The use of financial models can assist in company business planning processes. This paper presents introductory concepts and considerations of financial models with emphasis on their structure and general design methodology.

Concepts of financial models

by P. L. Kingston

The use of computers in financial planning has become an area of increasing interest to financial management and data processing users. Computing systems facilitate the use of financial models in that they allow for the storage and retrieval of a representation of a financial plan and also for the evaluation of the consequences of "what if" conditions. Thus a financial model is a tool that can assist in the entire business planning process whether it be forecasting, cash management, or projection of profits. This paper presents introductory concepts that provide a basis for systems design and implementation of financial models. Described are the terminology, the basic components of financial models, and two general approaches to the construction of these models.

Introductory definitions and considerations

A *financial model* is a representation of a business problem in terms of accounting considerations. An example of a basic financial model is the logic and data comprising an accounting statement such as income and expense, source and application of funds, and asset and liability statements. More complex financial areas of financial modeling are facility planning, capital budgeting, cash management, international financial problems, mergers, acquisitions, and salary planning. Most accounting statements and financial models consist of *line items*, the horizontal row names comprising the detail of an accounting statement. Particular line items that can be indicators of business performance such as earnings per share, price of stock, expense-to-revenue ratio, available manufacturing space, and excess funds are termed *decision lines*.

The time span over which the accounting statement is being projected is termed a *planning horizon* and can be partitioned into equal or variable time slices, such as years, quarters, months, or days, called *planning periods.*

types of models

Financial models can be classified into at least three basic categories according to the duration of the planning horizon and the type of business planning being performed. A *strategic model* is a financial model with a long-range planning horizon used for setting objectives and goals of an organization. This type of model tends to deal with such things as economic factors and new business opportunities. A short-range financial model used for allocation of resources is a *tactical model.* It deals with current, well-established business conditions such as accounting statement items. An *operational model* is a tool that can be used daily for monitoring and control of a plan. In addition to differing in their planning horizon and function, these models differ in their sources of information, types of line items, amount of detail, forecasting techniques, and line-item relationships. More complex or specialized aspects of financial models are addressed elsewhere in this issue.[1]

source of information

A frequent source of information for a strategic model is an external or environmental data base that refers to the general economy. On the other hand, a tactical model may draw on an industry set of statistics for competitive information while an operational model may require information only from an internal transaction data base.

types of line items

Line items in a strategic model may include economic projections such as Gross National Product, disposable income, population trends, housing starts, and so forth. In addition, future investments in new products not fully researched or developed, new markets by geographic area or industry, and company divisions reorganized by acquisition or merger are other examples.

Tactical and operational models contain line items which can include the explosion of the general ledger by division, department, geographic territory, product line or industry.

amount of detail

A strategic model normally has a broad viewpoint since it tends to partition products by class, geographic territories by large areas (continent or country), or industry by standard industry class. Tactical and operational models generally examine all products, smaller territories such as states or cities, and industry

Figure 1 Development of a tactical or operational model from a strategic model using an incorrect approach

PROFIT AND LOSS STATEMENT

STRATEGIC MODEL	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
SALES ($1000)	12,000	13,200	14,000	15,400	16,000	17,600	18,000	19,800	22,000	24,000	26,000	28,000
ACCOUNTS RECEIVABLE ($1000)	1920	2112	2240	2464	2560	2816	2880	3168	3520	3840	4160	4480

BALANCE SHEET

TACTICAL OR OPERATIONAL MODEL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
SALES ($1000)	1000	1000	500	500	1500	2000	1000	1000	500	2000	2000	500
ACCOUNTS RECEIVABLE ($1000)	2000	2000	1000	1000	3000	4000	2000	2000	1000	4000	4000	1000

classification. Thus, strategic models tend to have line items reflecting a few coarse partitions while the more detailed line items of tactical and operational models select finer partitions.

forecasting techniques

The forecasting techniques often used in strategic models are DELPHI techniques, econometric models, visionary forecasts and so forth. Tactical models tend to use regression analysis, input/output models, market research, and intuition while operational models generally use moving average, exponential smoothing, and lower-level estimates.

line-item relationships

In general, the relationships between variables of a type of model cannot be transferred to another type, although line items may be identical. For example, an operational or tactical model cannot be correctly derived from a strategic 12-year model by changing the years to months and scaling down the inputs. Only in the most elementary models is this true. To illustrate, assume there exists a strategic model based on a balance sheet and the income and expense statement. Also, assume that accounts receivable are 16 percent of sales (16 + percent equates to 60 days accounts receivable turnover—60 days being approximately 1/6 of a year). The implicit assumption is that 60 times the average daily sales is an adequate approximation for the balance-sheet line item, accounts receivable, at fiscal year end.

The incorrect approach, namely using a strategic model as a tactical or operational model, relabels the years to months, realizes that 60 days equates to 200 percent, and scales down the model inputs. This is shown in Figure 1. But, if the sales inputs are at all seasonal, the model has a poor approximation for accounts receivable. A better approximation of accounts receivable in tactical or operational models would be the sum of the

Figure 2 Tactical or operational model derived from example equation

TACTICAL OR OPERATIONAL MODEL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
SALES ($1000)	1000	1000	500	500	1500	2000	1000	1000	500	2000	2000	500
ACCOUNTS RECEIVABLE ($1000)	NOV + DEC	DEC + 1000	2000	1500	1000	2000	3500	3000	2000	1500	2500	4000

previous two months' sales as shown in Figure 2. Examples of generalized equations following this approach where the accounts receivable, inventory, or payable turnover days, are allowed to vary, appear in the Appendix.

uses and advantages

A financial model executed on a computer provides speed, accuracy, and consistency of calculation logic from run to run. In addition, the level of detail, available options, planning and control, audit trail, and communications are enhanced. The level of detail is expanded through the use of *supporting subschedules*, financial models that supply data to line items in other financial models. An example, depicted in Figure 3, is a forecasting model supplying two line items to a profit and loss model.

A computerized financial model increases the number of views or options available to the business planner. Thus the effects of economic growth or decline of any percentage amount can be investigated. A financial model becomes a control tool if it can provide monitoring and early-warning functions to control a plan to meet desired goals, and also, it provides an audit trail of the business planning process. Each recalculation results in a new output or plan and the collection of these outputs provides the audit trail.

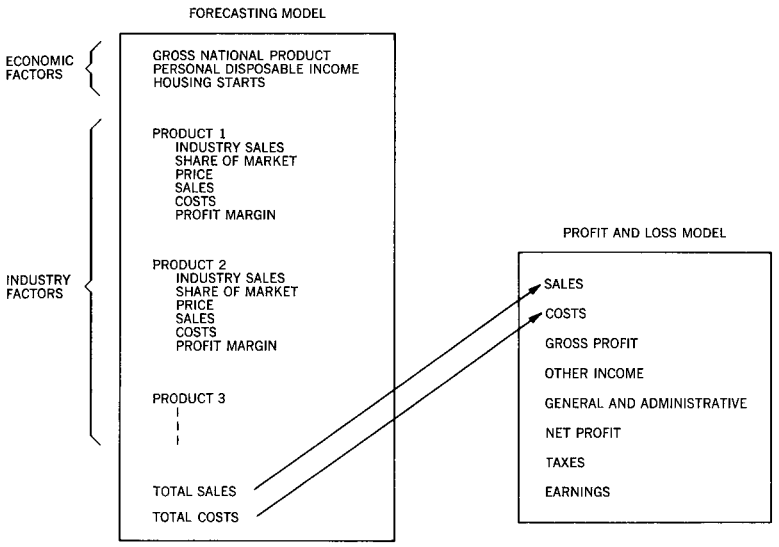
Also, a communication mechanism is provided by a financial model. Because computerized financial models are programmed, the logic of the model tends to be more precisely defined than in manual methods. Secondly, when multiple functional units interact, the model provides documentation and precise definition of the assumptions and rules upon which a plan is developed.

Components of financial models

Most financial models are composed of:

- Input data.
- Relationships.
- Projections.
- Documentation.
- Base case.

Figure 3 Example of a supporting subschedule



input data

Input data can be generally categorized as actual, judgmental, or transferred. *Actual data* are historical, factual, non-negotiable information as opposed to *judgmental data*, which are negotiable numbers, assumptions, and estimates. In many instances, the amount of judgmental data as a percentage of total data increases as the planning horizon increases; that is, more judgmental data are used in a strategic model than in an operational model. The third category of input data, *transferred data*, are summarized data generated by a supporting subschedule and forwarded to a given portion of a line item.

relationships

Relationships between line items and between planning periods within a line item can be described by two categories of equations. *Exact equations* essentially are derived from self-evident relationships. Examples are:

SALARY = RATE × TIME

PROFIT = REVENUE − EXPENSES

1973 OLD BALANCE = 1972 NEW BALANCE

INCOME AFTER TAXES = GROSS INCOME − FEDERAL INCOME TAX

Judgmental equations, at first, are based on intuition or coarse approximation. The following are examples:

PROFIT = .03 × REVENUE

ACCOUNTS RECEIVABLE = .08 × NET SALES

INVENTORY = .16 × COST OF SALES

1973 SALES = 1.08 × 1972 SALES

Figure 4 An example projection

EXAMPLE COMPANY (FISCAL PLANNING MODEL)

STATEMENT OF FINANCIAL POSITION

DESCRIPTION	TERM	YEAR ENDED OCTOBER 31 1971	1972	1973	1974	1975	1976	1977	1978
ASSETS									
CURRENT ASSETS									
CASH		1944	1822	1822	1822	1822	1822	1822	1822
MARKETABLE SECURITIES		13	26	26	26	26	26	26	26
RECEIVABLES		32990	35529	37917	41678	45439	49200	53272	57682
INVENTORIES		11344	12590	13049	14343	15638	16932	18333	19851
PREPAID ADVERTISING AND OTHER		509	506	506	506	506	506	506	506
TOTAL CURRENT ASSETS		46800	50473	53320	58375	63431	68486	73960	79886
INVESTMENTS		8126	9233	9233	10156	9233	10156	9233	9233
PROPERTY,PLANT,AND EQUIPMENT		9845	10887	12039	13313	14723	16281	18004	19909
DEFERRED CHARGES(FUTURE TAX BENEFIT)		275	174	174	174	174	174	174	174
UNAMORTIZED DEBENTURE DISC. AND EXP.		30	27	27	27	27	27	27	27
TOTAL ASSETS		65076	70794	74793	82046	87587	95124	101398	109230
LIABLITIES									
CURRENT LIABLITIES									
NOTES PAYABLE		17306	18972	19507	22252	23483	26142	27505	29782
ACCOUNTS PAYABLE		2938	3302	3838	4219	4599	4980	5392	5838
ACCRUED EXPENSES		2182	2360	2556	2808	3062	3316	3590	3886
ACCRUED TAXES		7269	8016	8504	9365	10200	11038	11954	12971
TOTAL CURRENT LIABLITIES		29695	32650	34405	38644	41344	45475	48440	52477
LONG TERM DEBT		4326	4743	4877	5563	5871	6535	6876	7445
TOTAL LIABLITIES		34021	37393	39281	44206	47214	52011	55317	59923
SHAREHOLDERS' EQUITY									
COMMON STOCK		3685	4015	4015	4015	4015	4015	4015	4015
RETAINED INCOME		27370	29386	31497	33824	36358	39098	42066	45292
TOTAL SHAREHOLDERS' EQUITY		31055	33401	35512	37839	40373	43113	46081	49307

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Figure 5 Managerial ratios

MANAGERIAL RATIOS EXAMPLE COMPANY FISCAL PLANNING MODEL

DESCRIPTION	TERM	1971	1972	1973	1974	1975	1976	1977	1978
LIQUIDITY									
QUICK RATIO		1.18	1.14	1.16	1.13	1.14	1.12	1.14	1.13
CURRENT RATIO		1.58	1.55	1.55	1.51	1.53	1.51	1.53	1.52
NET WORKING CAPITAL		17105	17823	18915	19732	22087	23010	25519	27409
INVENTORY TO CAPITAL		.66	.71	.69	.73	.71	.74	.72	.72
ACTIVITY									
INVENTORY TURNOVER		6.96	6.80	7.09	7.09	7.09	7.09	7.09	7.09
A/R TURNOVER		2.39	2.41	2.44	2.44	2.44	2.44	2.44	2.44
ASSET TURNOVER		1.21	1.21	1.24	1.24	1.27	1.26	1.28	1.29
NET WORTH TURNOVER		2.54	2.56	2.60	2.69	2.75	2.78	2.82	2.85
CAPITAL TURNOVER		4.62	4.80	4.89	5.15	5.02	5.22	5.09	5.13
LEVERAGE									
CAPITAL TO FUNDED DEBT		3.95	3.76	3.88	3.55	3.76	3.52	3.71	3.68
DEBT TO ASSETS		.52	.53	.53	.54	.54	.55	.55	.55
PROFITABLITY									
RETURN ON SALES		.04	.04	.04	.04	.04	.04	.04	.04
RETURN ON NET WORTH		.11	.11	.11	.11	.11	.12	.12	.12
RETURN ON CAPITAL		.19	.21	.20	.21	.21	.22	.21	.21
RETURN ON ASSETS		.05	.05	.05	.05	.05	.05	.05	.05
OTHER MEASUREMENTS									
AVERAGE DAILY CREDIT SALES		219	238	257	282	308	333	361	391
COLLECTION PERIOD	DAYS	150.37	149.37	147.60	147.60	147.60	147.60	147.60	147.60
INVENTORY PERIOD	DAYS	51.71	52.93	50.80	50.80	50.80	50.80	50.80	50.80
DEBT TO NET WORTH		1.10	1.12	1.11	1.17	1.17	1.21	1.20	1.22
FUNDED DEBT TO CAPITAL		.25	.27	.26	.28	.27	.28	.27	.27

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Figure 6 Input documentation

EXAMPLE COMPANY (FISCAL PLANNING MODEL)

STATEMENT OF FINANCIAL POSITION INPUT ASSUMPTIONS

CODE	DESCRIPTION		TERM	PRIOR	1971	1972	1973	1974	1975	1976	1977	1978
COL.1-7				18-24	25-31	32-38	39-45	46-52	53-59	60-66	67-73	74-80
ASSETS												
0100007	CASH	EXTEND LAST GIVEN		2912.	1944.	1822.	.	.	.	.	.	.
0100008	MKT. SEC.	EXTEND LAST GIVEN		19.	13.	26.	.	.	.	.	.	.
0100009	RECEIVABLES			26516.	32990.	35529.	.	.	.	.	.	.
0100010		PERCENT OF SALES	%	.	.	.	41.00	41.00	41.00	41.00	41.00	41.00
0100011		TURNOVER	DAYS	.	.	.	.	.	.	.	.	.
0100012	INVENTORIES			9221.	11344.	12590.	.	.	.	.	.	.
0100013		PERCENT COST OF SALES	%	.	.	.	17.00	17.00	17.00	17.00	17.00	17.00
0100014		TURNOVER	DAYS	.	.	.	.	.	.	.	.	.
0100015	PREPAID ADV	EXTEND LAST GIVEN		562.	509.	506.	.	.	.	.	.	.
0100016	INVESTMENTS	EXTEND LAST GIVEN		9932.	8126.	9233.	.	.	.	.	.	.
0100017		VARIANCE	%	.	.	.	.	10.00	.	10.00	.	.
0100018	PROPERTY,PLANT,ETC.	EXTEND CGR		9589.	9845.	10887.	.	.	.	.	.	.
0100019	DEFERRED CHARGES	EXTEND LAST GIVEN		389.	275.	174.	.	.	.	.	.	.
0100020	UNAMORTIZED DD&E	EXTEND LAST GIVEN		33.	30.	27.	.	.	.	.	.	.
LIABILITIES												
0100021	ACCOUNTS PAYABLE			3142.	2938.	3302.	.	.	.	.	.	.
0100022		PERCENT COST OF SALES	%	.	.	.	5.00	5.00	5.00	5.00	5.00	5.00
0100023		TURNOVER	DAYS	.	.	.	.	.	.	.	.	.
SHAREHOLDERS' EQUITY												
0100024	COMMON STOCK	EXTEND LAST GIVEN		3528.	3685.	4015.	.	.	.	.	.	.

NOTES AND ASSUMPTIONS

1. RECEIVABLES ARE THE SUM OF
   A. GIVEN
   B. PERCENT OF NET SALES
   C. TURNOVER(DAYS/360) OF NET SALES

   NOTE: SINCE THIS IS A SUM ONE AND ONLY ONE OF THE ABOVE LINES SHOULD BE USED FOR EACH YEAR.
2. INVENTORIES ARE THE SUM OF
   A. GIVEN
   B. PERCENT COST OF SALES
   C. TURNOVER(DAYS/360) OF COST OF SALES

   NOTE: SINCE THIS IS A SUM ONE AND ONLY ONE OF THE ABOVE LINES SHOULD BE USED FOR EACH YEAR.
3. INVESTMENTS ARE CALCULATED IN FOLLOWING SEQUENCE
   A. GIVEN
   B. EXTENDED BY LAST YEAR GIVEN
   C. VARIANCE IS A PERCENT OF INVESTMENTS,ADDED ON
4. ACCOUNTS PAYABLE ARE THE SUM OF
   A. GIVEN
   B. PERCENT COST OF SALES
   C. TURNOVER(DAYS/360) OF COST OF SALES

   NOTE: SINCE THIS IS A SUM ONE AND ONLY ONE OF THE ABOVE LINES SHOULD BE USED FOR EACH YEAR.
5. ACCRUED EXPENSES = 3 PERCENT OF TOTAL EXPENSE
6. ACCRUED TAXES = 1.371 OF(FEDERAL TAX + TAXES)
7. REQUIRED DEBT = TOTAL ASSETS - SHAREHOLDERS EQUITY - ACCOUNTS PAYABLE
8. NOTES PAYABLE = .80 REQUIRED DEBT
9. LONG TERM DEBT = .20 REQUIRED DEBT

PLANNING SYSTEMS GENERATOR II 02/09/73

As models are further developed, the numerical values of the factors in this category of equation can be improved by advanced analytical techniques such as time-series analysis (for example, exponential smoothing), or statistical regression (for example, multiple linear regression).[2-5]

projections

Printed outputs showing data of line items by planning period over the planning horizon are termed *projections*. An example of a projection of a financial position is shown in Figure 4. Incorporated in these numerical views of the future can be *managerial ratios*, depicted in Figure 5. These are optional outputs such as growth rates of line items, line items as a percentage of a total, financial ratios (such as working capital, return on sales), and internal ratios (such as gross margin on a particular product line).

documentation

Documentation consists of all input data, relationships, and projections and also includes verbal descriptions such as comments, goals, tasks of planners, organizational structure, and departmental functions. Illustrated in Figure 6 is example input

documentation. Documentation can be fixed or variable. *Fixed documentation*, usually stored and maintained on auxiliary storage, is that portion of the financial model which is unlikely to change during simulation runs. *Variable documentation* is that portion of the model likely to change during simulation.

Actual data is *fixed documentation.* However, some of these data values will be output and used as a reference point with each simulation run. For example, one may have 1950–1972 sales revenues and use it in forecasts, but each computer simulation output may include only 1971 and 1972 sales revenues alone with 1973–1979 projections. Judgmental data frequently changes; therefore, that data are generally printed during each simulation run to supplement the audit trail of input data assumptions.

Actual equations are usually intuitively obvious. If not, they should be included with the fixed documentation. All judgmental equations that are variable documentation should be available in a readable form for the financial analyst, since a program listing is usually not adequate documentation of the judgmental equations. As judgmental equations are modified by the user and programmer, these can be reflected in the variable documentation.

base case

When a financial model is first programmed, the initial judgmental data and judgmental equations may yield unacceptable or unrealistic projections. The data and equations are then modified and negotiated to hone in on a base case. *Base case* is a user-accepted set of input data, relationships, projections, and documentation that provides the agreed-upon or expected direction of the enterprise. After a base case is accepted, "what if" questions are compared with the base case. It is at this point that the financial model is available to simulate actions of the company.

Construction of financial models

Financial models are designed, programmed, redesigned, reprogrammed, expanded, enhanced, and eventually discarded. New, replacement models repeat the same cycle. The basis for this process derives from the fact that the goals of a company, the organizational structure, the individual personnel involved, and the accounting structures are dynamic. As changes occur, existing models are modified or new ones are developed. Thus a consideration in selecting a program or programming language for constructing financial models is the minimization of programming expense. A more extensive presentation of some of the

Figure 7 Top-down view of an income statement

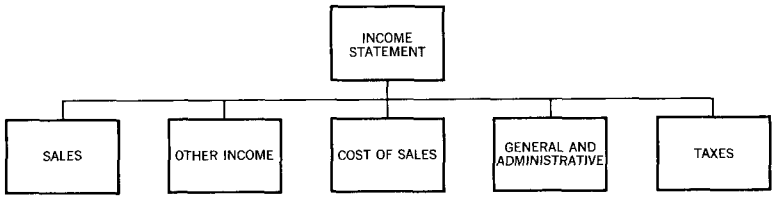
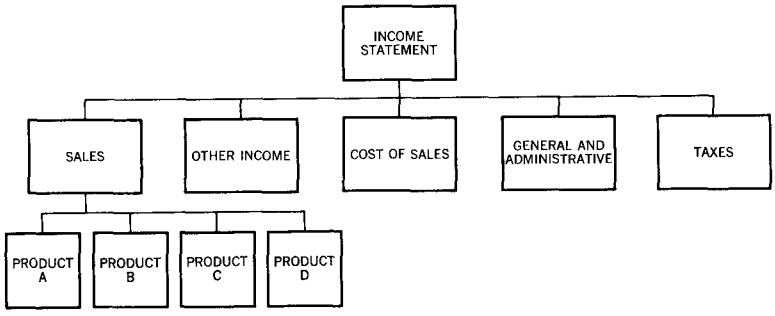


Figure 8 Supporting subschedule development in sales



programming tools and techniques available to the business planner follows in this issue.[6] Also included in this issue is a discussion of a planning-data system implemented using a planning systems generator.[7]

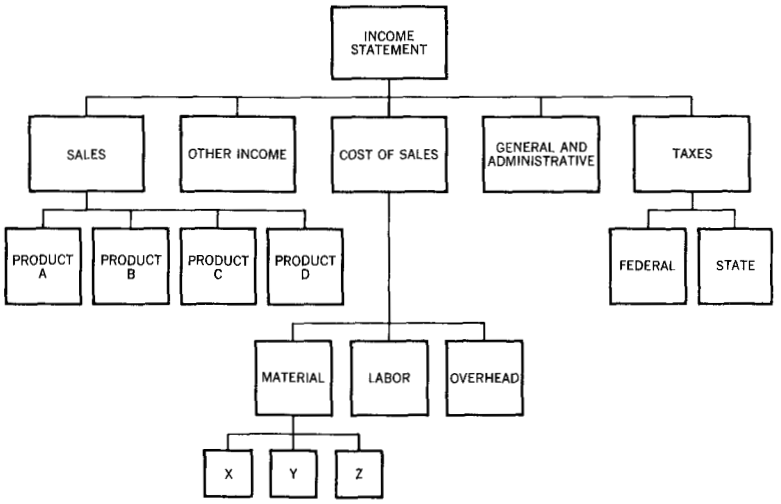
top-down approach

Programming development of strategic and tactical financial models is generally from the *top-down* (in contrast to financial planning which can be top-down, bottom-up, or a combination). An adaptation of this approach for small systems is presented elsewhere in this issue.[8] This semi-structured approach usually begins with a gross-level model of the basic financial report of the company and, eventually in the downward development, results in the creation of operational models. Decision lines are identified and other line items are estimated or obtained. Relationships are then defined as a combination of percentages of other items, fixed amounts, and calculated data. As an example, assume the top-down view of an income statement shown in Figure 7. Sales are given; other income, cost of sales, and general and administrative are expressed as a percent of sales; and taxes are a given percent of:

sales − cost of sales + other income − general and administrative

This basic example is a financial model and, although it may not be very useful as is, it does encompass the entire company, can be developed quickly, is understandable, has the ability to evolve, and is useful (although its use is restricted to such

Figure 9 Downward development in cost of sales and taxes



questions as those concerning growth or decline of sales, growth or decline of cost of sales, and effects of tax options).

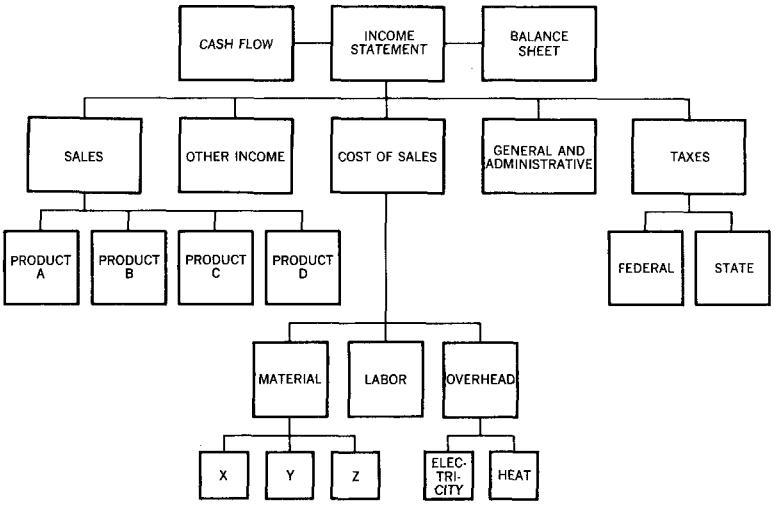
Supporting subschedules can now be developed downward in areas of concern to company management. Figure 8 illustrates this downward development in the sales area. At this point, the model can assist in answering questions regarding pricing, sales volume, profits, and product introduction or elimination.

The model is developed further in the areas of cost of sales and taxes as depicted in Figure 9. The model can now address questions pertaining to allocation of resources, bulk purchasing, and profits.

Further downward development and the addition of enhancements can result in a model as shown in Figure 10. At this stage of development, more sophisticated techniques such as mathematical programming and discrete or continuous simulation may be employed to assist in functional planning. For example, linear programming can be used for material acquisition, transportation, processing, and distribution; and discrete simulation can assist in the sequencing of the processing function.

As model development progresses downward, organizational boundaries are crossed and various functional units begin to develop their own financial models for planning purposes. As a result, what was a line item for the financial model of one functional unit can become a decision line or an expanded financial model for another functional unit. Also, other aspects of the company can now be considered such as cash flow management,

Figure 10 Resulting collection of financial models



stockholder relations, and multi-national operations in addition to strategic, tactical, and operational considerations.

Thus the top-down approach starts with a basic model and develops it downward into a highly complex model whose outputs are supporting subschedules which supply data to the higher-level models. This entire process may require several man-years of effort. However, because of the modular development, the models are usable throughout the entire development phase. The resulting system is a collection of multiple financial models that vary in planning horizon and functional requirements on company organizational levels.

bottom-up approach

The construction of financial models using the bottom-up approach begins with the programming of detailed, lower-level items and then consolidates upward to produce a financial statement. Ordinarily a data base providing detail is assumed. Because this development is not modular, programming effort tends to be substantial and thus this method is not generally recommended for the construction phase.

Concluding remarks

Financial models can be used to project accounting statements and other complex financial statements. These models provide the business planner with the ability to view many future alternative plans, to ask "what if" questions, and to monitor plans in progress. The introductory concepts and methodology presented in this paper can assist him in the initial design and implementation of financial models in the future.

Appendix: Typical balance sheet equations for use in a tactical or operational model

The following are example judgmental equations used to approximate accounts receivable on a monthly basis as depicted in Figure 2:

$$R_i = \begin{cases} \dfrac{d_i^R}{30} S_i & 0 \le d_i^R \le 30 \\ S_i + \dfrac{d_i^R - 30}{30} S_{i-1} & 30 < d_i^R \le 60 \\ S_i + S_{i-1} + \dfrac{d_i^R - 60}{30} R_{i-1} & 60 < d_i^R \end{cases}$$

where:

$R_i \equiv$ receivables

$S_i \equiv$ sales

$d_i^R \equiv$ receivables turnover days

In this equation i is an index corresponding to the months of the year such that index 0 corresponds to the previous December, index 13 corresponds to the next January, and index 14 represents the next February. It is assumed that:

$S_i \qquad i = 0, 1, 2, \cdots, 12$

R_0

$d_i^R \qquad i = 1, 2, 3, \cdots, 12$

are all given or previously calculated. In most instances, d_i^R would be constant over the twelve periods.

Similar equations can also be used to approximate inventory and payables:

$$I_i = \begin{cases} \dfrac{d_i^I}{30} C_{i+1} & 0 \le d_i^I \le 30 \\ C_{i+1} + \dfrac{d_i^I - 30}{30} C_{i+2} & 30 < d_i^I \le 60 \\ C_{i+1} + C_{i+2} + \dfrac{d_i^I - 60}{30} I_{i-1} & 60 < d_i^I \end{cases}$$

$$P_i = \begin{cases} \dfrac{d_i^P}{30} C_i & 0 \le d_i^P \le 30 \\ C_i + \dfrac{d_i^P - 30}{30} C_{i-1} & 30 < d_i^P \le 60 \\ C_i + C_{i-1} + \dfrac{\mathrm{d}_i^P - 60}{30} P_{i-1} & 60 < d_i^P \end{cases}$$

where, in addition to the previously defined variables:

$I_i \equiv$ inventory

$P_i \equiv$ payables

$C_i \equiv$ cost of goods sold

$d_i^I \equiv$ inventory turnover days

$d_i^P \equiv$ payables turnover days

The indexing described earlier pertains to these equations and it is also assumed that:

$C_i \qquad i = 1, 2, 3, \cdots, 14$

P_0

I_0

$d_i^I \qquad i = 1, 2, 3, \cdots, 12$

$d_i^P \qquad i = 1, 2, 3, \cdots, 12$

are all given or previously calculated. In most cases, d_i^I and d_i^P would be constants over twelve periods.

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