,100,2).

Most of the components of the above formulas are identical. To keep from repeating the definitions of each component for every formula listed above, they are summarized below:

- *Annual coupon rate*. The listed coupon rate on a security.
- *First Interest date*. The first date on which interest is earned on a security.
- *Issue date*. The date on which a security is issued.
- *Last coupon date*. The last coupon date for a security prior to its redemption date.
- *Maturity date*. The date on which a security expires.
- *No. of payments per year*. The number of coupon payments per year.
- *Par value*. The listed price on a security.
- *Price per $100 face value*. The actual price paid for a security can be higher or lower than the face value, depending on the discount or premium paid to acquire the stated interest to be paid on the security.
- *Redemption value*. The amount paid at the termination date of the security per $100 of face value.
- *Settlement date*. The date when the security is issued to the buyer.

The formulas described here should be sufficient for calculating the interest rates or accrued interest for the majority of investment situations for which one will need to calculate interest earnings.

RISK ANALYSIS

When constructing a financial analysis of the likely results of a set of projected cash flows, one must always remember that these cash flows are *projected*—they are not facts, and may vary considerably from reality. Given the level of uncertainty involved, it may be useful to determine the spread of possible outcomes. By doing so, one can see if all expected outcomes are grouped tightly about a single estimate, which relates to a low level of risk, or if there is a significant spread of possible outcomes, which greatly increases the risk of meeting the targeted outcome. Excel provides a wide array of statistical tools for determining the level of risk, of which this section describes six that are easy to understand and use.

The first step when using the following statistical tools is to generate a list of possible outcomes for whatever the analysis may be. For example, if there is a capital project under discussion, try to obtain a number of possible outcomes, either by polling several experts in the company or industry, or by personal knowledge of previous actual outcomes for similar types of projects. Then, the first step in the risk analysis work is to determine the highest, lowest, and median values in the list of possible outcomes. These are shown in Exhibit 14.11, where we have itemized a dozen possible annual cash inflows from a project. All possible variations are noted at the top of the worksheet. Below them are the Excel formulas to find the minimum, maximum, and median values from amongst the list, alongside a listing of the formulas used. However, these are not very precise measures, and do not give a sufficiently accurate view of the level of risk.

To provide us with a more detailed idea of the spread of possible outcomes, we can use the Excel QUARTILE formula to generate the average outcome for the first, second, third, and fourth quartiles of all possible outcomes, which we have also converted into a graph with the Excel Chart Wizard icon. Yet another formula that tells us if there is a "lean" in the data toward the lower or higher end of the spectrum of possible results is the SKEW formula. This formula determines the presence of skew toward the higher end of the possible outcomes (which is positive skew) or a skew toward the lower end of the outcomes (which is a negative skew). A skew of zero indicates no skew in either direction. Finally, the standard deviation is an extremely useful tool for determining the dispersion of possible outcomes about the median of all outcomes. The larger the standard deviation of the sample, the larger the dispersion about the median, and the greater the degree of risk that the average outcome will not be attained.

The detail of the formulas shown in Exhibit 14.11 are very simple. All of the formulas reference the range of projected cash inflows, which are noted in cells C5 through C16. The only variation from this pattern is for the quartile formulas, which also require the addition of the quartile number at the end of the formula.

Risk Analysis for a Capital Project

Projected Outcome	Projected Cash Inflow
1	$5,400
2	$3,200
3	$1,700
4	$6,100
5	$2,900
6	$4,700
7	$5,800
8	$8,000
9	$3,900
10	$4,250
11	$5,950
12	$2,500

	Result		Text of Formula
Minimum value of all Outcomes	$1,700	=	MIN($C$5:$C$16)
Maximum value of all Outcomes	$8,000	=	MAX($C$5:$C$16)
Median value of all Outcomes	$4,475	=	MEDIAN($C$5:$C$16)
Minimum value	$1,700	=	QUARTILE($C$5:$C$16,0)
Value of 25th percentile	$3,125	=	QUARTILE($C$5:$C$16,1)
Value of 50th percentile	$4,475	=	QUARTILE($C$5:$C$16,2)
Value of 75th percentile	$5,838	=	QUARTILE($C$5:$C$16,3)
Maximum value	$8,000	=	QUARTILE($C$5:$C$16,4)
Degree of skew	0.24	=	SKEW($C$5:$C$16)
Standard deviation	$1,808	=	STDEV($C$5:$C$16)

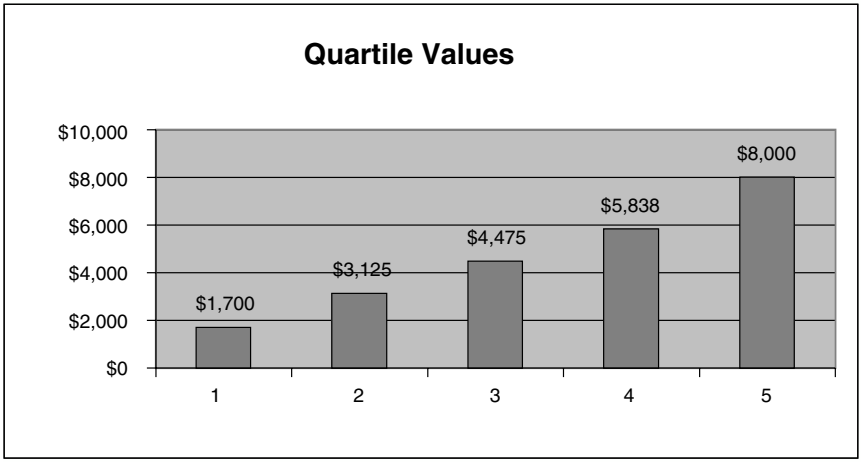


Exhibit 14.11 Risk Analysis for a Capital Project.

The analysis shown in Exhibit 14.11 tells us that the project has an extremely wide range of possible outcomes, with a maximum value that is more than four times higher than the minimum value. The range of possible outcomes has a positive skew of 0.24, which tells us that those people providing the estimates have generally guessed that the actual outcome should be higher than the projected average. Finally, the standard deviation from the mean is $1,808, which is slightly more than a 40% variation from the median. With such a large dispersion of possible outcomes, the underlying data requires a great deal more validation before the project can be approved. Also, given the higher degree of risk, the cost of capital used to discount the cash flows from the project may be set higher, thereby making it more difficult to obtain approval for the project.

Glossary*

Accounts payable. Current liability on the balance sheet, representing short-term obligations to pay suppliers.

Accounts receivable. Current asset on the balance sheet, representing short-term amounts due from customers who have purchased on account.

Accrual accounting. Recording of revenue when earned and expenses when incurred, irrespective of the dates on which the associated cash flows occur.

Accumulated depreciation. Sum total of all deprecation expense recognized to date on a depreciable fixed asset.

Additional paid-in capital. Any payment received from investors for stock that exceeds the par value of the stock.

Allowance for bad debts. An offset to the accounts receivable balance, against which bad debts are charged. This allowance is used to avoid severe changes in the period-to-period bad debt expense by expensing a steady amount to the allowance account in every period, rather than writing off large bad debts to expense on an infrequent basis.

Amortization. Write-off of an asset over the period when the asset is used. This term is most commonly applied to the gradual write-down of intangible items, such as goodwill or organizational costs.

Asset. A resource, recorded through a transaction, that is expected to yield a benefit to a company.

Average inventory. The beginning inventory for a period, plus the amount at the end of the period, divided by two. It is most commonly used in situations where just using the period-end inventory yields highly variable results, because of constant and large changes in the inventory level.

Bad debt. An account receivable that cannot be collected.

Balance sheet. Report that summarizes all assets, liabilities, and equity for a company for a given point in time.

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*Adapted from Appendix E of *Accounting Reference Desktop*, by Steven M. Bragg (John Wiley & Sons, 2002).

Bill of materials. Itemization of the parts and subassemblies required to create a product, frequently including assumed scrap rates that will arise as part of the production process.

Book inventory. Amount of money invested in inventory, per a company's accounting records. It comprises the beginning inventory balance, plus the cost of any receipts, less the cost of sold or scrapped inventory. It may be significantly different from the actual on-hand inventory if the two are not periodically reconciled.

Book value. An asset's original cost, less any depreciation that has been subsequently incurred.

Bottleneck. An operation in the midst of a manufacturing or service process in which the required production level matches or exceeds the actual capacity.

Break-even point. Sales level at which a company, division, or product line makes a profit of exactly zero; it is computed by dividing all fixed costs by the average gross margin percentage.

Capital. Investment by a company's owners in a business, plus the impact of any accumulated gains or losses.

Capital asset. A fixed asset, something that is expected to have long-term use within a company, and which exceeds a minimum dollar amount (known as the capitalization limit, or cap limit).

Capital lease. Lease in which the leasee obtains some ownership rights over the asset involved in the transaction, resulting in the recording of the asset as company property on its general ledger.

Capitalize. Purchase that has been recorded on the company books as an asset. The grounds for capitalizing an item include a purchase price that is higher than a minimum limit (known as the capitalization limit) and an estimated lifetime for the item that will exceed one year.

Contribution margin. Margin that results when variable production costs are subtracted from revenue. It is most useful for making incremental pricing decisions where a company must cover its variable costs, though perhaps not all of its fixed costs.

Cost. Expense incurred to create and sell a product or service. If a product is not sold, then it is recorded as an asset, whereas the sale of a product or service will result in the recording of all related costs as an expense.

Cost of capital. Blended cost of company's currently outstanding debt instruments and equity, weighted by the comparative proportions of each one. During a capital budgeting review, the expected return from a capital purchase must exceed this cost of capital, or else a company will experience a net loss on the transaction.

Cost of goods sold. Accumulated total of all costs used to create a product or service, which is then sold. These costs fall into the general subcategories of direct labor, materials, and overhead.

Current asset. Typically the cash, accounts receivable, and inventory accounts on the balance sheet, or any other assets that are expected to be liquidated within a short time interval.

Current cost. Under target costing concepts, the cost that would be applied to a new product design if no additional steps were taken to reduce costs, such as through value engineering or kaizen costing. Under traditional costing concepts, this is the cost of manufacturing a product with work methods, materials, and specifications currently in use.

Current liability. Typically the accounts payable, short-term notes payable, and accrued expenses accounts on the balance sheet, or any other liabilities that are expected to be liquidated within a short time interval.

Debt. Funds owed to another entity.

Deficit. Negative balance in the retained earnings account that is caused by cumulative losses that exceed the amount of equity.

Depreciation. Refers to both the decline in value of an asset over time, as well as the gradual expensing of an asset over time, roughly in accordance with its level of usage or decline in value through that period.

Direct cost. Costs that can be clearly associated with specific activities or products.

Direct labor. Labor that is specifically incurred to create a product.

Direct materials cost. Cost of all materials used in a cost object, such as finished goods.

Dividend. Payment made to shareholders that is proportional to the number of shares owned. It is authorized by the board of directors.

Equity. Difference between the total of all recorded assets and liabilities on the balance sheet.

Expenditure. Payment or the incurrence of a liability by an entity.

Expense. Represents the reduction in value of an asset as it is used for current company operations.

Extraordinary item. Transaction that rarely occurs and is unusual, such as expropriation of company property by a foreign government. It is reported as a separate line item on the income statement.

Factory overhead. All the costs incurred during the manufacturing process, minus the costs of direct labor and materials.

Fair market value. Price that an asset or service will fetch on the open market.

Finished goods inventory. Goods that have been completed by the manufacturing process or purchased in a complete form, but have not yet been sold to customers.

Fixed asset. Item with a longevity greater than one year, and which exceeds a company's minimum capitalization limit. It is not purchased with the intent of immediate resale, but rather for productive use within a company.

Fixed cost. Cost that does not vary in the short run, irrespective of changes in any cost drivers. For example, the rent on a building will not change until the lease runs out or is renegotiated, irrespective of the level of business activity within that building.

Fixed overhead. Portion of total overhead costs that remain constant in size irrespective of changes in activity within a certain range.

Gain. Profit earned on sale of an asset, computed by subtracting its book value from the revenue received from its sale.

Goodwill. Excess of the price paid to buy another company over the book value of its assets and the increase in cost of its fixed assets to fair market value.

Gross margin. Revenues less the cost of goods sold.

Gross sales. Total sales recorded prior to sales discounts and returns.

Income. Net earnings after all expenses for an accounting period are subtracted from all revenues recognized during that period.

Income statement. Financial report that summarizes a company's revenue, cost of goods sold, gross margin, other costs, income, and tax obligations.

Income tax. A government tax on the income earned by an individual or corporation.

Indirect cost. Cost that is not directly associated with a single activity or event. Such costs are frequently clumped into an overhead pool and allocated to various activities, based on an allocation method that has a perceived or actual linkage between the indirect cost and the activity.

Indirect labor. Cost of any labor that supports the production process but not directly involved in the active conversion of materials into finished products.

Intangible asset. This is a nonphysical asset with a life greater than one year. Examples are goodwill, patents, trademarks, and copyrights.

Interest. Cost of funds loaned to an entity. It can also refer to the equity ownership of an investor in a business entity.

Leasehold improvement. Any upgrade to leased property by a leasee that will be usable for more than one year and exceeds the lessee's capitalization limit. It is recorded as a fixed asset and depreciated over a period no longer than the life of the underlying lease.

Liability. Dollar amount of obligation payable to another entity.

Long-term debt. Debt for which payments will be required for a period of more than one year into the future.

Loss. Excess of expenses over revenues, either for a single business transaction or in reference to the sum of all transactions for an accounting period.

Market value. Price at which a product or service could be sold on the open market.

Marketable security. Easily traded investment, such as treasury bills, which is recorded as a current asset, since it is easily convertible into cash.

Negative goodwill. A situation when a business combination results in the fair market value of all assets purchased exceeds the purchase price.

Net income. Excess of revenues over expenses, including the impact of income taxes.

Net realizeable value. Expected revenue to be gained from the sale of an item or service, less the costs of the sale transaction.

Net sales. Total revenue, less the cost of sales returns, allowances, and discounts.

Obsolescence. Reduction in utility of an inventory item or fixed asset. If it is an inventory item, then a reserve is created to reduce the value of the inventory by the estimated amount of obsolescence. If it is a fixed asset, the depreciation method and timing will be set to approximate the rate and amount of obsolescence.

Operating expense. Any expense associated with the general, sales, and administrative functions of a business.

Operating income. Net income of a business, less the impact of any financial activity, such as interest expense or investment income, as well as taxes and extraordinary items.

Other assets. Cluster of accounts that are listed after fixed assets on the balance sheet, and which contain minor assets that cannot be reasonably fit into any of the other main asset categories.

Owners' equity. Total of all capital contributions and retained earnings on a business's balance sheet.

Paid-in capital. Any payment received from investors for stock that exceeds the par value of the stock.

Par value. Stated value of a stock, which is recorded in the capital stock account. Equity distributions cannot drop the value of stock below this minimum amount.

Preferred stock. Type of stock that usually pays a fixed dividend prior to any distributions to the holders of common stock. In the event of liquidation, it must be paid off before common stock. It can, but rarely does, have voting rights.

Prepaid expense. Expenditure that is paid for in one accounting period but not be entirely consumed until a future period. Consequently, it is carried on the balance sheet as an asset until it is consumed.

Product cost. Total of all costs assigned to a product, typically including direct labor, materials (with normal spoilage included), and overhead.

Property, plant, and equipment. Comprises of all types of fixed assets recorded on the balance sheet and is intended to reveal the sum total of all tangible, long-term assets used to conduct business.

Quick asset. Any asset that can be converted into cash on short notice. This is a subset of a current asset, because it does not include inventory. Its most com-

mon components are the cash, marketable securities, and accounts receivable accounts.

Raw materials inventory. Total cost of all component parts currently in stock that have not yet been used in work-in-process or finished goods production.

Retained earnings. A company's accumulated earnings since its inception, less any distributions to shareholders.

Revenue. Inflow of cash, accounts receivable, or barter from a customer in exchange for the provision of a service or product to that customer by a company.

Rework. Product that does not meet a company's minimum quality standards and is then repaired in order to meet those standards.

Sales allowance. Reduction in a price that is allowed by the seller, because of a problem with the sold product or service.

Sales discount. Reduction in the price of a product or service that is offered by the seller in exchange for early payment by the buyer.

Salvage value. Expected revenue to be garnered from the sale of a fixed asset at the end of its useful life.

Scrap. Excess unusable material that is left over after a product has been manufactured.

Share. Minimum unit of ownership in a corporation.

Statement of cash flows. Part of the financial statements, summarizing an entity's cash inflows and outflows in relation to financing, operating, and investing activities.

Statement of retained earnings. Adjunct to the balance sheet, providing more detailed information about the beginning balance, changes, and ending balance in the retained earnings account during the reporting period.

Stock option. Right to purchase a specific maximum number of shares at a specific price no later than a specific date. It is a commonly used form of incentive compensation.

Stockholder. Person or entity who owns shares in a corporation.

Transfer price. Price at which one part of a company sells a product or service to another part of the same company.

Variable cost. Cost that changes in amount in relation to changes in a related activity.

Working capital. Amount of a company's current assets minus its current liabilities, considered to be a prime measure of its level of liquidity.

Work-in-process inventory. Inventory that has been partially converted through the production process, but for which additional work must be completed before it can be recorded as finished goods inventory.

APPENDIX

Measurement Summary

This appendix contains all the measurements described in Chapters 2 through 13. It is intended to be a quick reference for the reader who needs to find a formula as soon as possible. However, refer back to the related discussion in the main body of the book, since there may be comments on alternative formula derivations or cautions on their use that may be pertinent.

The following measurements are listed in the same order as they are found within each chapter, and the name of each measurement and its derivation are shown. In some cases, multiple variations on the same measurement are shown.

Asset Utilization Measurements

Name	*Formula*
Sales to working capital ratio	$\frac{\text{Annualized net sales}}{\text{(Accounts receivable + Inventory – Accounts payable)}}$
Sales to fixed assets ratio	$\frac{\text{Annualized net sales}}{\text{Total fixed assets}}$
	$\frac{\text{Annualized net sales}}{\text{Total fixed assets prior to accumulated depreciation}}$
Sales to administrative expenses ratio	$\frac{\text{Annualized net sales}}{\text{Total general and administrative expenses}}$
Sales to equity ratio	$\frac{\text{Annual net sales}}{\text{Total equity}}$
Sales per person	$\frac{\text{Annualized revenue}}{\text{Total full-time equivalents}}$

Sales backlog ratio	$\frac{\text{Backlog of orders received}}{\text{Sales}}$
	$\frac{\text{Total backlog}}{\text{Annual sales / 360 Days}}$
Sales returns to gross sales ratio	$\frac{\text{Total sales returns}}{\text{Gross sales}}$
Repairs and maintenance expense to fixed assets ratio	$\frac{\text{Total repairs and maintenance expense}}{\text{Total fixed assets before depreciation}}$
Accumulated depreciation to fixed assets ratio	$\frac{\text{Accumulated depreciation}}{\text{Total fixed assets}}$
Fringe benefits to wages and salaries expense	$\frac{\text{Life insurance + Medical insurance + Pension funding expense + Other benefits}}{\text{Wages + Salaries + Payroll taxes}}$
Sales expenses to sales ratio	$\frac{\text{Sales salaries + Commissions + Sales travel expenses + Other sales expenses}}{\text{Sales}}$
Discretionary cost ratio	$\frac{\text{Discretionary costs}}{\text{Sales}}$
Interest expense to debt ratio	$\frac{\text{Interest expense}}{\text{(Short-term debt) + (Long-term debt)}}$
Foreign exchange ratios	$\frac{\text{Foreign currency gains and losses}}{\text{Net income}}$
	$\frac{\text{Foreign currency gains and losses}}{\text{Total sales}}$

Overhead rate	$\frac{\text{Total overhead expense}}{\text{Direct labor}}$
	$\frac{\text{Total overhead expense}}{\text{Total machine hours}}$
Goodwill to assets ratio	$\frac{\text{Unamortized goodwill}}{\text{Total assets}}$
Overhead to cost of sales ratio	$\frac{\text{Total overhead expenses}}{\text{Cost of goods sold}}$
	$\frac{\text{Total overhead expenses}}{\text{Direct materials + Direct labor}}$
	$\frac{\text{Total overhead expense}}{\text{Direct materials}}$
Investment turnover	$\frac{\text{Sales}}{\text{Stockholders' equity + Long-term liabilities}}$
Break-even point	$\frac{\text{Total operating expenses}}{\text{Average gross margin percentage}}$
	$\frac{\text{Total operating expenses – (Depreciation + Amortization + Other non-cash expenses)}}{\text{Average gross margin percentage}}$
Margin of safety	$\frac{\text{Current sales level – Break-even point}}{\text{Current sales level}}$
Tax rate percentage	$\frac{\text{Income tax paid}}{\text{Before-tax income}}$
	$\frac{\text{Income tax expense}}{\text{Before-tax income}}$

Operating Performance Measurements

Name	*Formula*
Operating assets ratio	$\frac{\text{Assets used to create revenue}}{\text{Total assets}}$
Sales to operating income ratio	$\frac{\text{Operating income}}{\text{(Net sales) – (Investment income)}}$
Sales margin	$\frac{\text{Gross margin – Sales expenses}}{\text{Gross sales}}$
Gross profit percentage	$\frac{\text{Revenue – (Overhead + Direct materials + Direct labor)}}{\text{Revenue}}$ $\frac{\text{Revenue – Direct materials}}{\text{Revenue}}$
Gross profit index	$\frac{\frac{\text{Gross profit in period two}}{\text{Sales in period two}}}{\frac{\text{Gross profit in period one}}{\text{Sales in period one}}}$
Investment income percentage	$\frac{\text{Dividend income + Interest income}}{\text{Carrying value of investments}}$
Operating profit percentage	$\frac{\text{Sales – (Cost of goods sold + Sales, general and administrative expenses)}}{\text{Sales}}$
Operating leverage ratio	$\frac{\text{Sales – Variable expenses}}{\text{Operating income}}$
Net income percentage	$\frac{\text{Net income}}{\text{Revenue}}$
Profit per person	$\frac{\text{Net profit}}{\text{Total full-time equivalents}}$

Cash Flow Measurements

Name	*Formula*
Cash flow from operations	$\frac{\text{Income from operations + Noncash expenses – Noncash Sales}}{\text{Income from operations}}$
`	$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Net income}}$
Cash flow return on sales	$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total sales}}$
Fixed charge coverage	$\frac{\text{Fixed expenses + Fixed payments}}{\text{Cash flow from operations}}$
Expense coverage days	$\frac{\text{Cash + Short-term marketable securities + Accounts receivable}}{\text{Annual cash expenditures} / 360}$
Cash flow coverage ratio	$\frac{\text{Total debt payments + Dividend payments + Capital expenditures}}{\text{Net income + Noncash expenses – Noncash sales}}$
Cash receipts to billed sales and progress payments	$\frac{\text{Cash receipts}}{\text{Billed sales + Billed progress payments}}$
Cash to current assets ratio	$\frac{\text{Cash + Short-term marketable securities}}{\text{Current assets}}$
Cash flow to fixed asset requirements	$\frac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Budgeted fixed asset purchases}}$

Cash flow to fixed asset requirements (*continued*)	$\dfrac{\text{Net income + Noncash expenses – Noncash sales – Dividends – Principal payments}}{\text{Budgeted fixed asset purchases}}$
Cash flow return on assets	$\dfrac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total assets}}$
Cash to working capital ratio	$\dfrac{\text{Cash + Short-term marketable securities}}{\text{Current assets – Current liabilities}}$
Cash reinvestment ratio	$\dfrac{\text{Increase in fixed assets + Increase in working capital}}{\text{Net income + Noncash expenses – Noncash sales – Dividends}}$
Cash to current liabilities ratio	$\dfrac{\text{Cash + Short-term marketable securities}}{\text{Current liabilities}}$
Cash flow to debt ratio	$\dfrac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Debt + Lease obligations}}$ $\dfrac{\text{Net income + Noncash expenses – Noncash sales}}{\text{Total long-term debt payments for the period}}$
Stock price to cash flow ratio	$\dfrac{\text{(Stock price) × (Number of shares outstanding)}}{\text{Earnings before interest, taxes, depreciation and amortization}}$
Dividend payout ratio	$\dfrac{\text{Total dividend payments}}{\text{Net income + Noncash expenses – Noncash sales}}$

Liquidity Measurements

Name	*Formula*
Accounts receivable turnover	$\frac{\text{Annualized credit sales}}{\text{Average accounts receivable + Notes payable by customers}}$
Average receivable collection period	$\frac{\text{Average accounts receivable}}{\text{Annual sales/365}}$
Days delinquent sales outstanding	$\frac{\text{365/Annualized credit sales from delinquent accounts}}{\text{Average delinquent accounts receivable}}$
Days' sales in receivables index	$\frac{\frac{\text{Accounts receivable in period two}}{\text{Sales in period two}}}{\frac{\text{Accounts receivable in period one}}{\text{Sales in period one}}}$
Accounts receivable investment	$\frac{\text{Average days to payment}}{\text{360 Days}} \times \text{Annual credit sales} \times (1 - \text{Gross margin \%}) \times \text{(Cost of capital)}$
Ending receivable balance	$\text{Average receivable collection period} \times \frac{\text{Sales forecast for period}}{\text{Days in period}}$
Inventory to sales ratio	$\frac{\text{Sales}}{\text{Inventory}}$
Inventory turnover	$\frac{\text{Cost of goods sold}}{\text{Inventory}}$ or,

Inventory turnover (*continued*)	$365 / \frac{\text{Cost of goods sold}}{\text{Inventory}}$
	or,
	$\frac{\text{Direct materials}}{\text{Raw materials inventory}}$
Inventory to working capital ratio	$\frac{\text{Inventory}}{\text{Accounts receivable + Inventory – Accounts payable}}$
Liquidity index	$\frac{(\text{Accounts receivable} \times \text{Days to liquidate}) + (\text{Inventory} \times \text{Days to Liquidate})}{\text{Accounts receivable + Inventory}}$
Accounts payable days	$\frac{\text{Accounts payable}}{\text{Purchases} / 360}$
Accounts payable turnover	$\frac{\text{Total purchases}}{\text{Ending accounts payable balance}}$
Current ratio	$\frac{\text{Current assets}}{\text{Current liabilities}}$
Quick ratio	$\frac{\text{Cash + Marketable securities + Accounts receivable}}{\text{Current liabilities}}$
Cash ratio	$\frac{\text{Cash + Short-term marketable securities}}{\text{Current liabilities}}$
Sales to current assets ratio	$\frac{\text{Sales}}{\text{Current assets}}$
Working capital productivity	$\frac{\text{Annual sales}}{\text{Working capital}}$

Defensive interval ratio	$\frac{\text{Cash + Marketable securities + Accounts receivable}}{\text{Expected daily operating expenses}}$
Current liability ratio	$\frac{\text{Current liabilities}}{\text{Total liabilities}}$
Required current liabilities to total current liabilities ratio	$\frac{\text{Current liabilities with required payment dates}}{\text{Total current liabilities}}$
Working capital to debt ratio	$\frac{\text{Cash + Accounts receivable + Inventory – Accounts payable}}{\text{Debt}}$
Risky asset conversion ratio	$\frac{\text{Cost of assets with minimal cash conversion value}}{\text{Total assets}}$
Noncurrent assets to noncurrent liabilities ratio	$\frac{\text{Non-current assets}}{\text{Non-current liabilities}}$
Short-term debt to long-term debt ratio	$\frac{\text{Total short-term debt}}{\text{Total long-term debt}}$
Altman's Z-score bankruptcy prediction formula	(Operating income/Total assets) × 3.3 + (Sales/Total assets) × 0.999 + (Market value of common stock + Preferred stock)/(Total liabilities) × 0.6 + (Working capital/Total assets) × 1.2 + (Retained earnings/Total assets) × 1.4

Capital Structure and Solvency Measurements

Name	*Formula*
Times interest earned	$\dfrac{\text{Average cash flow}}{\text{Average interest expense}}$
Debt coverage ratio	$\dfrac{\text{Earnings before interest and taxes}}{\text{Interest} + \dfrac{\text{Scheduled principal payments}}{(1 - \text{Tax rate})}}$
Asset quality index	$\dfrac{1 - \dfrac{\text{Current assets in period two} + \text{Net fixed assets in period two}}{\text{Total assets in period two}}}{1 - \dfrac{\text{Current assets in period one} + \text{Net fixed assets in period one}}{\text{Total assets in period one}}}$
Accruals to assets ratio	$\dfrac{\text{Change in working capital} - \text{Change in cash} - \text{Change in depreciation}}{\text{Change in total assets}}$
Times preferred Dividend earned	$\dfrac{\text{Net income}}{\text{Preferred dividend}}$
Debt to equity ratio	$\dfrac{\text{Debt}}{\text{Equity}}$
Funded capital ratio	$\dfrac{\text{Stockholders' equity} + \text{Long-term debt}}{\text{Fixed assets}}$
Retained earnings to stockholders' equity	$\dfrac{\text{Retained earnings}}{\text{Total stockholders' equity}}$
Preferred stock to total stockholders' equity	$\dfrac{\text{Preferred stock}}{\text{Stockholders' equity}}$

Issued shares to authorized shares	$\frac{\text{Issued shares + Stock options + Stock warrants + Convertible securities}}{\text{Total authorized shares}}$

Return on Investment Measurements

Name	*Formula*
Net Worth	$\frac{\text{Total assets – Total liabilities – Preferred stock dividends}}{\text{Total outstanding common shares}}$
Book value per share	$\frac{\text{Total equity – Cost to liquidate preferred stock}}{\text{Total number of common shares outstanding}}$
Tangible book value	Book value – (Goodwill + Other intangibles)
Return on assets employed	$\frac{\text{Net profit}}{\text{Total assets}}$
Return on operating assets	$\frac{\text{Net income}}{\text{Assets used to create revenue}}$
Return on equity percentage	$\frac{\text{Net income}}{\text{Total equity}}$
Return on common equity	$\frac{\text{Net income – Preferred stock dividends}}{\text{Common stockholders' equity}}$
Financial leverage index	$\frac{\text{Return on equity}}{\text{Return on assets}}$
Equity growth rate	$\frac{\text{Net income – Common stock dividends – preferred stock dividends}}{\text{Beginning common stockholders' equity}}$

Earnings per share	$\frac{\text{Net income – Dividends on preferred stock}}{\text{Number of outstanding common shares + Common stock equivalents}}$
Percentage change in earnings per share	$\frac{\text{Incremental change in earnings per share}}{\text{Earnings per share from previous period}}$
Economic value added	(Net investment) × (Actual return on investment – Percentage cost of capital)
Dividend payout ratio	$\frac{\text{Dividend per share}}{\text{Earnings per share}}$
Dividend yield ratio	$\frac{\text{Dividend per share}}{\text{Market price per share}}$

Market Performance Measurements

Name	*Formula*
Insider stock buy – sell ratio	$\frac{\text{Number of stock sale transactions by insiders}}{\text{Number of stock purchase transactions by insiders}}$
Market value added	(Number of common shares outstanding × Share price) + (Number of preferred shares outstanding × Share price) – (Book value of invested capital)
Stock options to common shares ratio	$\frac{\text{Total stock options}}{\text{Total common shares outstanding}}$
	$\frac{\text{Total vested stock options}}{\text{Total common shares outstanding}}$

Stock options to common shares ratio (*continued*)	$\frac{\text{Total vested options in the money}}{\text{Total common shares outstanding}}$
Cost of capital	$\frac{\text{Interest expense} \times (1 - \text{Tax rate})}{\text{Amount of debt} - \text{Debt acquisition fees} + \text{Premium on debt} - \text{Discount on debt} + \frac{\text{Interest expense}}{\text{Amount of preferred stock}} + \text{Risk-free return} + (\text{Beta} \times (\text{Average stock return} - \text{Risk-free return}))}$
Sales to stock price ratio	$\frac{\text{Annual net sales}}{\text{Average common stock price}}$
Price/earnings ratio	$\frac{\text{Average common stock price}}{\text{Net income per share}}$
Capitalization Rate	$\frac{\text{Earnings per share}}{\text{Market price per share}}$

Measurements for the Accounting/Finance Department

Name	*Formula*
Purchase discounts taken to total discounts	$\frac{\text{Total purchase discounts taken}}{\text{Total purchases}}$
Percentage of payment discounts missed	$\frac{\text{Number of payment discounts missed}}{\text{Total number of payment discounts available}}$

Transactions processed per person	$\frac{\text{Total number of transactions processed}}{\text{Number of full-time equivalents required to complete transactions}}$
Transaction error rate	$\frac{\text{Number of errors}}{\text{Total number of transactions processed}}$
Average time to issue invoices	$\frac{\text{(Sum of invoice dates) – (Sum of shipment dates)}}{\text{Number of invoices issued}}$
Average employee expense report turnaround time	(Date of payment to employees) – (Date of expense report receipt)
Payroll transaction fees per employee	$\frac{\text{Total payroll outsourcing fee per payroll}}{\text{Total number of employees itemized in payroll}}$
Time to produce financial statements	Financial statement issue date – First day of the month
Percentage of tax filing dates missed	$\frac{\text{Total number of tax returns filed late}}{\text{Total number of tax returns filed}}$
Proportion of products costed prior to release	$\frac{\text{Number of products costed prior to release}}{\text{Total number of products released}}$
Internal audit savings to cost percentage	$\frac{\text{Internal audit recommended savings}}{\text{Internal audit expense}}$
Internal audit efficiency	$\frac{\text{Number of internal audits completed}}{\text{Number of internal audits planned}}$

Bad debt percentage	$\frac{\text{Total bad debt dollars recognized}}{\text{Total outstanding accounts receivable}}$
	$\frac{\text{Total bad debt dollars recognized}}{\text{Total credit sales}}$
Percent of receivables over XX days old	$\frac{\text{Dollar amount of outstanding receivables > XX days old}}{\text{Total dollars of outstanding receivables}}$
Percentage collected of dollar volume assigned	$\frac{\text{Cash received from collection agency}}{\text{Total accounts receivable assigned to collection agency}}$
Percent of cash applied on day of receipt	$\frac{\text{Dollars of cash receipts applied on day of receipt}}{\text{Total dollars of incoming cash on day of receipt}}$
Cost of credit	Discount %/(100-Discount %) × (360/(Full allowed payment days – Discount days))
Earnings rate on invested funds	$\frac{\text{Interest earned + Increase in market value of securities}}{\text{Total funds invested}}$
Brokerage fee percentage	$\frac{\text{Bank/broker transaction fees charged}}{\text{Total funds invested}}$
	$\frac{\text{Bank/broker transaction fees charged}}{\text{Number of bank/broker transactions processed}}$

Borrowing base usage percentage	$\frac{\text{Amount of debt outstanding}}{(\text{Accounts receivable} \times \text{Allowable percentage}) + (\text{Inventory} \times \text{Allowable percentage})}$

Measurements for the Engineering Department

Name	*Formula*
Bill of material accuracy	$\frac{\text{Number of accurate parts listed in bill of materials}}{\text{Total number of parts listed in bill of materials}}$
Labor routing accuracy	$\frac{\text{Number of correct machine times or machine codes}}{\text{Total number of routing line items}}$
Percentage of new products introduced	$\frac{\text{Number of new products introduced in the period}}{\text{Number of products available at the beginning of the period}}$
Percentage of sales from new products	$\frac{\text{Sales from new products}}{\text{Total sales}}$
Percentage of new parts used in new products	$\frac{\text{Number of new parts in bill of materials}}{\text{Total number of parts in bill of materials}}$
Percentage of existing parts re-used in new products	$\frac{\text{Number of approved parts in bill of materials}}{\text{Total number of parts in bill of materials}}$
Average number of distinct products per design platform	$\frac{\text{Total number of distinct products}}{\text{Total number of design platforms}}$

Percentage of products reaching market before competition	$\frac{\text{Number of products released before competition}}{\text{Total number of products released}}$
	$\frac{\text{Number of products released on schedule}}{\text{Total number of products released}}$
Ratio of actual to target cost	$\frac{\text{Total of actual product costs}}{\text{Total of target costs}}$
Warranty claims percentage	$\frac{\text{Total number of warranty claims received}}{\text{Total number of products sold}}$
Time from design inception to production	(Completed design sign-off date) – (Design start date)
Percentage of floor space utilization	$\frac{\text{Amount of floor space used for machinery, operator, and materials movement}}{\text{Total floor space}}$

Measurements for the Logistics Department

Name	*Formula*
Production schedule accuracy	$\frac{\text{Number of scheduled jobs completed}}{\text{Number of jobs scheduled for completion}}$
Economic order quantity	The root of ((2 × Total usage in units × Cost per order)/ Carrying cost per unit)
Number of orders to place in a period	$\frac{\text{Total usage in units}}{\text{Economic order quantity}}$
Economic production run size	The root of ((2 × Total unit demand × Run setup cost)/ Carrying cost per unit)

Raw material inventory turns	(Raw material dollars consumed/raw material inventory dollars on hand) × 12
Raw material content	$\frac{\text{Raw material dollars sold}}{\text{Sales}}$
Finished goods inventory turns	(Finished goods dollars consumed/finished goods inventory dollars on hand) × 12
Obsolete inventory percentage	$\frac{\text{Cost of inventory items with no recent usage}}{\text{Total inventory cost}}$
Percentage of inventory > XX days old	$\frac{\text{Dollars of inventory > XX days old}}{\text{Total dollars of inventory}}$
Percentage of returnable inventory	$\frac{\text{Dollars of returnable inventory}}{\text{Total dollars of inventory}}$
Inventory accuracy	$\frac{\text{Number of accurate test items}}{\text{Total number of items sampled}}$
Percentage of certified suppliers	$\frac{\text{Number of certified production suppliers}}{\text{Total number of production suppliers}}$
EDI supplier percentage	$\frac{\text{Number of suppliers with EDI linkages}}{\text{Total number of suppliers}}$
On-time parts delivery percentage	(Actual arrival date) – (Requested arrival date)
Purchased component defect rate	$\frac{\text{Number of rejected components}}{\text{Total number of components received}}$

Incoming components correct quantity percentage	$\frac{\text{Quantity of orders with correct parts quantity delivered}}{\text{Total quantity of orders delivered}}$
Percentage of actual payments varying from purchase order price	$\frac{\text{Dollar total of excess costs over purchase order costs}}{\text{Total of all purchase order costs}}$
Percentage of purchase orders issued below minimum dollar level	$\frac{\text{Number of purchase orders issued below minimum dollar level}}{\text{Total number of purchase orders issued}}$
Proportion of corporate credit card usage	$\frac{\text{Number of credit card purchase transactions}}{\text{Total number of purchase transactions}}$
Percentage of receipts authorized by purchase orders	$\frac{\text{Receipt line items authorized by open purchase orders}}{\text{Total receipt line items}}$
Freight audit recovery ratio	$\frac{\text{Total freight billings refund}}{\text{Total freight billings}}$
Picking accuracy for assembled products	$100\% - \frac{\text{Number of quantity errors + Number of part errors}}{\text{Total number of product kits sampled}}$
Average time to ship	(Delivery date) – (Date order was sent to shipping area)
On-time delivery percentage	Required delivery date – Actual delivery date
Percentage of products damaged in transit	$\frac{\text{Damage-related customer complaints}}{\text{Number of orders shipped}}$

Percentage of sales through distributors	$\frac{\text{Total dollars of sales to distributors}}{\text{Total dollars of sales}}$

Measurements for the Production Department

Name	*Formula*
Constraint productivity	$\frac{\text{Number of units produced per hour}}{\text{Number of hours worked}}$
Constraint rework percentage	$\frac{\text{Rework hours used in constraint operation}}{\text{Total hours of constraint}}$
Constraint schedule attainment	$\frac{\text{Part hours produced + Rework hours – Reduction in actual hours from standard}}{\text{Part hours scheduled}}$
Constraint utilization	$\frac{\text{Actual hours used in constraint operation}}{\text{Total constraint hours available}}$
Degree of unbalance	$\frac{\text{Maximum capacity of the work cell bottleneck operation}}{\text{Maximum capacity of the next most restrictive work cell operation}}$
Throughput effectiveness	$\frac{\text{Gross revenue – Variable expenses}}{\text{Operating expenses}}$
Break-even plant capacity	$\frac{\text{Current utilization level} \times \text{total fixed costs}}{\text{Sales – variable expenses}}$
Manufacturing effectiveness	$\frac{\text{Throughput hours shipped}}{\text{Constraint hours consumed}}$

Productivity index	$\frac{\text{Total change in output quantities}}{\text{Total change in input quantities}}$
Unit output per direct labor hour	$\frac{\text{Total units completed + Total unit equivalents – Total carry forward unit equivalents}}{\text{Total number of direct labor hours}}$
Average equipment setup time	(Start time for new production run) – (Stop time for last production run)
Unscheduled machine downtime percentage	$\frac{\text{Total minutes of unscheduled downtime}}{\text{Total minutes of machine time}}$
Acceptable product completion percentage	$\frac{\text{(Number of products in production run) – (Number of rejected products)}}{\text{Number of products in production run}}$
Work-in-process turnover	$\frac{\text{Annual cost of goods sold}}{\text{Total work-in-process}}$
Scrap percentage	$\frac{\text{(Actual cost of goods sold) – (Standard cost of goods sold)}}{\text{Standard cost of goods sold}}$
Warranty claims percentage	$\frac{\text{Total number of warranty claims received}}{\text{Total number of products sold}}$
Maintenance expense to fixed assets ratio	$\frac{\text{Maintenance and repair expense}}{\text{Total gross fixed assets}}$
Indirect expense ratio	$\frac{\text{Indirect production cost in period two/units produced in period two}}{\text{Indirect production cost in period one/units produced in period one}}$

Reorder point	(Average usage per time period × Lead time) + Safety stock
On-time delivery ratio	$\frac{\text{Number of orders shipped by due date}}{\text{Total number of orders shipped}}$

Measurements for the Sales and Marketing Department

Name	*Formula*
Market share	$\frac{\text{Dollar volume of company shipments}}{\text{Dollar volume of industry shipments}}$
Customer turnover	$\frac{\text{Total number of customers} - \text{Invoiced customers}}{\text{Total number of customers}}$
Browse to buy conversion rate	$\frac{\text{Number of buying customers}}{\text{Number of browsing customers}}$
Direct mail effectiveness ratio	$\frac{\text{Number of leads generated}}{\text{Number of direct mail pieces issued}}$
	$\frac{\text{Gross profit on direct mail sales}}{\text{Total direct mail expense}}$
Inbound telemarketing retention rate	$\frac{\text{Number of customer order cancellations reversed}}{\text{Number of initial customer order cancellations requested}}$
Quote to close ratio	$\frac{\text{Dollar value of orders received}}{\text{Dollar value of quoted orders}}$
Sales per salesperson	$\frac{\text{Nonrecurring sales}}{\text{Number of FTE sales personnel}}$

Sales productivity	$\frac{\text{(Gross nonrecurring revenue) – (Variable cost of sales)}}{\text{Sales expense}}$
Sales effectiveness	$\frac{\text{Gross revenue – Variable cost of goods sold}}{\text{Constraint time used}}$
Sales trend percentage	$\frac{\text{(Total sales in current period) – (Total sales in previous period)}}{\text{Total sales in previous period}}$
Product demand elasticity	$\frac{\text{Percentage change in quantity}}{\text{Percentage change in price}}$
Days of backlog	$\frac{\text{Dollar volume of sales backlog}}{\text{Average annual Sales / 365}}$

Index

Accounting measurements
  Bad debt percentage, 168–169
  Borrowing base usage percentage, 177–178
  Brokerage fee percentage, 175–176
  Cash applied on day of receipt, percentage of, 172–173
  Credit, cost of, 173–174
  Earnings rate on invested funds, 174–175
  Employee expense report turnaround time, average, 158–159
  Internal audit efficiency, 167–168
  Internal audit savings to cost percentage, 165–167
  Payment discounts missed, percentage of, 154
  Payroll transaction fees per employee, 160–162
  Products costed prior to release, proportion of, 164–165
  Purchase discounts taken to total discounts, 152–153
  Receivables collected as percent of dollar value assigned, 171–172
  Receivables over xx days old, percentage of, 169–171
  Tax filing dates missed, percentage of, 163–164
  Time to issue invoices, average, 157–158
  Time to produce financial statements, 162–163
  Transaction error rate, 156–157
  Transactions processed per person, 155–156
Accounts payable days, 83–84
Accounts payable turnover, 84–85
Accounts receivable investment, 74–76
Accounts receivable turnover, 69–71
Accumulated depreciation to fixed assets ratio, 17–18
Accruals to assets ratio, 107–109
Actual to target cost ratio, 188–190
Administrative expenses to sales ratio, 9–10
Altman's Z-score bankruptcy prediction formula, 99–101
Asset quality index, 104–105
Asset utilization measurements
  Accumulated depreciation to fixed assets ratio, 17–18
  Break-even point, 30–31
  Discretionary cost ratio, 20–21
  Foreign exchange ratios, 22–23
  Fringe benefits to wages and salaries expense, 18–19
  Goodwill to assets ratio, 26–27
  Interest expense to debt ratio, 21–22
  Investment turnover, 29–30
  Margin of safety, 31–32
  Overhead rate, 24–26
  Overhead to cost of sales ratio, 27–28
  Repairs and maintenance expense to fixed assets ratio, 15–16
  Sales backlog ratio, 13–14

Asset utilization measurements (*cont.*)
Sales expense to sales ratio, 19–20
Sales per person, 11–12
Sales returns to gross sales ratio, 14–15
Sales to administrative expenses ratio, 9–10
Sales to equity ratio, 10–11
Sales to fixed assets ratio, 7
Sales to working capital ratio, 6
Tax rate percentage, 32–33
Assets to accruals ratio, 107–109
Assets to goodwill ratio, 26–27
Authorized shares to issued shares ratio, 115–117
Average receivable collection period, 71–72

Backlog, days of, 270–271
Bad debt percentage, 168–169
Bill of material accuracy, 179–180
Billed sales and progress payments to cash receipts, 56–57
Book value, tangible, 122–123
Book value per share, 121–122
Borrowing base, 99
Borrowing base usage percentage, 177–178
Break-even plant capacity, 234–236
Break-even point, 30–31
Brokerage fee percentage, 175–176
Browse to buy conversion ratio, 258–259

Capacity, break-even plant, 234–236
Capital asset analysis, 288–290
Capital structure and solvency measurements
Accruals to assets ratio, 107–109
Asset quality index, 106–107
Debt coverage ratio, 104–105
Debt to equity ratio, 110–112
Funded capital ratio, 112–113
Issued shares to authorized shares ratio, 115–117
Preferred stock to total stockholders' equity, 114–115
Retained earnings to stockholders' equity, 113–114
Times interest earned, 103–104
Times preferred dividend earned, 109–110
Capitalization rate, 149–150
Cash applied on day of receipt, percentage of, 172–173
Cash flow analysis, 286–8
Cash flow from operations, 49–50
Cash flow measurements
Cash flow coverage ratio, 55–56
Cash flow from operations, 49–50
Cash flow return on assets, 59–61
Cash flow return on sales, 51–52
Cash flow to debt ratio, 64–65
Cash flow to fixed assets requirements, 58–59
Cash receipts to billed sales and progress payments, 56–57
Cash reinvestment ratio, 62–63
Cash to current assets ratio, 57–58
Cash to current liabilities ratio, 63–64
Cash to working capital ratio, 61–62
Dividend payout ratio, 67
Expense coverage days, 53–54
Fixed charge coverage, 52–53
Stock price to cash flow ratio, 66
Cash flow coverage ratio, 55–56
Cash flow return on assets, 59–61
Cash flow return on sales, 51–52
Cash flow to debt ratio, 64–65
Cash flow to fixed assets requirements, 58–59
Cash flow to stock price ratio, 66
Cash ratio, 87–88
Cash receipts to billed sales and progress payments, 56–57
Cash reinvestment ratio, 62–63
Cash to current assets ratio, 57–58
Cash to current liabilities ratio, 63–64
Cash to working capital ratio, 61–62
Certified suppliers, percentage of, 208–209
Chart Wizard function, 281–282
Common equity, return on, 127–129

Common shares to stock options ratio, 143–144
Compounding analysis, 290–292
Constraint productivity, 228
Constraint rework percentage, 229
Constraint schedule attainment, 230–231
Constraint utilization, 231–232
Corporate credit card usage, proportion of, 217–218
Cost of capital, 144–147
Cost of sales to overhead ratio, 27–28
Credit, cost of, 173–174
Current assets to cash ratio, 57–58
Current assets to sales ratio, 88–89
Current liabilities to cash ratio, 63–64
Current liability ratio, 92–93
Current ratio, 85–86
Customer turnover, 256–257

Days delinquent sales outstanding, 72–73
Days of backlog, 270–271
Days sales in receivable index, 73–74
Debt coverage ratio, 104–105
Debt to cash flow ratio, 64–65
Debt to equity ratio, 110–112
Debt to interest expense ratio, 21–22
Debt to working capital ratio, 94–95
Defensive interval ratio, 90–92
Degree of unbalance, 232–233
Depreciation, double-declining balance, 288–289
Depreciation, fixed-declining balance, 289
Depreciation, straight line, 289
Depreciation, sum of the years' digits, 289–290
Depreciation, variable declining balance, 290
Direct mail effectiveness ratio, 260–261
Discretionary cost ratio, 20–21
Distinct products per design platform, average number of, 186–187
Dividend payout ratio, 67, 136–137
Dividend yield ratio, 137–138

Earnings per share, 131–132
Earnings per share, percentage change in, 132–133
Earnings rate on invested funds, 174–175
Economic order quantity, 197–198
Economic production run size, 199–200
Economic value added, 133–136
Electronic data interchange supplier, percentage of, 209–210
Employee expense report turnaround time, average, 158–159
Ending receivable balance, 76–77
Engineering measurements
  Actual to target cost ratio, 188–190
  Bill of material accuracy, 179–180
  Distinct products per design platform, average number of, 186–187
  Existing parts re-used in new products percentage, 186
  Floor space utilization, percentage of, 192–193
  Labor routing accuracy, 181–182
  New parts used in new products percentage, 184–186
  New products introduced percentage, 182–183
  Products reaching market before competition, percentage of, 187–188
  Sales from new products percentage, 183–184
  Time from design inception to production, 191–192
  Warranty claims percentage, 190–191
Equipment setup time, average, 240–241
Equity growth rate, 130–131
Equity to debt ratio, 110–112
Equity to sales ratio, 10–11
Equity, return on, 126–127
Existing parts re-used in new products percentage, 186
Expense coverage days, 53–54

Finance measurements, *see* Accounting measurements
Financial leverage, 281
Financial leverage index, 129–130
Financial statement ratio analysis, 275–277
Financial statements, time to produce, 162–163
Finished goods inventory turns, 202–203
Fixed assets to accumulated depreciation ratio, 17–18
Fixed assets to maintenance expense ratio, 248–249
Fixed assets to repairs and maintenance ratio, 15–16
Fixed assets to sales ratio, 7
Fixed assets requirements to cash flow ratio, 58–59
Fixed charge coverage, 52–53
Floor space utilization, percentage of, 192–193
Forecast analysis, 283–286
Foreign exchange ratio, 22–23
Freight audit recovery ratio, 219–220
Fringe benefits to wages and salaries expense, 18–19
Funded capital ratio, 112–113
Future value, 290–291

Generally accepted accounting principles, 25–26, 112
Goodwill to assets ratio, 26–27
Gross profit index, 40–41
Gross profit percentage, 39–40
Gross sales to sales returns ratio, 14–15

Inbound telemarketing retention ratio, 262–263
Incoming components correct quantity percentage, 213–214
Indirect expense ratio, 249–250
Insider stock buy/sell ratio, 139–141
Interest expense to debt ratio, 21–22
Internal audit efficiency, 167–168
Internal audit savings to cost percentage, 165–167
Inventory accuracy, 206–208
Inventory greater than xx days old, percentage of, 204–205
Inventory to sales ratio, 77–78
Inventory to working capital ratio, 81
Inventory turnover, 78–80
Investment analysis, 292–295
Investment income percentage, 41–42
Investment turnover, 29–30
Issued shares to authorized shares ratio, 115–117

Labor routing accuracy, 181–182
Leverage analysis, 279–281
Leverage, financial, 281
Leverage, operating, 280
Liquidity index, 82–83
Liquidity measurements
  Accounts payable days, 83–84
  Accounts payable turnover, 84–85
  Accounts receivable investment, 74–76
  Accounts receivable turnover, 69–71
  Altman's Z-score bankruptcy prediction formula, 99–101
  Average receivable collection period, 71–72
  Cash ratio, 87–88
  Current liability ratio, 92–93
  Current ratio, 85–86
  Days delinquent sales outstanding, 72–73
  Days' sales in receivables index, 73–74
  Defensive interval ratio, 90–92
  Ending receivable balance, 76–77
  Inventory to sales ratio, 77–78
  Inventory to working capital ratio, 81
  Inventory turnover, 78–80
  Liquidity index, 82–83
  Noncurrent assets to noncurrent liabilities ratio, 96–98

Quick ratio, 86–87
Required current liabilities to total current liabilities ratio, 93–94
Risky asset conversion ratio, 95–96
Sales to current assets ratio, 88–99
Short-term debt to long-term debt ratio, 98–99
Working capital productivity, 89–90
Working capital to debt ratio, 94–95
Logistics measurements
Certified suppliers, percentage of, 208–209
Corporate credit card usage, proportion of, 217–218
Economic order quantity, 197–198
Economic production run size, 199–200
Electronic data interchange supplier, percentage of, 209–210
Finished goods inventory turns, 202–203
Freight audit recovery ratio, 219–220
Incoming components correct quantity percentage, 2130–214
Inventory accuracy, 206–208
Inventory greater than xx days old, percentage of, 204–205
Number of orders to place in a period, 198–199
Obsolete inventory percentage, 203–204
On-time delivery percentage, 223–224
Parts delivery percentage, on-time, 210–212
Payments varying from purchase order price, percentage of, 214–215
Picking accuracy for assembled products, 220–221
Production schedule accuracy, 196–197
Products damaged in transit, percentage of, 224–225
Purchase orders issued below minimum dollar level, percentage of, 215–217
Purchased component defect rate, 212–213
Raw material content, 201–202
Raw material inventory turns, 200–201
Receipts authorized by purchase orders, percentage of, 218–219
Returnable inventory, percentage of, 205–206
Sales through distributors, percentage of, 225–226
Time to ship, average, 221–222
Long-term debt to short-term debt ratio, 98–99

Machine downtime percentage, unscheduled, 241–242
Maintenance expense to fixed assets ratio, 248–249
Manufacturing effectiveness, 236–237
Margin of safety, 31–32
Market performance measurements
Capitalization rate, 149–150
Cost of capital, 144–147
Insider stock buy-sell ratio, 139–141
Market value added, 141–143
Price/earnings ratio, 148–149
Sales to stock price ratio, 147–148
Stock options to common shares ratio, 143–144
Market share, 255–256
Market value added, 141–143
Marketing measurements, *see* Sales measurements

Net income percentage, 45–46
Net worth, 119–121
New parts used in new products percentage, 184–186
New products introduced percentage, 182–183
Noncurrent assets to non-current liabilities ratio, 96–98

NPV command, 287–288
Number of orders to place in a period, 198–199

Obsolete inventory percentage, 203–204
On-time delivery percentage, 223–224
On-time delivery ratio, 252–253
Operating leverage, 280
Operating performance measurements
  Gross profit index, 40–41
  Gross profit percentage, 39–40
  Investment income percentage, 41–42
  Net income percentage, 45–46
  Operating assets ratio, 35–37
  Operating leverage ratio, 43–45
  Operating profit percentage, 42–43
  Profit per person, 46–47
  Sales margin, 38
  Sales to operating income ratio, 37–38
Operating assets, return on, 125–126
Operating assets ratio, 35–37
Operating income to sales ratio, 37–38
Operating leverage ratio, 43–45
Operating profit percentage, 423
Overhead rate, 24–26
Overhead to cost of sales ratio, 27–28

Parts delivery percentage, on-time, 210–212
Payment discounts missed, percentage of, 154
Payments varying from purchase order price, percentage of, 214–215
Payroll transaction fees per employee, 160–162
Picking accuracy for assembled products, 220–221
Preferred stock to total stockholders' equity, 114–115
Present value, 291–292
Price/earnings ratio, 148–149
Product completion percentage, acceptable, 242–243
Production measurements
  Break-even plant capacity, 234–236
  Constraint productivity, 228
  Constraint rework percentage, 229
  Constraint schedule attainment, 230–231
  Constraint utilization, 231–232
  Degree of unbalance, 232–233
  Equipment setup time, average, 240–241
  Indirect expense ratio, 249–250
  Machine downtime percentage, unscheduled, 241–242
  Maintenance expense to fixed assets ratio, 248–249
  Manufacturing effectiveness, 236–237
  On-time delivery ratio, 252–253
  Product completion percentage, acceptable, 242–243
  Productivity index, 237–238
  Reorder point, 250–252
  Scrap percentage, 245–246
  Throughput effectiveness, 233–234
  Unit output per direct labor hour, 239–240
  Warranty claims percentage, 247–248
  Work-in-process turnover, 244–245
Production schedule accuracy, 196–197
Productivity index, 237–238
Product demand elasticity, 269–270
Products costed prior to release, proportion of, 164–165
Products damaged in transit, percentage of, 224–225
Products reaching market before competition, percentage of, 187–188
Profit per person, 46–47
Proportional analysis, 274–275
Purchase discounts taken to total discounts, 152–153
Purchase orders issued below minimum dollar level, percentage of, 215–217
Purchased component defect rate, 212–213

Quick ratio, 86–87
QUARTILE command, 295–296
Quote to close ratio, 263–264

Ratio analysis of financial statements, 275–277
Ratio result analysis, 278–279
Raw material content, 201–202
Raw material inventory turns, 200–201
Receipts authorized by purchase orders, percentage of, 218–219
Receivables collected as percent of dollar value assigned, 171–172
Receivables over xx days old, percentage of, 169–171
Recency, 259–260
Regression analysis, 284
Reorder point, 250–252
Repairs and maintenance expense to fixed assets ratio, 15–16
Required current liabilities to total current liabilities ratio, 93–94
Retained earnings to stockholders' equity, 113–114
Return on assets employed, 123–125
Return on investment measures
  Book value per share, 121–122
  Book value, tangible, 122–123
  Dividend payout ratio, 136–137
  Dividend yield ratio, 137–138
  Earnings per share, 131–132
  Earnings per share, percentage change in, 132–133
  Economic value added, 133–136
  Equity growth rate, 130–131
  Financial leverage index, 129–130
  Net worth, 119–121
  Return on assets employed, 123–125
  Return on common equity, 127–129
  Return on equity percentage, 126–127
  Return on operating assets, 125–126
Returnable inventory, percentage of, 205–206
Revenue trend line, 284
Risk analysis, 295–296
Risky asset conversion ratio, 95–96

Sales backlog ratio, 13–14
Sales effectiveness, 266–267
Sales expense to sales ratio, 19–20
Sales from new products percentage, 183–184
Sales margin, 38
Sales measurements
  Browse to buy conversion ratio, 258–259
  Customer turnover, 256–257
  Days of backlog, 270–271
  Direct mail effectiveness ratio, 260–261
  Inbound telemarketing retention ratio, 262–263
  Market share, 255–256
  Product demand elasticity, 269–270
  Quote to close ratio, 263–264
  Recency, 259–260
  Sales effectiveness, 266–267
  Sales per salesperson, 264–265
  Sales productivity, 265–266
  Sales trend percentage by product line, 268–269
Sales per person, 11–12
Sales per salesperson, 264–265
Sales productivity, 265–266
Sales returns to gross sales ratio, 14–15
Sales through distributors, percentage of, 225–226
Sales to administrative expenses ratio, 9–10
Sales to equity ratio, 10–11
Sales to fixed assets ratio, 7
Sales to inventory ratio, 77–78
Sales to operating income ratio, 37–38
Sales to current assets ratio, 88–89
Sales to sales expense ratio, 19–20
Sales to stock price ratio, 147–148
Sales to working capital ratio, 6
Sales trend percentage by product line, 268–269
Scrap percentage, 245–246
Short-term debt to long-term debt ratio, 98–99
SKEW command, 295–296

Spreadsheet, 273
Stock options to common shares ratio, 143–144
Stock price to cash flow ratio, 66
Stock price to sales ratio, 147–148
Stockholders' equity to retained earnings, 113–114

Tax filing dates missed, percentage of, 163–164
Tax rate percentage, 32–33
Time from design inception to production, 191–192
Time to issue invoices, average, 157–158
Time to produce financial statements, 162–163
Time to ship, average, 221–222
Times interest earned, 103–104
Times preferred dividend earned, 109–110
Throughput accounting, 26
Throughput effectiveness, 233–234
Total current liabilities to required current liabilities ratio, 93–94
Total stockholders' equity to preferred stock, 114–115
Transaction error rate, 156–157
Transactions processed per person, 155–156
Trend analysis, 281–282
TREND command, 283–286

Unit output per direct labor hour, 239–240

Wages and salaries expense to fringe benefits ratio, 18–19
Warranty claims percentage, 190–191, 247–248
Work-in-process turnover, 244–245
Working capital productivity, 89–90
Working capital to cash ratio, 61–62
Working capital to debt ratio, 94–95
Working capital to inventory ratio, 81
Working capital to sales ratio, 6
Worksheet, 273

Z-score bankruptcy prediction formula, 99–101