

## 8

## ACCOUNTING AND BUDGETS

We live in a world in which budgets of all types have a profound influence on our lives. Contact with budgets ranges from somewhat informal personal budgets for our income and time, to the direct or indirect influence of governmental budgets, to the strict control exercised by our employer's business or corporate budgets. In a budget the funds that have been established for specific purposes very much determine what activities will be pursued and the extent that they will be accomplished. This pattern is definitely the case in the chemical process industries, varying from such simple and basic functions as whether there are funds to hire additional engineers, the amount of money allocated for specific projects, and the extent that the company will invest in new projects and make capital expenditure based on recommendations you have made after performing cost estimates and economic analyses.

Budgets basically address the fact that there are limited resources available for almost all activities, and they present a plan on how these resources may be distributed in order to obtain the maximum benefit. Budgets are also utilized for the allocation of time, again ranging from your own personal activities to very complex planning assignments on major projects. In this chapter simple budgets will be considered for capital and cost allocation, and in a following chapter project management budgets will be considered for time and manpower programming.

The basis for the formulation and control of all budgets is through accounting records, subdividing the expenditures into categories and then compiling the actual amount spent to determine how the costs compare with the original planning of the initial budget. Since accounting records control the budgets both in their conception and execution, this subject will be discussed first.

### BASIC ACCOUNTING PRINCIPLES

Accounting departments perform a critical and indispensable role in every business organization. They accumulate and systematize the records of expenses made by all operations within the facility, keep track of monies due or payable,

receive or make payments, monitor all transactions required on debt or tax payment, pension and health insurance monies, and so on, and in general keep track of all of the money input, output, and commitments to and from the corporation. Their basic job is to record the company's business transactions in a systematic manner.

The average chemical engineer interfaces with the accounting department only in the budgeting and control function, and on occasion with input and feedback on the monitoring of plant construction and operating performance. If suitable information is available it allows the engineer to better perform these functions, control his assignments, and with luck to compare previous economic estimates with actual performance. This later function, however, is often exceedingly difficult to do because of the complexities and interaction of the many facets of an operation, but if complete analysis is not available, at least a partial analysis can often be obtained so that an engineer may have enough feedback on some of the actual project costs to improve his estimates for the future. Accounting also can provide a file of prior information on other projects to use in the estimates. For every engineer who aspires to understand his company's business and to progress into management a general working knowledge of accounting, its methods, and its output are essential.

To better understand this accounting function, and in order to work with accountants to obtain the maximum benefits from their department, the following fundamentals on accounting methods are presented: There are many excellent books, articles, and courses given on this subject when greater detail is required (Clark and Lorenzoni 1985; AMR 1971; Ernst and Whinney 1986, etc.).

### Journals

The outline of Table 8-1 indicates some of the basic functions utilized in general accounting procedures. It starts with a business transaction, whether it be a purchase, sale, operating expense, debt transaction, or any other of the financial activities performed within the company. The transaction is entered into an appropriate journal, in prior times and for very small companies at present, manually. These were separate books or pages kept on each major subdivision of the company's operation. At present, however, the transaction is entered into a computer, along with code numbers that allow it to be organized into the appropriate sections of the accounting records, which is the equivalent to it having been entered into journals. With the aid of the computer, however, one entry with the appropriate coding will allow the software program to not only classify it and enter it as part of totals within that class, (such as accounts payable, accounts receivable, capital, numerous subdivisions of operating costs, etc.), but also if appropriate, prepare for payment through automatic check writing, invoicing customers for sales, inventory and reordering records, and so on. For small companies where the computer capability isn't quite so elabo-

**Table 8-1**  
**Partial Outline of Business Accounting Functions**

1. Company transaction
2. Enter in appropriate journals (actually enter in computer and distribute appropriately)
a. Purchase journal, with a sequence of documents:
(1) Purchase order
(2) Delivery receipt
(3) Billing
(a) Accounts payable
(4) Payment made
b. Accounts payable journal
(1) Salaries, wages
(2) All other bills (utilities, taxes, fees, services, and so on)
(3) Other charges and debt
c. Sales journal, with a sequence of documents:
(1) Purchase order
(2) Delivery invoice
(3) Billing
(a) Accounts receivable
(4) Payment received
d. Accounts receivable or cash journal
(1) All funds due and received
e. Other journals
3. Post in the general ledger
4. Handle tax, debt, and other obligations
5. Prepare financial statements
a. Balance sheets
b. Income statements
c. Flow of funds statement
d. Operating cost statements

rate, some of these functions must be done separately or by hand, but nevertheless one entry into even a simple computer allows the business transaction to be not only entered into the journals but tabulated into various other segments of the accounting records.

The accounting records for each transaction can be quite demanding in order to ensure that each entry is valid and properly completed. With a purchase, for instance, a purchase order (PO) signed by an authorized manager must first be obtained and then filled out with adequate detail by the purchasing agent. When the equipment is delivered a delivery receipt, signed by an authorized company representative joins the file. Later a billing is received, checked against the PO and receipt, and entered in the accounts payable ledger. Finally, payment is made, and the entire group of documents are filed together for future reference or auditing. Such a procedure provides a verification that the correct equipment was properly authorized for purchase, ordered, received, and paid for. The

records can also be very useful for reordering and providing the basis for cost and maintenance analysis. A similar procedure is used for product sales.

### Ledgers

Once again referring to the older manual entries, after a transaction had been posted into the appropriate journal it was then reentered into an overall or general ledger, again with the appropriate coding. For very small operations the ledger might utilize columns on the same pages that would be equivalent to separate journal entries for larger operations. With computer entries an equivalent ledger printout from the machine can be directly obtained with all of the appropriate journal categories and subdivisions that are required.

### Basis

Each company may select its own accounting method (basis) and accounting period (it need not be from January 1 through December 31 of each year), and these can have a significant impact on the records of a business organization. The methods are:

*Cash receipts and disbursements* is the simplest and most commonly used accounting procedure. Under this system, income is entered in the company books (for tax purposes) at the time it is actually received, rather than when the sale was made or the income was earned. Likewise, deductions or expenses are shown on the books when the payment is actually made.

*Accrual accounting*, conversely, enters the sales in the books when it was made, regardless of when payment is received, and shows expenses when the liability was incurred regardless of when the purchase payment is made. The accrual method for purchases and sales is required by the government when it is necessary to maintain an extensive inventory, since inventories have a major influence on income when the production, purchase, or sale of merchandise is a sizable part of the business. Thus, any company that produces or sells merchandise must use the accrual method for at least its purchases and sales; other items of income and expense could be accounted for on a cash basis if desired.

*Hybrid methods* of accounting are a combination of accounting methods, acceptable by the Internal Revenue Service if the combination properly reflects income and is consistently applied. For example, a small manufacturing business might deduct operating expenses when payments are made, but inventories would be included, and gross profit from sales would be determined by accruing sales and purchases. In general, the method used in computing taxable income must "clearly reflect income," and if it does not, the government can substitute a method which does. Of course, for the government's own books it does not do this.

## FINANCIAL STATEMENTS

Financial statements of all types can be prepared from the information placed in ledgers. For the company as a whole this would mean balance sheets and income statements for the entire operation, and subtabulations would be made for the individual groups or divisions within the company. Even for a single plant, for instance, separate operating statements would be sent to the research, maintenance, production and sales departments so that each of these groups can be separately monitored and compare their actual expenditures against their own budgets. A well-run accounting department would have immediate information available for each of the divisions within the company to check the meaning or details on any charges, and they in turn could request of the operating division explanations about budget deviations. For the overall organization the balance sheet would list all of the physical assets, liabilities, and equity of the corporation, while the operating statements would itemize the detailed breakdown of all expenses and the income that was received.

### Assets

Balance sheets will be discussed again in the chapter on corporate annual reports, but in general they show the assets of a corporation in two categories: (1) current or liquid assets such as cash, stock, bonds, or other securities, accounts receivable or funds owed to the company, inventories, and any other accounts that might be reasonably quickly converted into cash; and (2) fixed assets, or all the machinery, equipment, and property the company owns. The initial cost or purchase price is first listed, followed by the accumulated depreciation, leaving a net fixed asset value. The concept of depreciation has been previously discussed as a hypothetical decrease in the value of assets each year, based upon various Internal Revenue Service (IRS) rules. The government allows specific deductions as operating costs for tax purposes from the initial value of each of the fixed assets (except land) as a certain percentage of the original cost each year in recognition that funds should be set aside for the ultimate replacement of that asset, or perhaps assuming that the equipment is wearing out or becoming obsolete and is no longer worth as much as it originally was. This hypothetical decrease in value (depreciation) is written off as an operating expense each year, which results in an apparently reduced income, which in turn permits a reduced tax payment.

### Liabilities

The word liabilities refers to all of the debt owed by the corporation. It also has several components, which are broadly divided into two categories. The first is current liabilities, which represents "cash" demands against the company, including accounts payable for equipment or purchases the company has made

and not yet paid the vendors, several categories of short-term debt that are due within the year, and that portion of long-term debt that is also due within the year. It may include accrued charges, such as the current portion of funds that might have been previously spent or due, but are only partially paid, or charged within the current year in order to expense them over a longer period. Examples are major research and development projects, taxes, and so on. The second portion of liabilities is primarily long-term debt, and consists of the funds the company has borrowed to be paid back many years hence. It includes bonds and debentures, either: (1) convertible, which means that they may change from pure debt with definite interest payments into stock (company ownership) at a certain time or at the discretion of the borrower, (2) subordinated debentures which mean that the debt is somewhat like a second trust deed where bond holders that are not subordinated have first call on the companies assets in case of a default, and (3) bonds and long-term debt with a fixed interest rate, which are secured by the assets of the corporation. Preferred stock has a specified dividend rate, so it is similar to debt as far as "interest" payments are concerned, but it is usually not listed as debt.

### Equities

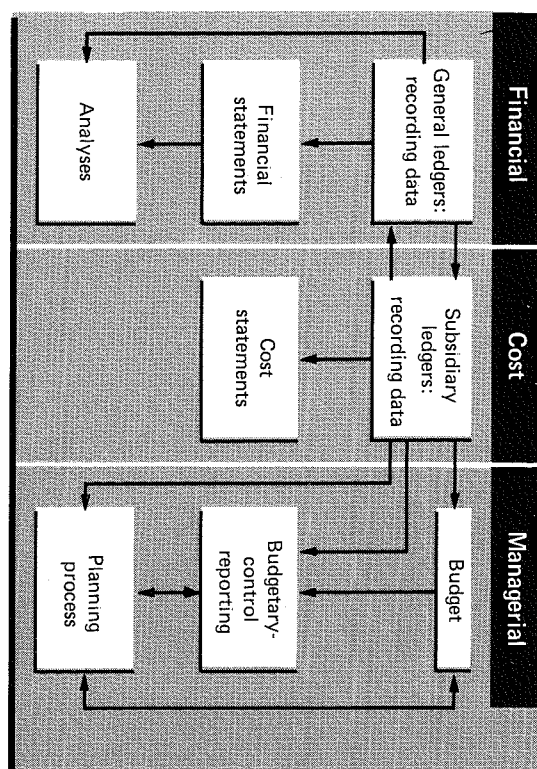
The final term that is used in accounting relationships is equities. Equity in general represent the net worth of the corporation, and commonly it is called stockholders equity. It can also be called proprietorship or capital, and it is obtained by the relationship that

$$\text{assets} - \text{liabilities} = \text{stockholders' equity}$$

It is thus seen to be the net, or free-and-clear depreciated property and assets of the corporation, and it often becomes the primary measure of the total net worth of the company. It is probably the most conservative and reliable indicator of a company's value, even though the original purchase price, before depreciation of the land and equipment, plus the current assets, represent the actual total capital investment.

## COST ACCOUNTING

Figures 8-1 and 8-2 give a rough indication of the relationships between various departments and their budgets in a large manufacturing plant, which are generally monitored by financial or asset accounting, cost accounting, and managerial accounting. For most engineers the industrial accountant most frequently dealt with is the cost accountant, whose main concern is monitoring the costs incurred in manufacturing a product.



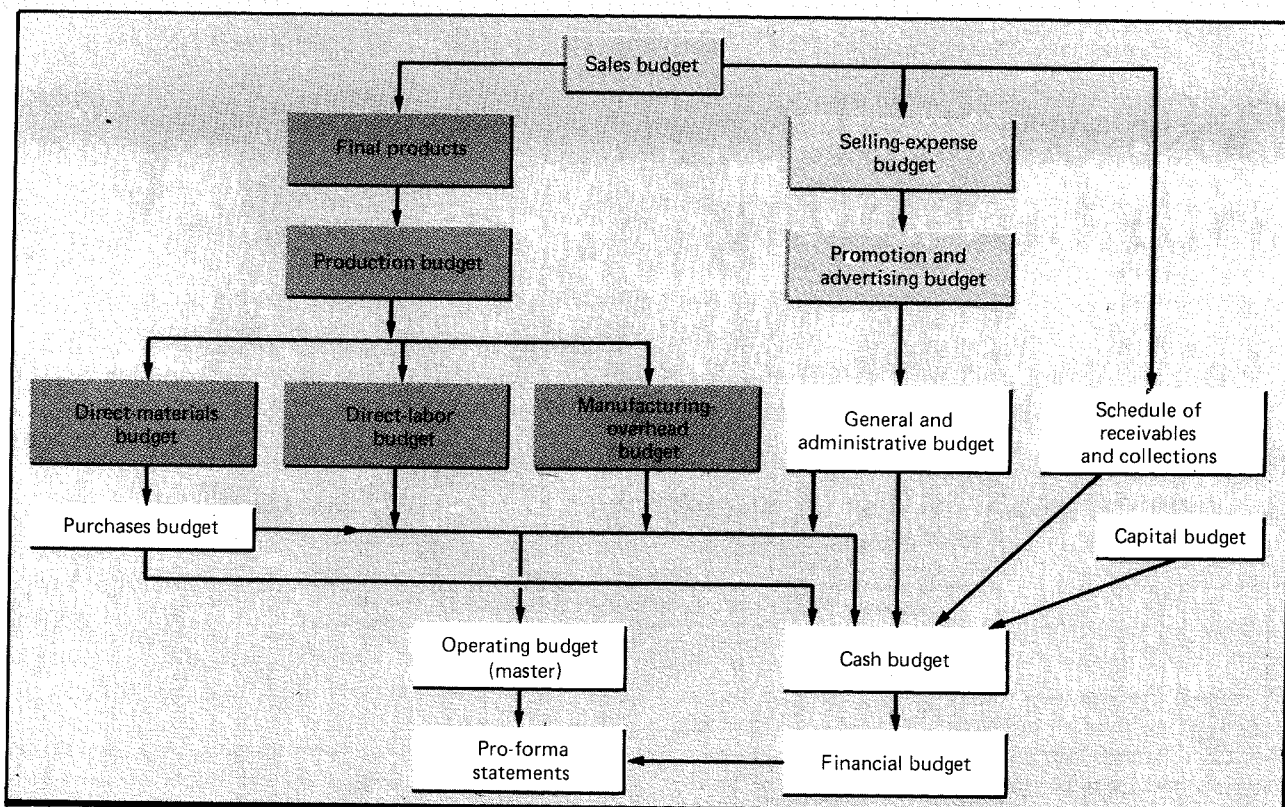
Source: Correia 1980. Excerpted by special permission from *Chemical Engineering*, March 24, 1980. Copyright © 1980, by McGraw-Hill, Inc., New York.

Figure 8-1. Industrial accounting types.

Cost accounting specifically refers to the gathering, classification, recording, summarizing, and reporting of manufacturing expenses and other data, including the recording of the amount of production, the inventory situation, and the purchase of raw materials. The data are compiled into reports both to management and to the individual departments within the company for them to review, and if required they can prepare various analyses and deviation reports. The review function may sometimes be considered as managerial accounting, through which the various division heads, group leaders, and so on are given information to supervise the operations and to plan and control. It provides all levels of management with the information needed for detailed budget making, production pricing, long-range forecasting, and for making the necessary efficiency moves that may be required and indicated.

### Plant Operating Statements

A somewhat typical example of a plant operating statement for a chemical manufacturing plant is shown in Table 8-2. As much detail or as many categories as desired may be listed with this statement, but usually they are limited to the more meaningful items that represent a significant dollar value. Also, statements are often broken down into groupings such as: items that vary directly with production, like raw materials and utilities; "controllable" items such as



Source: Correia 1980. Excerpted by special permission from *Chemical Engineering*, March 24, 1980. Copyright © 1980, by McGraw-Hill, Inc., New York.

Figure 8-2. Industrial budget and accounting relationships

**Table 8-2  
Partial Example of a Monthly Production Department Operating  
Statement**

Item	Actual Expenses		Period Budget	
	Current Period	Year to Date	Current Period	Year to Date
	Amount	\$/ton	Amount	\$/ton
Plant _____				
Production, tons				
Net value to plant, \$				
Controllable Costs:				
Raw materials: A				
B				
Additives, catalysts:				
A				
B				
Packaging materials:				
A				
B				
Freight in, out				
Operating labor				
Overtime				
Other labor				
Group insurance				
Retirement plan				
Workman's compensation				
Payroll taxes				
Other payroll expenses				
Warehouse, stores expense				
Maintenance labor				
Maintenance material				
Contact maintenance				
Gas				
Electricity				
Water				
Telephone				
Office supplies				
Dues, subscriptions, books				
Professional services				
Laboratory expense				
Travel				
Environmental				
Miscellaneous				
Subtotal				
Fixed Costs:				
Depreciation				
Taxes				
Insurance				
G & A				
Management salaries				
Sales salaries				
Sales expense				
Interest, rent, royalties				
R & D				
Subtotal				
Total				

travel, and so on; and fixed charges that do not change appreciably with the plant operating output, and are not directly within the control of the plant staff, such as depreciation and corporate general and administrative (G & A) overhead charges. The budgetary control and analysis of spending in each of these groups is quite different, and decisions on efficiency improvements such as new plants, changes in the operation, or manufacture or purchase raw materials analyses must be made with the differences and new budgets compared to the old ones, so that fixed costs and overhead do not become ignored or improperly distributed.

For these reasons, cost accounting and cost allocation among products must be a shared responsibility between accountants, engineers, and management, with initial budgets and proposed changes made jointly, and major reviews or proposed changes carefully analyzed for all of the direct, indirect, canceled, and ongoing charges (Strauss 1987). For instance, in a proposed production change, which items will remain as real costs (G & A, contractual charges, etc.), and which as "book" charges only, such as depreciation on the discontinued equipment. Likewise, shared or arbitrarily allocated charges between different operations or products within the plant must be carefully examined and considered when changes are proposed to safeguard improvements that would genuinely increase efficiency, but might not appear attractive because of previously allocated charges. In the reverse direction, it is often easy to assume that general and administrative, plant security, facility maintenance, research and development and other fixed costs might not increase with a new operation or a plant expansion, which if true would greatly improve its economics. This may be the case, but usually most of these fixed costs will increase, at least with time, and the new operation should share in their burden.

### Standard Costs

In developing budgets and cost accounting methods most facilities will have first established a system of standard costs. This will have included records of the cost of plant-wide services: management, clerical, accounting, research and development and so on. A general allocation formula will then be determined for each product (if it is a multiproduct facility), such as based upon the FOB sales income of each product, the total tonnage produced, or some more complex relationship. In a similar manner common services such as steam, electricity and compressed air will probably be charged on a usage basis and the cost per unit will have been established. Also, individual operations' basic costs will have been established for all categories of labor and associated charges, maintenance, local taxes, insurance, raw materials, and so on.

**Materials, Overhead, Labor** The considerations noted above in cost accounting and cost distribution to products have become of ever-increasing



concern (Chowdhury 1987; Dudick 1987; Lunde 1984; Worthy 1987) to industry because of their importance in accurately determining each product's costs when a large number of products are produced in a given plant, and when competition is severe. Only with an accurate and fair assignment of costs can the profitability of each product be determined, and a reliable assessment made of the best competitive sales price, when to expand or discontinue production of certain items, whether to buy or produce raw materials or intermediates, close, modernize, or expand other plants making the same product, and so on.

In assigning costs, materials, labor and utilities, and some services can usually be fairly accurately allocated to a product, as noted above. However, overhead charges are much more difficult to assign, especially with the ever-growing tendency to substitute equipment and controls for labor, and to share services. Improper allocation of overhead (which includes depreciation, research and development, testing, security, management, etc.) can frequently result in as much as a 50% error in assigning costs and calculating profitability. The error is most frequently encountered in large-volume, basic chemicals and in batch operations. It is easy to visualize that such inaccuracy can result in very wrong decisions on products to discontinue or price competitively. This problem appears to be surprisingly prevalent in current industrial operations (Worthy 1987) because of obsolete accounting-management practices, such as using labor costs as the assignment basis in some cases. Other problems arise from the improper sharing of inventory costs, and in considering the total, individual cost of marketing and distribution, such as even on a customer-to-customer basis. Of course, too broad a capital distribution charge, as previously noted, can also be particularly in error. All of these factors have resulted in the more progressive companies reorganizing their cost systems to a more competitive environment by more detailed and accurate breakdowns, and more complex computer assisted cost assignment.

### Plant Management

A second and somewhat independent aspect of accounting in the chemical process industries is involved with sales, inventory, and operating cost feedback in the management of plants. Improved performance is often obtained through computer assisted programs such as PMS or CIM (plant management system; computer integrated manufacturing), or MRPII (manufacturing resource planning) (Chowdhury 1987). The former stresses process control, while the latter emphasizes better plant scheduling strategies, particularly with batch processing plants.

The PMS software considers economic information of sales demands and prices, inventories, raw material prices and availability, energy costs, operating

costs versus product output, and so on. By using such detailed data, the input costs and effort are considerable, but the plant manager can often much more efficiently manage the plant output, inventory, yields, and profitability. The profit increases can be considerable.

**Control Layers.** The PMS program basically integrates four "control layers" in a plant. The first concerns the normal plant control instruments and functions at their optimum settings; the second is the management or supervision of an entire process unit at its most favorable operation. The third layer is plant management control of a complete plant, and the final layer is information control, which includes raw material, product and energy costs, product sales and inventory, business data, and so on. Information such as product quality, production costs and optimum operation from several view points all may become immediately available to management from the program.

An alternative planning scheduling and inventory control method is MRPII. When off-the-shelf programs are modified for CPI batch process plants they have proven very useful not only for inventory control, but also for production planning if sales projections are fed into the system as one of its more than a dozen data bases (e.g. bill of materials, raw material ordering policy, production scheduling, materials requirement planning, plant floor control, purchasing, cost management, order management, etc.) Extremely demanding input frequency and accuracy are required for the system to function properly.

More detailed information on cost control methods and procedures may be found in numerous articles on the subject, and in texts, such as Dudick (1987) when needed in an engineers' career.

### BUDGETS

Budgets are used in every aspect of the chemical industry, and each engineer's degree of contact with the budgets depends greatly upon his position in the organization. As an entry level engineer all wage increases, projects, equipment availability, and the activities of the corporation that he sees depends upon budgets. Once an employee has been with an organization for some time, or has risen in the company, he generally becomes an integral part of the budget formulation process, as well as being governed by it. At higher levels one's advancement record is partly determined by one's skill in budgeting and accomplishing the desired results within the budget. Conversely, it often appears for those doing government contracting, success depends upon *not* completing the work, and carefully overrunning the costs (budgets), but believably, so that the government will extend the contracts or grant new ones and feel that they are advancing the project.

### Operating Budgets

Preparing budgets is another form of cost estimating, but one that usually is based largely upon the individual groups and the accounting department's records. Overhead factors are generally available to be applied to actual salary and labor charges, as are other standard costs, as noted above. Business tax, local fees, utility rates and depreciation estimates are also jointly determined with the accounting department. The manufacturing overhead budget is complex because it contains both variable and fixed costs, includes many cost elements (some of which are relatively small), and represents costs for which different groups or managers are responsible.

Other aspects of manufacturing cost have been covered in Chapter 4, but will be briefly highlighted here. The amount of manpower required is often as simple as knowing the size of the group available, but in other cases it will have to be estimated based upon previous work, or as best possible from a knowledge of what is desired to be accomplished, and perhaps manning charts. Often this is done by breaking the project or work into as many component parts and types as can be visualized, and then estimating the manpower and staffing for each unit. An estimate of the materials, supplies, utilities, and so on that will be required to manufacture the desired amount of product generally can be obtained from heat and material balances, adjusted for actual plant efficiency factors. On the manufacturing cost and budget sheet shown in Table 8-2, many of the cost elements are also of considerable importance to other groups within the organization. The raw materials component is important to the purchasing department, which must make sure that the desired quantities will be available when needed. The treasurer-controller uses the dollar amounts of the total budget for input to the cash budget to ensure that the money will be available when the materials are delivered and wages and other costs are due. The maintenance equipment and supplies need to be ordered by the purchasing or maintenance departments, and so on (see Table 4-6).

### Inventory Budgeting

Several different conventions may be considered in regard to the value attached to raw materials in inventory. Finished product inventory is always budgeted at cost, but since the initial purchase price may change, the value of the raw material inventory will also change. The amount of both inventories may be determined by such considerations as storage capacity, raw material availability, processing time, shipping schedules, sales demand, production capacity, and most importantly, the pattern used in withdrawing the inventory. Once the desired amount is determined, the following conventions may be used to establish the raw material inventory value and to consider for product inventory tax treatment:

1. The current average or current value method. The average price of all the inventory on hand at the time of delivery or use is employed in this method. In other words, it is the actual cost of the inventory. It may be adjusted, if appropriate, for its current value, if this is lower than the purchase price.
2. The first-in, first-out (FIFO) method. This method assumes that the oldest material is always used first, and the inventory is valued at the most recent cost.
3. The last-in, first-out (LIFO) method. With this method, the oldest prices are used for the entire inventory value. In a period of rising prices this results in lower priced inventories, higher costs of sales and, consequently, lower taxable earnings. Many businesses adopt LIFO in order to reduce taxes and thus improve cash flow.  
The dollar value LIFO inventory method is the most common LIFO technique used. It measures inventory quantities in terms of dollars, rather than physical units, and this is done for a pool of items, rather than for specific items.
4. The "just-in-time" method of sizing the inventory. In this procedure, raw material inventory is kept to an absolute minimum, assuming that new supplies can be received as needed. This reduces the working capital requirement, but if a company sells to "just-in-time" companies (as is usually the case with automotive, etc. customers), then much larger product inventories are required since the customers' inventory is so low (*Chemical Business* 1988).
5. UNICA (uniform capitalization) rules for the taxation of inventories came into effect on January 1, 1987. They are very complex, but basically require "full absorption costing" for inventory, including some overhead and administrative costs to be allocated to the goods that are being produced, and that some inventory be capitalized and not shown on the books as an expense (Gomez 1987). Engineers may need to be aware of these inventory procedures and complications, but all details will normally be handled by the accounting department.

### Budget Preparation

Budgets are a key factor, as noted before, for managers to efficiently run their operations. Generally the budget preparation procedure starts at fairly low levels when each group or function within the organization is given general guidelines of what the management feels they would like to accomplish during the following year, the general priorities, and the increase or decrease in spending limitations. Then the component groups within the company assemble their data, suggest programs, and formulate detailed operational plans for accomplishment, manpower, time, and spending requirements. An engineer might be asked

to participate in this budget making process by outlining what he anticipates will be required for the projects he should be working on during the coming year.

The preliminary budget requests are then gathered by each line of management. Generally they are reviewed with the individual groups preparing them and are consolidated, often with considerable discussion, editing, selection, and choice between alternatives, and passed on to the next level of management. The process is repeated until finally they are presented to the top management of the corporation, and again generally with fairly detailed and elaborate reports and presentations as to why each subgroup within the organization believes that their programs should be followed. Considerable detail is given supporting these requests, including preliminary project cost estimates, manufacturing costs, and the anticipated economic analysis or DCF results. Top management then compares and evaluates the spending desires with the funds available (including increasing debt if justified) and sets out the final detailed budgets.

Once approved, budgets become a rather absolute guideline for all activities during the following year. They certainly can be changed, and all of them have some degree of flexibility, but as a first approximation management expects that they be rigorously adhered to unless they have given advance authorization for a change, or after an intermediate review period, management allows alterations to be made. This frequently happens, but it is not the prerogative of the groups within the organization to change budgets on their own, and a fairly complex review procedure is usually required for management to authorize such changes.

### Budget Control

The accounting department of the company generally sends monthly reports to each group letting them know how well they are conforming to the budget (see Cost Accounting). These records show not only the direct spending but also all of the indirect expenses and the company overhead charged to them. The accounting department will clarify all questions concerning the spending, but if there are overruns the group usually must immediately explain them and lay out a corrective plan. Chronic or worrisome overruns almost always result in higher management intervention unless they can be satisfactorily explained and/or excused.

This accounting department feedback has become a vital part of most company's operation, for with the advent of computer accounting it is not too difficult for detailed breakdowns to be given to every subdivision of the company frequently (such as on a monthly basis) and soon after the period closes. Even with maintenance work it has become common practice for the cost and repair history of most major equipment to be entered into the accountant's (or depart-

ment's) computer, and be retrievable in a wide variety of analyses. This greatly assists in planning, parts inventory control, preventative maintenance, and in improved equipment selection.

Budgetary control reports based upon actual expenditures and charges thus provide the manager at each level with much of the information he needs to control his day-to-day operations. In production control reports can be found answers to such questions as raw material usage, production rates, on-stream efficiencies, total production, manpower, all categories of expenses, and the inventory of raw materials and products. In most companies monthly budget meetings are held in which any deviation from the budget is discussed and explained, and this information is then passed on to the next level of management. Such budget meetings also often serve as the focus for improvement suggestions, company news, and "esprit de corps" formation.

All company divisions have to plan for both local management and corporate general and administrative overhead (G & A) charges spread out to their divisions by management, service groups, research and development, and so on. These charges can be quite large, and management always has the prerogative to increase them. Such "distributed" charges may thus be both substantial and sometimes appear as unexpected additions. Well-run organizations have worked hard to significantly reduce these charges over the past few years by cutting back on bureaucracy and unnecessary overhead costs. This has helped to make the industry more competitive for the world markets.

Corporate policy with regard to decentralization will dictate the extent to which the overall budgets are supervised and reviewed at the plant or headquarters. In a decentralized organization the master budget and all support budgets are normally prepared and analyzed at the plant level. Although the operating managers may not be directly concerned with the overall corporate budget, they will contribute to its preparation. The operation managers acceptance of and dedication to achieving the goals set in the master budget certainly depends to some extent upon their knowledge of its preparation and the give-and-take of its components.

**Variance Analysis.** Variance analysis is one of the methods used to systematize the control of an operation. By noting the variance between actual and budgeted costs it provides a number, and pinpoints where problems exist and the extent of the problem. It sometimes may help show where greater or in-depth analyses may be needed for recurring problems. It may indicate that better planning is required or that the budgets should be revised. It is the end-product of the budgeting and control system, and its value depends on whether it is used as a tool for improving operations or for finding fault. Corporate budgeting is thus the base, or beginning, of operational control.



Many excellent books (Schwartzman and Ball 1977; etc.) and courses (AMR 1971; Nevitt 1975; Symonds 1978; etc.) frequently appear on these general accounting/financial subjects.

## PERSONAL BUDGETS

Many people go through life with only a vague idea of how much they should save, whether they actually can afford their lifestyle, or even if they are going to have enough money to live comfortably when they retire. A multitude of books, seminars, sales people, and television pitches are available to advise on what to do with your money, but most of them jump right into complex investing techniques. In practice, if you don't have the basics down, you're not going to have the money to get into more sophisticated investing. It is invariably necessary for you to start with a good personal budget.

To determine where you are you have to organize your papers, figure your net worth and set up expense categories. These steps will require considerable analysis on your part, and at first will not be too accurate. By organizing your documents into some sort of logical filing system you make it easier on yourself to come up with supporting evidence if you are audited by the government, and it also helps you to determine spending categories. Establishing a budget is actually a three-pronged effort that can take as little time as a month or two or as long as six months to a year. Your first need is to track your income and expenses to see where your money is going. Once you get an idea of how you are spending your money, you can allocate your spending into different headings within two general groups—fixed expenses and variable expenses.

The last step in setting your budget is living with the allocations you made for a short period and then adjusting them where needed. You'll find that fixed expenses can't be changed easily—you'd have to move to a new place where you would pay less rent or make smaller mortgage payments, for instance. And even though variable expenses are easier to rearrange, this kind of cost cutting does not make such dramatic changes. However, whether it be major structural changes or small ones, improvement usually can be obtained.

Finally, the major reason for the budgeting process is so that you can regularly and systematically save some of your income for investments. No matter how small, once the saving habit is started and maintained, your financial security is greatly increased. Most people find this to be progressively easier to accomplish with practice, and then the enjoyment and profit from investments will multiply. Your net worth is the difference between everything you own and everything you owe. If calculated once a year, as many planners recommend, the results tell you how you are progressing on the road to security. A typical budget worksheet is shown in Table 8-3.

Table 8-3  
Typical Personal Budget Worksheet

INCOME	
Monthly earnings (take home)	\$ _____
Other income	\$ _____
<b>TOTAL INCOME</b>	..... \$ _____

MONTHLY EXPENSES	
<b>FIXED EXPENSES</b>	
House/rental payments	\$ _____
Car & transportation	\$ _____
Other loan payments	\$ _____
Food	\$ _____
Utilities	\$ _____
Child care	\$ _____
Household help	\$ _____
Savings & investments	\$ _____
Personal allowance	\$ _____
Other	\$ _____
<b>Subtotal</b>	\$ _____

VARIABLE EXPENSES	
Tax payments	Annual cost \$ _____ Monthly pro-rated cost \$ _____
Insurance premiums	\$ _____
Health care expenses	\$ _____
Education	\$ _____
Household repairs	\$ _____
Car repairs	\$ _____
Clothing	\$ _____
Entertainment & travel	\$ _____
Gifts & donations	\$ _____
Other	\$ _____
<b>Subtotal</b>	\$ _____

<b>TOTAL MONTHLY EXPENSES (fixed plus variable)</b>	..... \$ _____
<b>TOTAL DISCRETIONARY DOLLARS (total income minus expenses)</b>	..... \$ _____

## REFERENCES

- Advanced Management Research. 1971. *Fundamentals of Finance and Accounting for Non-Financial Executives*. New York:118.
- Alcott, Martha J. 1987. Personal budgets. *Fresno Bee* (Jan. 12):C-7-8. McClatchy News Service (McClatchy Newspapers, Inc.).
- Chemical Business* 1988. Just in time. (Feb.):7.
- Chowdhury, J. 1987. CPI find big dividends in better plant management. *Chemical Engineering* (Nov. 28):29-33. McGraw-Hill, New York.
- Clark, Forrest D., and A. B. Lorenzon. 1985. *Applied Cost Engineering*. Marcel Dekker, New York:352.
- Corraia, Ernest V. 1980. Cost control begins with budgeting. *Chemical Engineering* (March 24):87-90. McGraw-Hill, New York.
- Dudick, Thomas S. 1987. *Manufacturing Cost Controls*. Prentice-Hall, Inc., Englewood Cliffs, N.J.
- Ernest and Whimney. 1986. Accounting and cash flow ideas. *Fertilizer Progress* (May/June):53.
- Gomez, Ins. 1987. In the short term, UNICAP hurts. *Chemical Week* (June 24):15-16.
- Lunde, Kenneth E. 1984. Joint product costing. *Chemical Engineering* (Dec. 10):89-92; 1985 (Jan. 7):95-100. McGraw-Hill, New York.
- Nevitt, Peter K. 1975. *Project Financing*. AMR International, Inc.:159.
- Schwartzman, Sylvan D., and Richard E. Ball. 1977. *Elements of Financial Analysis*. Van Nostrand Reinhold, New York:133.
- Strauss, Richard 1987. Use and misuse of manufacturing cost systems. *Chemical Engineering* (March 16):106; (April 27):65-70; (May 25):87-88. McGraw-Hill, New York.
- Symonds, Curtis W. 1978. *Basic Financial Management*. AMACOM, New York:208.
- Worthy, F. S. 1987. Accounting bores you? Wake up. *Fortune* (Oct. 12):45-52. Time, Inc.

## 9

## CORPORATE ANNUAL REPORTS

Every employee should regularly read his company's annual reports, and other similar publications when possible. They are mailed to all stockholders, so purchasing at least a few shares of company stock will automatically have them delivered to you. A review of competitors' reports can also often be quite informative, but probably less so than technical journals until one reaches the middle-to-upper management ranks. These reports discuss what management feels is important about the business, and can give the working engineer some idea of how his work fits into the total operation. Often new directions that the company is interested in pursuing are outlined, as well as general objectives and statements concerning the company's financial health. A knowledge of these factors can usually be of general value in performing one's work, and certainly makes the engineer more responsive to the company needs. It also may occasionally open the door to otherwise unknown opportunities within the company or give a hint when one should start looking for another job.

As actual examples of this, a young research and development engineering group leader in one of a medium-sized chemical company's plants was invited to an evening social gathering when the company president visited the operation. The engineer had just read the annual report and the latest issue of *Fortune* magazine. While part of a large group chit-chatting with the president he happened to observe that if the company continued its present rate of growth, next year it would make the *Fortune* 500 list (the 500 largest U. S. industrial corporations) (Fortune 1987). The president had not been aware of that, was intrigued, and wanted more information, which the young engineer supplied. From that time onward the engineer was remembered by the president, and his rise in the corporation was accelerated.

In another case a section manager in a chemical plant that was part of a major corporation noted in the annual report that a large desalination plant was about to be built in a foreign country by the company's technical engineering department. The technical vice-president visited his plant's research and development laboratory frequently, so on the next visit he arranged with research and development friends to ask for an interview. This came about, and he volunteered to

help start up and operate the new plant. The research and development vice-president had not yet hired a plant manager, so he checked the engineer's credentials with his boss, got his permission, and offered the engineer the job. The former section manager did an excellent job, and rather quickly was promoted to head part of the company's total operations in that country.

The above examples must be considered as quite unusual, but the point is that for all employees, reading the corporate annual reports cannot help but improve job understanding and satisfaction, and perhaps aid in job performance and advancement.

## BALANCE SHEETS

All public companies are required to disclose fully "material" information (material here means any information that might affect the well-being of a company). They are not required to disclose it in a highly readable form nor does the Securities Exchange Commission (SEC) make any value judgments about what is disclosed. It's up to the reader to get what they can from the reports. They are usually written in somewhat of a jargon by accountants and lawyers, but once you figure out the code, understanding financial statements becomes more a matter of practice than of intellect.

An annual report often consists of a president's letter, a text explaining how the company has prospered during the past year and its future plans, a financial section that includes a balance sheet, income statement, often a flow of funds accounting, and a set of footnotes at the end that explains in more detail those things that didn't get sufficiently explained up front.

The balance sheet is the first indicator of the company's strength and vigor. As noted in the accounting section, for any balance sheet the total value of what is owned (assets) minus the total value of what is owed (liabilities) equals the net worth (stockholder's equity) of the company:

$$\text{assets} - \text{liabilities} = \text{stockholder's equity}$$

An abbreviated average balance sheet for 12 major chemical companies is shown in Table 9-1 (note that the 12 companies change in 1984-1985). It, like all others, must cover an exact period, such as one year, and have a precise starting and ending date, such as January 1 through December 31 of the year in question. Any accounting period and ending dates are acceptable, just so that they are clearly indicated.

Table 9-1 has fewer entries listed than is found in most annual reports, but the most important items are there, and the resulting simplicity aids in reviewing it. First, note the two subsections marked current assets and fixed assets. Current assets are essentially the working capital of the company, which at least theoretically could be fairly readily converted into cash, such as:

Table 9-1  
Typical Chemical Industry Balance Sheet and Financial Data.

Assets, \$ billions	1986	1985	1984	1983	1982
Current assets					
Cash and U.S. bank deposits	\$ 2.52	\$ 1.32	\$ 1.10	\$ 1.28	\$ 1.04
Short-term securities	0.95	1.14	1.29	1.57	1.36
Receivables	11.69	12.33	13.12	14.01	13.26
Inventories	11.21	10.76	12.26	11.60	12.43
Other current assets	3.16	2.50	2.89	2.25	2.77
Total	29.54	28.05	30.66	30.71	30.86
Fixed assets					
Depreciable fixed assets	77.42	76.21	82.17	79.31	
Land and mineral rights	2.87	2.98	3.44	3.18	80.15
Less: accumulated depreciation and depletion	41.51	40.19	41.48	38.24	35.59
Net fixed assets	38.78	39.00	44.13	44.25	44.56
Other assets, including investments and intangibles	22.76	21.80	19.27	17.20	17.54
Total assets	\$91.08	\$88.85	\$94.06	\$92.16	\$92.95
Liabilities and Stockholders' Equity, \$ billions					
Current liabilities					
Short-term debt	\$ 3.27	\$ 3.27	\$ 1.89	\$ 1.74	1.78
Accounts payable	5.76	5.90	6.75	6.79	6.28
Accrued income taxes	1.31	1.05	1.44	1.24	0.50
Current portion of long-term debt	0.85	1.03	1.27	1.11	0.91
Other current liabilities	8.87	9.40	9.69	8.91	8.53
Total	20.06	20.64	21.04	19.79	18.00
Long-term debt	20.87	19.21	18.14	19.43	22.04

Table 9-1 (Continued)

<i>Liabilities and Stockholders' Equity, \$ billions (Continued)</i>	1986	1985	1984	1983	1982
Other noncurrent liabilities, including deferred taxes and minority interest	8.53	8.19	8.02	7.68	6.97
Total Liabilities	49.45	48.04	47.19	46.91	47.01
Stockholders' equity					
Capital stock and other capital	14.91	13.90	17.06	17.79	17.85
Retained earnings	26.72	26.92	29.82	27.47	28.10
Total stockholders' equity	41.63	40.82	46.87	45.26	45.95
Total liabilities and stockholders' equity	\$91.08	\$88.85	\$94.06	\$92.16	\$92.25

## Debt Ratios

<i>\$ Billions</i>	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976
Industrial Chemicals and Synthetics											
Long-term debt	\$20.9	\$19.2	\$18.1	\$19.4	\$22.0	\$21.4	\$16.8	\$14.8	\$13.6	\$12.3	\$11.8
Stockholders' equity	\$41.6	\$40.8	\$46.5	\$45.3	\$45.9	\$42.5	\$39.8	\$32.3	\$29.3	\$26.3	\$25.0
Debt ratio <sup>a</sup>	33.4%	32.0%	28.0%	30.0%	32.4%	33.5%	29.6%	31.4%	31.8%	31.9%	32.0%
Chemicals and Allied Products											
Long-term debt	\$45.8	\$38.2	\$33.8	\$36.2	\$38.2	\$36.9	\$28.3	\$24.9	\$23.5	\$21.1	\$19.4
Stockholders' equity	\$100.0	\$100.3	\$100.3	\$97.2	\$95.3	\$89.9	\$79.5	\$67.4	\$60.8	\$54.9	\$50.8
Debt ratio <sup>a</sup>	31.4%	27.7%	25.2%	27.2%	28.6%	29.1%	26.3%	27.0%	27.9%	27.8%	27.6%

Table 9-1 (Continued)

<i>\$ Millions, % of total</i>	Cash Flow									
	1986		1985		1984		1983		1982	
Sources of Funds										
Net income	\$3,414	13.6%	\$ 986	6.5%	\$ 3,859	29.7%	\$ 2,795	23.1%	\$2,750	21.4%
Depreciation and depletion	5,117	20.4	5,010	32.8	4,710	36.2	4,601	38.0	4,341	33.8
Deferred taxes	568	2.3	-34	-0.2	507	3.9	333	2.7	623	4.8
Other internal sources	6,084	24.3	6,707	43.9	2,357	18.1	2,623	21.7	2,062	16.0
Long-term debt	8,773	35.0	2,356	15.4	1,441	11.1	1,352	11.2	2,665	20.6
Stock	1,091	4.4	264	1.7	136	1.0	396	3.3	432	3.4
Total	\$25,047	100.0%	\$15,289	100.0%	\$13,009	100.0%	\$12,100	100.0%	\$12,864	100.0%
Applications of Funds										
Dividends	\$ 1,992	8.0%	\$ 2,049	13.4%	\$ 1,998	15.4%	\$ 1,868	15.4%	\$ 1,791	13.9%
Capital expenditures	5,986	23.9	6,500	42.5	6,400	49.2	5,685	47.0	7,370	57.3
Additions to working capital	-567	-2.3	49	0.3	-436	-3.4	-265	-2.2	-1,402	-10.9
Reduction of long-term debt	7,669	30.6	2,555	16.7	2,529	19.4	3,249	26.9	3,592	27.9
Other applications	9,966	39.8	4,137	27.1	2,518	19.4	1,563	12.9	1,512	11.8
Total	\$25,047	100.0%	\$15,289	100.0%	\$13,009	100.0%	\$12,000	100.0	\$12,864	100.0%

a. Long-term debt as a percentage of long-term debt plus stockholders' equity; Data from company annual reports.

Note: 1985-1986 Data are totals for 12 major chemical producers: American Cyanamid, Dow Chemical, Du Pont, Ethyl, W. R. Grace, Hercules, Monsanto, National Distillers, Olin, Penwalt, Rohm & Haas, and Union Carbide.

Note: 1976-1984 Data are totals for: American Cyanamid, Celanese, Dow Chemical, Du Pont, Ethyl, Hercules, Monsanto, Olin, Penwalt, Rohm & Haas, Union Carbide, and Williams Cos.  
Source: Chemical and Engineering News, 1984, 1985, 1986, 1987. Reprinted with permission from *Chemical and Engineering News*, June 8-11, 1984-87. Copyright 1984, 1985, 1986, 1987, American Chemical Society.

Cash on hand.

Marketable (or short-term) securities listed at their actual cost, not the current value.

Accounts receivable (adjusted for bad debts).

Inventories (raw materials, products, supplies, or in-process materials listed by value according to the actual, LIFO or FIFO convention).

The first two items are called liquid or quick assets because they are either cash or nearly equivalent to cash.

The fixed assets (property, plant, buildings and equipment) are listed at their original acquisition cost (direct fixed capital), and accumulated depreciation is shown separately. The net fixed assets, before depreciation, are therefore generally identifiable with the investment of the corporation in property and equipment. This number, plus the working capital (current assets) gives a first approximation of the total capital utilized by the corporation. Assets are kept on the books and shown as assets as long as they are in use, even though they may be completely depreciated. They are only removed from the balance sheet when they are discarded and physically removed from the property. At that time both fixed assets and accumulated depreciation are equally reduced. The asset value of land, buildings, mineral holdings, and so on are usually shown at their actual acquisition value, and thus are frequently tremendously undervalued, or occasionally vice versa. The numbers can be adjusted upward or downward to reflect actual market conditions if desired, but this then results in a taxable gain (profit) or a loss that year. If a gain, a commensurate tax payment is required and if a loss, it shows on the books as reduced earnings that year. Consequently, this profit or "write down" is generally only done under unusual circumstances.

Some other items that may be on the assets side of the balance sheet merit further explanation. Prepayments refer to payments for materials or services for which full value has not yet been received. Examples are prepayments on taxes or insurance, and down payments on construction contracts or equipment and supplies. Deferred charges are in some ways the reverse of prepayments, in that they indicate an expenditure that has not yet been made, but from which benefits will accrue over a number of years, and a growing (book) liability will increase, such as deferred taxes resulting from using accelerated depreciation (compared to straight line). As another example, with research and development on a major project, the corporation may feel that it is more reasonable (or required by the IRS) to consider the expenditure as if it were spread out over several years. The deferred charges specific to a particular expenditure then decrease annually over the full period of deferment.

Sometimes intangibles are listed, referring to assets which have no physical existence but which nevertheless have assignable value. Patent rights are an example, the value of which may be determined by the purchase cost of the

rights, or by the cost of developing the patent. Goodwill is the assigned value of those qualities which bring patronage to a business. For instance, the exclusive (or nonexclusive) right to produce or distribute a product in a particular area is a goodwill item having some inherent value. The assignment of value must be reasonable, and preferably it should be based upon monetary transactions such as the cost of a franchise, license, or research and development work performed. The assessed value of intangibles must be included in the income statement when they are sold, depreciated, or cancelled.

The debit side of the balance sheet (the liabilities) consists of three major categories, current and long-term liabilities and equity. The current liabilities, just like the current assets, are identified with a potential quick demand for cash. Examples are short-term (one-year) loans, obligations, and accounts payable which represent money that is owed for materials and services that have already been ordered, provided, or delivered (raw materials, equipment, and so forth). Notes payable are the current year's portion (the part that must be repayed during that year) of longer term debt from bonds or loans. Accrued expenses payable are salaries, interest payments, insurance premiums, taxes, and other expenses which are due at that time, or at the end of the quarter or year, and remain unpaid at the date of the balance sheet.

Long-term liabilities are debts (promissory notes, debentures, bonds, bank loans, etc.) due after more than one year from the date of the balance sheet. The principal item under long-term liability usually consists of (first mortgage) bonds which guarantee that the purchasers will have top priority claims upon mortgaged assets of the corporation if for some reason the corporation cannot pay the value of the bonds at the maturity date. Many other entries may be listed, such as debentures, other types of bonds, loans, debt to subsidiaries, and so on.

The final item in a balance sheet is the stockholder's equity, which must satisfy the balance, assets - liabilities = equity. Essentially it is the "net worth" of the corporation. Capital stock, both preferred and common is listed at its originally issued, or "par" value. It should be noted that par value has no great significance, and some corporations issue stock with no stated par value. Stock is almost always sold by the corporation above par value, at an amount deemed to be equal to its current market value. The excess that is received from shareholders above the par value is called capital surplus.

The accumulated retained earnings category is the other important component of stockholders' equity. The retained earnings represent all of the profits that have cumulatively been earned over the years and saved or plowed back into the corporation. Each year's net profit (after subtracting all costs and taxes), diminished by the amount of stock dividends, contributes to the accumulated retained earnings total. This amount is not primarily cash that has been accumulated, but instead represents all of the assets and investments purchased by the corporation from these funds. Increases in retained earnings result in increasing



assets and investments (fixed assets) obtained by using some of the current profits or cash flow. The accumulated retained earnings are thus a running balance which serves to satisfy, year after year, the rigid requirements assets — liabilities = equity. It may be based somewhat upon intangible and even vague elements such as goodwill and accrued or deferred charges, so consistent accounting principles are very necessary to come up with a perfectly balanced and accurate balance sheet.

In most annual reports the yearly distribution of the retained earnings or cash flow are also tabulated to show the stockholders what has happened to their profits (see Table 9-1, Cash Flow, p. 177).

## INCOME STATEMENTS

Whereas balance sheets show the corporate position at one point in time, the income statement reflects the results of operations throughout one year or quarter. Income statements are generally only partially presented in annual reports, showing items of general stockholder interest such as total sales, research and development, tax payments, depreciation, perhaps profits from sale of certain assets, energy purchases, and so on. (For internal use, within the company, however, operating statements will generally be very detailed.) A hypothetical income statement is shown in Table 9-2.

Simplified statements start with the total sales revenue for the year, diminished by production cost, depreciation, selling and administrative expenses, which are normally called the total manufacturing cost. Accountants, however, often use the term "cost of sales" and list depreciation, sales, general and administrative, other expenses, and income taxes separately. The cost of sales is thus only the general expenses (or the out-of-pocket expenditures), and unfortunately you are never totally sure what items it contains (i.e., is interest included? Usually.) The revenue minus the cost of sales difference is called the gross or operating profit, and may be adjusted for interest, and other expense, plus income from interest or short-term investments such as securities held by the corporation, and gains from the sale (or book appreciation) of property. This gives a total pretax profit, unless other items not considered in the cost of sales are still unaccounted for, such as perhaps interest on bonds and other borrowed money, or in Table 9-2, research and development. The balance is finally the gross profit upon which income tax is paid. The net profit is the gross profit minus the total of all income taxes.

## FLOW OF FUNDS, FOOTNOTES

Corporations are complex financial entities, and the consolidated statements found in annual reports cannot be expected to convey all of the important details of that financial complexity with only the sections noted above. For this reason corporate annual reports include a section entitled "notes to financial statements" or "footnotes" that explain the methodology and data used in formu-

**Table 9-2**  
**Example of an Income Statement.**

<i>Fiscal Year Ending</i>	<i>12/31/86</i>	<i>12/31/85</i>
Revenues		
Net sales	\$800,000	\$750,000
Cost of sales		
Cost of goods	\$550,000	\$500,000
Depreciation of amortization	30,000	25,000
Selling, general, and administrative expenses	\$120,000	\$110,000
Total costs of sales and operating expenses	700,000	635,000
Gross Profit	\$100,000	\$115,000
R & D expenditures	\$10,000	\$5,000
Nonoperating income	6,500	7,000
— Interest expense	— 15,000	— 15,000
Income before taxes	\$81,500	\$102,000
Provision for income taxes	20,000	15,000
Net income	\$61,500	\$87,000
Common shares outstanding (in thousands)	15,000	15,000
Earnings per share	\$4.10	\$5.80
Prior accumulated retained earnings	\$220,000	\$200,000
Net income	61,500	87,000
Total	\$281,500	\$287,000
Less dividends on		
Preferred stock	\$400	\$400
Common stock	20,000	18,000
Retained earnings	\$261,100	\$268,600

Source: *Compressed Air Magazine* 1987.

lating the statements. In fact, such footnotes may contain a great deal of important supplemental information, and occasionally they explain otherwise unmentioned details very pertinent to the corporation's operation.

There is no specific requirement regarding the substance of the footnotes, but a typical annual report may show some or all of the items noted below, among others:

- The components of income tax paid by the corporation, including a subdivision among federal, state, local, and foreign taxes.
- Explanation of the effect of using different depreciation schedules for tax and book purposes.
- A breakdown of plant properties.
- Statistics on mineral and energy reserves.
- Retirement plan statistics (often pension fund deposits can be very large, and represent complex investment requirements).
- Details of long-term debts and the interest rate on various loans or bonds.
- Stock options and awards; officer's salaries.
- Details of divisional operations.
- Product group sales analysis.

Other useful information in annual reports may include a historical financial summary covering several years, or the effects of inflation upon financial performance criteria. Some mention is always given of the earnings per share of common stock, and of the dividends distributed.

As previously mentioned, Table 9-1, p. 177, outlines the source and disposition of the total corporate annual cash flow. Among other things it provides an idea of the new investments made by the company and the source of funds. In Table 9-1 the term "other internal sources" of funds can represent any type of income, but generally implies divisional divestitures and/or equipment or property sales, or revaluations. It also includes profits from investments, foreign currency exchange, and so on. In a similar manner, "other applications" generally means acquisitions and purchase of other businesses. It is seen that both of these areas have been unusually active during the 1980s.

## RATIO ANALYSIS

One of the principal means of analyzing financial performance of corporations is by means of "ratio analysis." It facilitates the year-by-year monitoring of corporate operations and hopefully permits a more rational comparison of different companies. While net profit may be the "bottom line" of the income statement, it may not truly or clearly indicate how well the company performed. For instance, if a corporation experienced a steady increase in net profits over the recent years, does this indicate a good performance? Much of that apparent growth could be due to inflation, acquisitions, or new projects, and the profit margin could be low. The increase could also be partly due to accounting manipulations, such as the reduction of inventories, the sale of assets for a profit, or deferring income tax. Consequently, other financial comparisons, such as the various "ratios" may more clearly compare the performance. Some of the more widely used financial ratios are listed below:

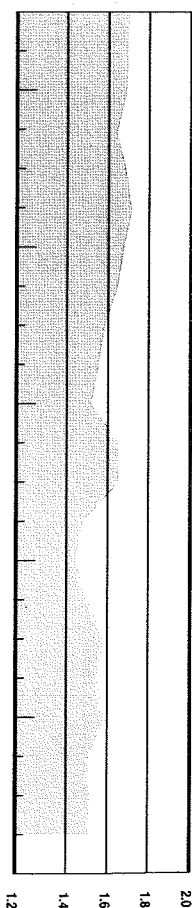
### Current Ratio

The current ratio is defined as

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

Using the data in Table 9-1, the average of 12 chemical companies for 1982 was

$$\begin{aligned}\text{current ratio} &= \frac{30.86 \times 10^6}{18.00 \times 10^6} = 1.71 \\ \text{for 1986, } &= \frac{29.54}{20.06} = 1.47\end{aligned}$$



Source: *Chemical Week* 1988. Excerpted by special permission from *Chemical Week*, January 27, 1988. Copyright © 1988, by McGraw-Hill, Inc., New York.

Figure 9-1. Chemical companies' current ratio. Current assets over current liabilities.

The current ratio is a measure of the corporation's "cash" availability and its capacity to meet current obligations, withstand periods of reduced sales, and have cash for unexpected opportunities. Financial analysts often state that a safe current ratio is about 2.0, but chemical companies tend to have a lower number, probably since chemical inventories are generally somewhat smaller than needed in other industries, and the collection period on sales is slightly shorter than some other industries. Also, their large sales to other manufacturers makes the accounts receivable somewhat more secure, with fewer bad debts. The average current ratio for the industry is published quarterly in *Chemical Week* (see Figure 9-1). It is seen to have been declining during the 1980s as companies have endeavored to operate more efficiently, reduce working capital, and increase profits.

### Acid Test Ratio

The acid test ratio, often called the quick assets ratio, is given by

$$\frac{\text{cash} + \text{marketable securities} + \text{receivables}}{\text{current liabilities}}$$

where the sum in the numerator is collectively termed quick assets. For the balance sheet in 1982,

$$\begin{aligned}\text{acid test ratio} &= \frac{(1.04 + 1.36 + 13.26) \times 10^6}{18.00 \times 10^6} = 0.87 \\ \text{for 1986} &= \frac{(2.52 + 0.95 + 11.69)}{20.06} = 0.76\end{aligned}$$

This ratio is perhaps a more valid measure of the ability of a company to quickly meet its obligations. Quick assets (without inventories) are readily convertible into cash, whereas inventories must first be sold, something that takes time and is by no means guaranteed. A ratio of 1 or more is generally

considered desirable, but again, the chemical industry runs somewhat lower than this, and this ratio has also been declining.

### Debt-to-Equity Ratio

Of the many financial ratios commonly used to help analyze company performance, one of the most important is the debt-to-equity ratio. It indicates the amount of debt the company has, and thus its basic strength, ability to raise more capital (debt), and the extent bankers will influence the company's decisions. It is difficult for a company to stay modern and competitive, and even more so to grow, without the considerable use of debt. Some debt is thus highly desirable for most companies, and when it is considered that on the average about 50% of the chemical industry's after-tax profit is used to pay dividends to the common stockholders, and a moderate amount more goes to preferred stockholders, not too much is left over. With the modest after-tax ROI realized by most companies the accumulation of capital for reinvestment is slow. This, coupled with borrowed money having its interest considered as an operating expense (and thus being deducted from taxes), and inflation reducing the real cost of debt repayment makes borrowing attractive if the interest rate is not too high. However, there is a limit: if the ratio of debt to equity becomes what the bankers (who hold much of the company debt) consider to be excessive, they will put pressure on the company and make its decisions so conservative that it is very difficult for it to stay healthy. In this book we shall define total debt as short-term debt, plus the current portion of long-term debt plus the long-term debt. The debt-to-equity ratio can be defined in many other ways, but long-term debt/equity and long-term debt/equity plus long-term debt are commonly used in addition to the preferred method. The 12 company Table 9-1 debt-to-equity ratios for 1982 and 1986 are

$$\begin{aligned} \text{debt-to-equity ratio} &= \frac{\text{total corporate debt}}{\text{stockholder's equity}} \\ (1982) \quad \frac{1.78 + 0.91 + 22.04}{45.05} &= 0.54 \\ (1986) \quad \frac{3.27 + 0.85 + 20.87}{41.63} &= 0.60 \end{aligned}$$

A debt-to-equity ratio of 0.5 has over the years been considered to be borderline; holding at this value is excellent, progressive management; above 0.5 needs close banker attention; >0.75 almost always brings considerable banking pressure, and >1.0 usually results in bankers' dominating management. Currently, with many large mergers and leveraged buy-outs these rules have tended to relax. Considerable debt is required to complete large, attractive mergers or to thwart unwanted takeover attempts. In this case the bankers will

allow the excess debt, but only for a limited time. Companies like du Pont and the former Allied Chemical have been under such pressure because of their large mergers, and Union Oil and Phillips Petroleum because of antitakeover maneuvers. They become almost forced to sell off some operations in order to reduce the debt, no matter how worthy these divisions may be, and while this is going on funding internally generated investment opportunities is greatly reduced.

Debt-to-equity problems usually result from a company operating at a normal ratio of close to 0.5 and then suddenly having some problem or opportunity that requires considerable borrowing. This can be tolerated, but if the problem persists they not only lose their credit worthiness and can't borrow more money, but also have to soon let paying back debt become the major objective of the company. Few can prosper, and many not even survive on that basis. The 1982-1986 average debt-to-equity ratio for the 12 chemical companies of Table 9-1 was about 0.53 (calculated on the above basis), and had been rising.

**Interest Payments.** The relationship between the yearly income and the amount of interest due on long-term debt and dividends for preferred stock says a lot about what will be left over for earnings per share of common stock. Analysts typically like to see a company generate enough annual income to cover its interest payments three to four times over. A company is considered highly leveraged that has a high proportion of bond interest and preferred stock dividends compared to the common stock dividends. In this situation, a slight increase in earnings can result in a dramatic increase in the ratio of earnings per share of stock. The opposite is also true, and a slight decrease in earnings could mean that earnings are eaten up by interest payments on debt, that is, the figure in the earnings per share spot on the income statement shows up as a loss (inside parentheses). In 1983 and 1984 the average of 60 chemical companies was 28 and 17%, respectively, of interest expense per operating income (before interest and taxes) (*Chemical Week* 1984).

### Return on Investment or Sales

The most direct measure of a corporation's performance may be obtained by various ratios relating its income to sales or assets. One such simplified ratio often reported in the press is the *return on equity*:

$$\begin{aligned} \text{ROE} &= \frac{\text{net profit after tax}}{\text{stockholder's equity}}, & \text{Table 9-1 (1982)} &= \frac{2.750}{45.95} = 6.0\% \\ (1985) \quad \frac{0.986}{40.82} &= 2.4\% \\ (1986) \quad \frac{3.414}{41.63} &= 8.2\% \end{aligned}$$

(See Figure 7-3 and Tables 7-3 and 7-4 for company and industry-wide values.) Stockholder's equity is a reasonable approximation of a company's net worth because it represents total assets — all liabilities, which means that it includes working capital and depreciated capital, less the company's debt (liabilities). This ROE will be somewhat higher than a rate of return ratio based upon undepreciated assets plus current assets (approximately, the total investment) since it does not include assets acquired from borrowed capital, but it does include the income from these assets.

Another common attempt to measure a company's rate of return is given in financial comparisons as the *return on sales*. It is widely used because sales and after tax profit are the principal financial items reported for any company, and a simple ratio gives some measure of profitability. It is intrinsically not too meaningful, and yet in actual practice it is a surprisingly useful and consistent measure. Values for various companies, and the industry average are shown in Tables 7-3 and 7-4 and Figure 7-4.

### Pseudo-DCF

An approximation of discounted cash flow (DCF) may be obtained by defining the needed financial terms as follows:

- Total investment = undepreciated assets + current assets.
- Working capital = current assets.
- Cash flow = net after tax income + depreciation.

If we assume a 20-year average project life with the factors shown on the balance and cash flow sheets for each year held constant over this period, the pseudo-DCF then uses the terms total investment at time 0, cash flow for 19 years, and the working capital returned on the twentieth year, plus the cash flow. Although not a very realistic DCF figure to compare with individual project DCF estimates, it at least allows a rough first approximation of the Table 9-1 12 corporations' average DCF. The 1982 through 1986 average pseudo-DCF values for these companies were 3.5, 4.1, 5.2, 2.8, and 5.7, respectively. Taking the actual five-year cash flows, the 1982 assets, and 1986 cash flow (and working capital return) for the remaining 15 years, the DCF was 4.9%.

Similar pseudo-DCF values are plotted in Figures 7-12 and 7-13. These ROE and DCF numbers are very low, but nevertheless fairly typical of most chemical companies. In many cases they have been reduced by high operating costs and company overhead, but more importantly, the reduction is caused by lower than anticipated sales prices and plant operating rates (because of limited markets). These low numbers provide all the greater reason why management desires new projects to have a higher DCF (i.e., hopefully over

15%) to cover the risk of any new project, and to attempt to raise the present low DCF values.

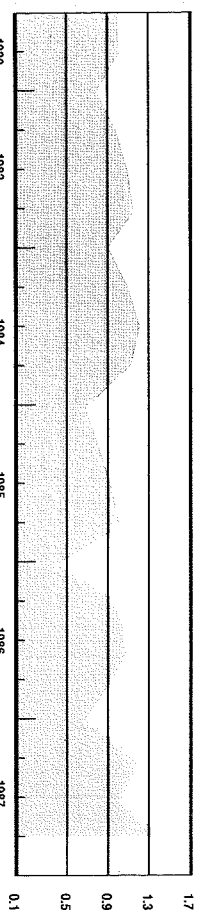
### Cash Flow/Capital Spending: Book Value

Capital spending is an easy to understand line item in the cash flow spending table, as is the change in capital spending over the years. However, the ratio of cash flow/capital spending provides a more graphic figure to show the company's commitment to new projects, modernization, and environmental spending. This ratio is also plotted quarterly in the magazine *Chemical Week*, as shown in Figure 9-2. It is seen that the capital spending percentage has been erratic, but has generally held fairly steady during the 1980s at a value averaging about 1.0.

The *book value* of a company is the sum of the total assets, less intangibles (good will, etc.), less the current and long-term liabilities, including preferred stock (which in this case can be considered as if it were a bond). In other words, it is the value that would be received for the company if the debt were paid and the assets sold at their stated value. This number can be compared with the market value per share of stock times the total number of shares outstanding. If the result is lower than the company's book value (which as we have noted before is often undervalued), then the stock is selling at too low a price. That is, you could buy all of the company's stock for less than it would cost you to buy the company's assets. This is the basic situation that attracts many "raiders" who, by acquiring a company, will make money selling some or all of its divisions at close to (or more than) the real value of the assets in each group.

### GENERAL

One can usually obtain an annual report by calling or writing the corporate secretary of the company you want to evaluate, or from stock brokerage companies. If you are a member of the Dow Jones News Retrieval Service you can call up the disclosure data base on your modem and download 10K and 10Q information (much more detailed financial information than annual reports)



Source: *Chemical Week* 1988. Excerpted by special permission from *Chemical Week*, January 27, 1988. Copyright © 1988, by McGraw-Hill, Inc., New York.

Figure 9-2. Chemical companies' cash flow over capital spending.

directly into your computer. There are many good books on reading financial reports. Merrill Lynch, Pierce, Finner & Smith, Inc., has a brochure called "How to Read a Financial Report." John Wiley & Sons publishes a book by John A. Tracy with the same name. American Management Associations publishes a book by Donald E. Miller called *The Meaningful Interpretation of Financial Statements*. Dun & Bradstreet publishes an annually updated "Guide to Your Investments" by Nancy Dunnan that includes a section on interpreting financial statements. Barrons publishes a *Dictionary of Finance and Investment Terms*, a handy companion piece to any other reading material.

Reading an annual report is never easy, and in the end you seldom feel that you fully understand what is happening with the company. However, for a company that you are interested in it is almost always an engaging and worthwhile experience. The message from the president and other text help you understand what the company feels is important in the way of past and future actions. Some analysis and manipulation of the numbers (i.e., ratio analysis, etc.) lets you draw some of your own conclusions on what and how the company is doing, and to some extent indicates the quality of the management. This latter point is the most difficult of all, since large corporations, just as all bureaucracies, tend to hide incompetence, marginal performance, and overconservatism. However, a close analysis of a series of annual reports can begin to show a pattern of static or declining earnings, few new projects, low research and development spending, competitive decline, and so on. Generally things will look fairly good, however, and reading the annual report may give you much better feelings of pride and knowledge of your own company, or a better feeling for where your investments should be.

### REFERENCES

- Chemical and Engineering News*. 1987. Facts & figures. (June 8):46; 1986 (June 9):55; 1985 (June 10):41; 1984 (June 11):45.  
*Chemical Week* 1984. Chemical financial review. (July 25).  
*Chemical Week* 1988. (Jan. 27):38.  
*Compressed Air Magazine*. 1987. Understanding financial reports. (June):10-15.  
*Fortune* 500 1987. (April 27):355-412.

## 10

# PROJECT MANAGEMENT

Many responsibilities of a chemical engineer have an important economic impact and an economic component, even though they are not direct economic functions in themselves. Such is the case with project management, where many job functions other than economics are involved, but where a large part of the work (e.g., cost control) has a direct financial reportability, and the successful completion of the entire project may have a significant economic impact upon the company or at least upon the division performing the work. For that reason project management will be briefly reviewed in this chapter, with its control function covered in somewhat greater detail.

### MANAGEMENT PRINCIPLES

As a chemical engineer begins to be given more job responsibility and/or starts to advance through the supervisory ranks there are many new skills to develop in relation to management principals and abilities. In general with each step of promotion the amount of individual work performed by the engineer decreases, and supervisory time increases, somewhat as diagrammatically shown in Figure 10-1. With promotion many engineers cling to their former level of personal work output, and do their new supervising function as an extra assignment. This can result in both poor supervision and job performance. Conversely, some engineers immediately want to be full time supervisors, and thus are often overbearing and harass the staff with detailed instructions. In this case the company has lost the services of a good engineer, and gained a very poor supervisor. A middle ground is obviously best with a strong suggestion to be sure to do an adequate amount of personal work, since this results in better supervision, greater output, and awareness of the group's problems—and the normal tendency is to over supervise.

Many engineers can naturally and intuitively switch into management and do an excellent job from the beginning. However, it is recommended that everyone can benefit from studying management requirements at every promotional step. The basics are very simple and primarily common sense, but a reminder about