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Financial Model Preparation

Philip L. Blumenthal, Jr., CPA
NOTICE TO READERS

MAS practice aids are designed as educational and reference material for the members of the Institute and others interested in the subject. They do not establish standards or preferred practices. The standards for MAS practice are set forth in the Statements on Standards for Management Advisory Services (SSMASs) issued by the AICPA. However, since the services described in this series of practice aids are management advisory services, the standards in the SSMASs should be applied to them, as appropriate.

The MAS Division expresses its appreciation to Philip L. Blumenthal, Jr., CPA, the author of this practice aid, who is a partner in the firm of George S. Olive & Co. in Indianapolis, Indiana. He is an MAS partner with over twenty years’ experience. Mr. Blumenthal is a member of the American Institute of Certified Public Accountants, the Institute of Management Sciences, the Operations Research Society of America, and the Data Processing Management Association.

During the preparation of this document, various members of the 1982–83 AICPA MAS Technical and Industry Consulting Practices Subcommittee, functioning in an advisory capacity, provided information, materials, and comments to the author and the staff. The members of that subcommittee are listed below.

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Monroe S. Kuttner, Director
Management Advisory Services
Monte N. Kaplan, Assistant Manager
Management Advisory Services
Financial Model Preparation

Philip L. Blumenthal, Jr., CPA
George S. Olive & Co.
Preface

This MAS practice aid is one in a series intended to assist practitioners in applying their knowledge of organizational functions and technical disciplines in the course of providing management advisory services. The Summers and Knight study, *Management Advisory Services by CPAs*, published by the AICPA in 1976, has subdivided such knowledge into seven areas: executive planning, implementation, and control; finance and accounting; electronic data processing; operations (manufacturing and clerical); human resources; marketing; and management science. Although these practice aids often will deal with aspects of those seven areas in the context of an MAS engagement, they are also intended to be useful to practitioners who provide advice on the same subjects in the form of an MAS consultation. MAS engagements and consultations are defined in Statement on Standards for Management Advisory Services 1, issued by the AICPA.

This series of MAS practice aids should be particularly helpful to practitioners who use the technical expertise of others while remaining responsible for the work performed.

MAS technical consulting practice aids do not purport to include everything a practitioner needs to know or do to undertake a specific type of service. Furthermore, engagement circumstances differ, and, therefore, the practitioner's professional judgment may cause him to conclude that an approach described in a particular practice aid is not appropriate.
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Scope of This Practice Aid

Practitioners often help their clients by rendering advice on and assisting in financial planning. Helping to prepare financial projections and forecasts has been one of the major types of financial planning assignments. Financial models make it easier to develop these projections and forecasts. Models range in complexity from those that are manually prepared to microcomputer-prepared electronic worksheets using sophisticated modeling languages.

In recent years packaged models covering a range of financial applications have become available. These packages, prewritten within set parameters, may provide alternatives to situations in which a fully customized model is not necessary for a particular financial application.

This practice aid, however, focuses on an engagement or an engagement segment that involves developing a custom financial model for a client. Such an engagement or segment might include—

• Reviewing or developing planning concepts in the client organization.
• Selecting, gathering, compiling, validating, and assessing data required in the planning process.
• Determining relationships and interactions of the key factors in client operations and finances.
• Reviewing assumptions with the client.
• Constructing a formal model of these key factors, relationships, and interactions.
• Analyzing, testing, and presenting results and assumptions produced by running the model, using various combinations of assumed decisions, relationships, and activity levels.
• Revising or updating the output as time progresses, using revised inputs.
• Turning over the model to the client for future use and maintenance, with appropriate documentation and training.

The term *model* is not merely a current buzz word for a financial projection developed on a computer. The concept of a model has been described this way:

Since the astronomer cannot manipulate the system he studies, he builds a *representation* of it. This he calls a “mathematical model.” It represents

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1. The output of this illustrative practice aid engagement is the model itself. The activities described are intended solely to facilitate development of the model. For engagements involving reporting on prospective financial information, refer to appropriate AICPA professional pronouncements.
the structure of the real system in quantitative terms. Models can be manipulated and analyzed more easily than the real system and hence permit the scientist, in effect, to carry on vicarious experimentation. He can systematically vary some properties of the system, holding others constant, and in this way determine how the system as a whole would be affected if the changes actually did occur. In fact, he simulates the real-life alteration and experiments in abstract terms.

The Operations Research team constructs and uses mathematical models in the study of organized man-machine systems and hence carries out experiments in this symbolic way. These models may be very difficult to construct and may turn out to be very complicated mathematical expressions. Underlying this complexity, however, is a relatively simple structure.2

This practice aid deals specifically with only a financial model, the purposes of which are to—

- Concentrate management planning on the most relevant aspects of a business and their interrelationships.
- Evaluate consequences of alternative decisions.
- Assess impacts of quantifiable outside forces.
- Provide a flexible structure for modification.
- Permit analysis and experimentation with complex situations to a degree that is difficult or impossible within the framework of the actual system (for example, due to time and legal constraints).
- Provide performance measurement capability.
- Forecast expectations.
- Provide a vehicle for improved communication among the various managers concerned.

Many of these purposes are interrelated. The client and the practitioner should realize that there are a very large number of possible models, as well as a much larger number of possible sets of inputs, that could be used to reflect any given situation. The initial task is selecting one set or a small number of sets for actual trial and presentation to achieve the stated purposes of management.

It should be noted that financial models appeal to managers, directors, and lending officers who expect them to reduce the uncertainty that exists about the future of the business. Statistical data about relationships and trends, introduced through a financial model, help to diminish this uncertainty.

The modeling approach can be applied throughout the entire spectrum of business and industry, as the following examples illustrate:

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• Manufacturing companies
• Distributors
• Retailers
• Real estate developments
• Service organizations and professional groups
• Banks and other financial institutions
• Construction contractors
• Government and community service organizations

Computer models can be developed to help answer specific questions for an organization, such as: Will the expansion of a plant be worth the cost, and can its financing be paid out of earnings? What will be the internal rate of return from the cash flows of a project over fifteen years? Given the data on operations for the current year to date, plus data on past seasonal patterns, how will the company's statements likely look at the end of the current fiscal year?

Three common classes of models are deterministic, probabilistic, and optimization.

Deterministic models are those in which each value of each variable is completely determined from the given assumptions. (This practice aid is concerned primarily with deterministic models designed to produce complete or major segments of future financial statements. However, the selected bibliography refers to material on probabilistic or optimization models also, which may be useful in specific types of engagements.)

Common engagements using deterministic models include—

• Development (through accounting and statistical analysis) of the values and relationships among variables and construction of models for subsequent client use. The practitioner may document the model and give it to client personnel. The deliverables are the model and its documentation and user guide.

• Statistical projections of single variables. Typical examples may be sales forecasts by product groups, geographical areas, and customers. The primary deliverable may be the set of forecasts in a report, letter, or even a copy of the computer printout, with appropriate transmittal documents.

• Financial projections of the principal financial statements: income statement, balance sheet, and statement of changes in financial position (or cash flow). The deliverable is normally a report to management.

• Detailed budgets. Development of an account-by-account, profit center-by-profit center model of a client organization, with the computer calculating the values for every item each period. This model would
be structurally similar to the one used in making financial projections, with these important differences:

- Shorter time span, typically a year
- Shorter time periods within the time span, typically one month or one quarter instead of a year
- More detail, often at line-item level, for each department of the client organization
- More attention to seasonality

**Probabilistic (or stochastic) models** include one or more random variables, the values of which are determined from a probability distribution. In nontechnical terms, the values are determined by the laws of chance governing each variable.

A typical probabilistic model would deliver output in the form of histograms, or tables of key output variables, with their calculated probabilities of occurrence. The deliverable is normally a copy of the computer printout and a user guide with a letter of transmittal and comment.

**Optimization models** are designed to find the best of a number of possible answers in terms of a given criterion, such as "least cost" or "greatest profit," subject to various limitations or constraints. These often have to do with some mix or blend of a list of items, such as products mix, ingredients or components blends, and marketing mix. Typical of optimization models are linear programming models and others designed to find the optimum value of some criterion and the input values associated with it.

In a typical modeling situation the practitioner may need to draw on a variety of concepts and skills. The real-world applications frequently confronted will lend themselves to more effective, concise, and sensitive models if the practitioner knows how and when to apply this knowledge. Financial models usually incorporate knowledge from several disciplines, such as—

- **Economics**—especially price-demand relationships in a marketplace.
- **Statistics**—probability and statistical inference; curve fitting and linear regression, both single and multiple.
- **Mathematics**—linear algebra, matrix notation, and solution of simultaneous equations.
- **Cost accounting**—especially cost/volume/profit relationships.
- **Mathematics of finance**—especially formulas for present values, debt repayment, and return on investment.
- **Graphic presentation methods**—especially those using logarithmic and probability scales.
- **Statistical forecasting**—time series methodology, from simple linear trends to growth curves to the Box-Jenkins approach.
• Financial accounting—to insure compatibility with client accounting policies and practices and with the financial statements to be issued in the future.

• Tax law—the model takes into account current tax consequences, for example, capital equipment, cash flow, and anticipated tax payment dates.

In a larger organization, the client may have individuals on his staff who can gather the data and analyze it, which results in inputs and equations for the model. Otherwise, the practitioner or his staff should expect to identify the essential model relationships, using data provided by the client’s marketing, production, engineering, financial, and personnel managers, who have an intuitive feel for, or a detailed, item-by-item view of their business. The practitioner and the client will need to think in terms of trends, averages, patterns, and planning factors that may not have appeared in previous financial statements.

Definitions of Modeling Terms

constant. A constant is a value that does not change over a given time period. It may be a portion of the total value, such as the fixed component of some expense.

constraint. A constraint is a limitation, upper or lower, on the value of a variable or a group of variables. Constraints may be imposed by physical capacities, legal or contractual restrictions, or management policies. For example:

• Cash is to have a minimum value of $10,000, below which short-term borrowing will take place, and a maximum value of $100,000, beyond which there will be short-term investment.

• Department B cannot schedule more than 2,250 hours per year.

dependent variable. A dependent variable is a quantitative measure whose value depends on the assigned values of other measures on which the estimate is based.

equation. In this context, an equation is one of the specified relationships in the model, such as general and administrative expense = $7,400 monthly + 2.7 percent of sales. (See also inequality.)

forecast. As used generally, a forecast is any computed set of future values of one or more variables, under a given set of assumptions and
methodologies. As defined by the AICPA, a forecast is an estimate of the most probable financial position, results of operations, and changes in financial position for one or more future periods.

**independent variable.** An independent variable is a quantitative measure whose value can vary in a somewhat arbitrary manner. The value of this variable is preassigned, and the value of the dependent variable results, at least in part, from this assignment.

**inequality.** An inequality is any relationship specifying a limited but undefined quantity (greater than $>$, less than $<$, greater than or equal to $\geq$, less than or equal to $\leq$). For example:

- Production level is to be more than 1,500 units monthly.
- Minimum advertising expenditures will be $2,500 monthly.
- Storage costs will be at least $1,000 monthly.

**modeling language.** Modeling language is computer software that is designed specifically for modeling applications.

**parameter.** A parameter is a "temporary constant" in the equations or inequalities in a model, often one that will be varied arbitrarily during "what if" runs of the model. Variables that are often used as parameters include sales growth rate, prime interest rate, and cost inflation rate.

**pro forma.** Pro forma is used to describe a set of historical financial statements adjusted to give effect to a related series of proposed or possible transactions or events that have significant impact on the statements, such as a reorganization, merger, or acquisition; major refinancing; or sale of significant assets.

**projection.** A projection is an estimate of financial results based on assumptions that are not necessarily the most probable (as contrasted with a forecast).

**regression analysis.** Regression analysis is a technique that uses trends in one type of activity (variable) as a guide to the probable future level of another related activity (variable). Regression analyses are often calculated by using the straight-line or "least squares" method, $Y = a + bx$. 

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4. Ibid.
Simulation. Simulation is a modeling technique for generating a series of events or transactions similar to those expected in a real-world situation and calculating their impact in terms of cost, profitability, or time. It is usually implemented using a computer. Situations in which simulation models have been useful include—

- Arrivals and servicing of customers at teller windows, port facilities, checkout counters, or toll booths to determine how long the waiting lines might get, how many servers should be on duty at a given time, and so forth.
- Equipment failures or breakdowns in production or transportation or communications processes.
- Forecasting a job shop work load.
- Use of hospital facilities, such as emergency rooms, operating rooms, and ambulances.

The computer's random processing is roughly analogous to rolling a die or selecting a card from a shuffled deck to decide what event happens next in the simulation. For example, years of experience can be obtained in a few minutes with a simulation routine.

Simultaneous equations. Simultaneous equations are two or more equations whose solutions depend on each other. The classic example in a business situation is the tax/bonus problem, in which the amount of the bonus is some percentage of after-tax income, but the bonus is deductible in calculating income taxes. (Some modeling languages [software] have the capability of detecting, isolating, and solving simultaneous equations in a model; others will merely use zero as the value of any variable not assigned another value by the time it is used in the second equation.)

Typical Engagement Situations

Client requirements for a financial model can occur under a number of different circumstances and conditions:

- The client’s banker has requested financial projections in connection with bank financing.
- A specific decision problem has arisen; for example, there is an opportunity to purchase another business or enter another market, acquire new facilities or equipment, or change production, marketing, or financial policies.
A department's budgeting process has been inaccurate for several years.
Management decides that a formal approach to financial planning is desirable or wishes to integrate existing individual unit plans into an overall financial plan.
The client seeks a financial model that can be used as a "what if" management tool in determining new product markets, product deletions, pricing impacts, and sales mix.
The client wishes to understand the interrelationships of activities occurring within the organization.

Engagement Considerations

MAS engagements involving the preparation and use of financial models can provide the practitioner with an opportunity to be of considerable assistance in the client's planning process. However, there may be many pitfalls that can complicate or limit the achievement of engagement objectives. The following are some of the most common pitfalls:

- Lack of specific industry and firm knowledge
- Inadequate definition of client needs and requirements
- Excessive complexity
- Client underinvolvement leading to assumptions that are inconsistent with the real-world client situation
- Client overenthusiasm leading to overexpectation
- Underestimation of computer and personnel time and costs to test, debug, and produce various alternative runs
- Failure to conform to current AICPA pronouncements on forecasts and projections
- Inconsistently classified historical data
- Lack of knowledge of or access to a suitable financial modeling language
- Insufficient attention to behavior of fixed and variable elements of operational costs
- Too much or too little emphasis on the accuracy of accrued income and expense items in the financial model
- Insufficient attention to time-frame requirements
- Inadequate review of the model and results (assumption that the model generates correct answers)
The practitioner new to this field is warned that selecting a modeling language (computer software) and learning its syntax and programming rules is not a trivial exercise. Even modeling languages described as "user friendly" require considerable practice. The CPA embarking on a first effort should plan to spend sufficient time selecting a suitable financial modeling language, finding out how to write the rules for his model, doing the actual writing, entering the model and data into the computer, and debugging the results until the output provides numbers that are appropriate. In addition, the cosmetic aspects of titling, underlining, spacing, and suppressing nonprinting variables frequently will be troublesome until experience is acquired.

Engagement Objectives and Client Benefits

The objective of financial model development is to enable the practitioner or the client to produce projected information that will assist management in one or more of the following activities:

- Weighing consequences of alternative courses of action (for example, whether to merge, acquire, divest, buy, lease, expand, commit, build, borrow, or reprice)
- Planning for activity on a continuing basis over some time frame (typically three to five years)
- Monitoring actual results against plans and updating plans over time
- Formulating operational plans by organization or market segments of the client's activity

The following points from a sample proposal letter indicate how engagement objectives might be stated. (For the purposes of this practice aid, the fictitious Practical Machine Company will be used as an illustration.)

The objectives of our assignment will be to—

- Assist you in creating, testing, and operating a computerized financial model of the Practical Machine Company's operations, financial condition, and cash flow for the five yearly periods ending 19XX, using assumptions that have been provided or approved by company management.
- Test and validate the results of several alternative sets of assumptions as provided by management regarding corporate policies and environmental conditions.
• Prepare a report to management containing projected financial statements resulting from the model, together with the underlying assumptions. The report will show results for the base case and will depict the impact of various other alternatives.

Potential benefits are often described in a proposal or engagement letter. Client benefits that might result from an engagement involving development of a financial model could include—

• Achieving the principal engagement objective.
• The client gaining new insights into relationships, priorities, limiting factors, and appropriate goals that he had not known before or had not been able to quantify.
• Identifying areas in which closer planning, measurement, monitoring, and control are desirable.
• Increased management ability to coordinate planning activities and to resolve the inherent conflicts between various functional areas, such as—
  Marketing’s desire for a large inventory and finance’s desire to reduce investment in inventory.
  Production’s desire for long-run shop orders and marketing’s desire for a wide product line and short response time.
• Determining which customers, product lines, and geographical distribution areas are profitable or unprofitable in a situation where costs may vary.
• Improving planning techniques.
• Enhancing staff communication.

If the proposal letter overstates or misrepresents the client’s potential benefits, the effectiveness of the engagement may be imperiled. Consequently, it is appropriate that the practitioner be precise, realistic, and cautious in his statements. The letter might point out that achieving potential benefits depends heavily on the client’s future actions, the quality of client-supplied data and assumptions, and other controllable or uncontrollable events.

Engagement Scope

In model development engagements a number of facets of client requirements need to be explored. The following are matters especially recommended for discussion and understanding with the client:
• The intended use of the model and the type of sensitivity analysis to be performed
• Amount of assistance to be provided by client personnel in data gathering, analysis, and summarization
• Degree of detail to be included in the model (for example, product line, product group, geographical divisions, plant work centers)
• Output reports required, including the variables of major interest, the format and level of detail, documentation if required for subsequent client or lender use
• Computer time for initial model development, data entry, testing, debugging, production runs, subsequent refinement, and reruns
• Time horizons (that is, the number of periods to be projected)
• Engagement ending statement, including the criteria for engagement conclusion

The following example illustrates how the engagement scope might be stated in an engagement letter for one type of financial modeling assignment.

The scope of the assignment will be the development of a financial model for the purpose of producing projected annual financial statements for a three-year period.
be incorporated among the variables in the model. This is done because many costs are partially or fully dependent on physical activity rather than on passage of time.

3. Select, gather, compile and assess specific data.

4. Analyze and test data to determine relations and interactions and causes and effects. Such analysis should balance statistical methods with manual methods, plotting variables against one another. This balancing will help to ensure that relationships derived through statistical analysis do, in fact, make good subjective sense to both the client and practitioner.

5. Lay out tentative model structure, both variables and relationships.

6. Review tentative structure with client management and amend as appropriate.

7. Write, code, debug, run, and validate the definitive model. Include (as documentation) detailed flow charts, narrative equation discussions, data source definitions, and gathering/validation processes. Make sufficient allowance at this stage for variable inputs rather than fixed quantities in the model's equations.

8. Review first results with client and agree on alternative assumptions.

9. Rerun.

10. Repeat steps 8 and 9 as required.

11. Analyze results and present conclusions.

12. Prepare explanatory detail and operating instructions, as required by the terms of the engagement.

Below is an example of how the approach section might appear in an engagement letter.

Our approach to meeting the objectives of the engagement will be to—

- Analyze the trends, ratios, and volumes in the major areas of company activity, as reflected in the accounts and statistics for recent years.
- Select the appropriate categories and relationships to be included in the model.
- Construct, test, validate, and run the model a sufficient number of times to permit management to select a definitive set of planning assumptions and contingency plans.\(^5\)
- Train your personnel in the sources of planning data, the working of the model, and the manner of making changes to reflect subsequent history and revised planning factors in subsequent years.

\(^5\) The output of this illustrative practice aid engagement is the model itself. The activities described are intended solely to facilitate development of the model. For engagements involving reporting on prospective financial information, refer to appropriate AICPA professional pronouncements.
Concepts to Be Considered in Model Preparation

In developing an approach to an engagement (or engagement segment) requiring the preparation of a financial model, the practitioner considers many factors that may be common to developing any financial model and some that may be unique to a specific situation because of the client's business or requirements. The following section discusses a number of concepts to be considered by the practitioner when preparing a financial model.

Relationships of Variables

The general approach to financial modeling will differ from engagements dealing with past history in that in most of his work dealing with the past, the practitioner has been concerned with classification of items such as these:

- Types of costs and expenses
- Organizational divisions or departments
- Capital expenditures versus current expense
- Taxable versus nontaxable, and deductible versus nondeductible components
- Direct versus indirect types of expenditures
- Current period versus some other period

In financial modeling, although classifications cannot be ignored, the primary focus becomes one of determining relationships, which can be realized by asking these questions:

- What item affects the action of another item?
- What item drives the other item (dependent variables)?
- What item moves in the same direction as another (correlation)?
- What time lags are involved in the relationships?

A good model, then, will do more than perform the calculations for a set of prospective financial statements. It will reveal what relationships exist between the company's activities and its accounts. The financial planning factors that are used in forward planning are embodied in the model. These factors include—

- Rates of change in costs, profitability, growth, and decline.
- Limits (upper or lower) imposed by physical capacity, market factors, contractual arrangements, and management policy.
• Fixed and variable components of costs, revenues, and balance sheet items.

Some financial modeling variable relationships deal with expenses, several of which are discussed below.

Expenses as a Function of Sales

Traditionally, accountants have expressed income statement items as percentages of net sales. They did not have to concern themselves with which items have a functional relationship with net sales and which do not. In constructing a model, however, certain items (variables) will have a clear-cut functional relationship to net sales. Common examples are sales commissions, royalties, and liability insurance premiums.

Expenses That Have No Identifiable Relationship to Sales

Other costs have little to do with net sales: interest costs, rents (except in some retail leases, where rent is based on a percentage of sales), and many of the general and administrative expense items.

Expenses That Are a Function of Other Variables

A third group of expenses provides some interesting problems. These expenses will be correlated to sales volume levels but can be found to have a more direct relationship with another variable. For example, in many manufacturing operations “direct labor hours worked” may be the best base for all of the payroll-related costs and many of the other manufacturing expenses. In such an instance “direct labor hours worked” is a variable that should be included in the model.

Variables to Be Included in the Model

For developing most financial models, the number of variables can be reduced significantly from the number required for a suitable set of financial statements or management reports. It is desirable to reduce the number of variables to help the user keep the overall picture in mind; simplify data gathering, verification, and analysis; and to hold the project within reasonable bounds of time and cost.

Because a model attempts to separate significant changes from random fluctuations, it typically depends on averages, or “central tendency over time.” Instead of attempting to plan for or forecast the behavior of individual accounts, it is frequently preferable to analyze the history of the average behavior of the aggregate of the related group and to project in terms of this average. For example, a group of a dozen or so factory expense or general and administrative expense accounts may have wide
and unexplained fluctuations from month-to-month. Their total, however, may vary between fairly narrow limits, such as between 9.1 and 11.3 percent of sales volume over the course of twelve or twenty-four months. Accordingly, depending on the intended usage of the model, it may well suffice to use 10.2 percent of sales as a planning factor for the group.

If the model is computerized, the process of choosing variables will probably involve a number of changes before the first computer run and during subsequent runs. Considerations of conciseness, flexibility, and cost/benefit tend to keep the number of variables small; temptations to "tell the whole story," to present it elegantly, and to stay with longstanding accounting practices tend to expand the number of variables used.

The purpose of the engagement, the intended audience, and the materiality of the items considered have a significant bearing on whether values are considered as separate variables or are grouped. There are, however, depending on the model, three general sources of variable items.

1. **Ledger accounts.** To tell the whole financial story, every dollar that appears in the accounts must be included in the model, although not necessarily under its own account caption. Ratios and trends derived from the ledger accounts may also be significant as separate variables. Examples are sales growth rate, receivables collection period, and gross profit ratio.

2. **Vital statistics of the company.** These items include direct labor hours, pounds of material used, units produced, number of employees, number of office employees, number of trucks operated, number of miles run, power used (in kwh or gallons), number of customers, number of patient-days, and number of ton-miles. All of the foregoing are the types of key variables that may apply to a specific client situation.

3. **External variables.** In determining model relationships, industry statistics, state and federal government statistics, local economic indicators that reflect conditions in the industry, the local economy, and the national economy may be helpful in isolating whether a problem is particular to the firm or widespread in the national economy.

Depending on the complexity of the application, a recommended approach for a practitioner new to the modeling process would be to keep the number of initial variables small and to increase them only when they are needed. For example, in the typical client organization with a volume of $50 million or under, the CPA will find that the interactions of perhaps twenty income statement items, twenty-five balance sheet items, twenty cash flow items, twenty rates and ratios (internal or industry or general economy), and ten physical volume measures will be sufficient to exercise his own and his client's ability to deal with the
many relationships and interactions that they provide, over a time span of five or ten future periods. Even if the chart of accounts contains 500 accounts, the practitioner will often find that fifty to one hundred variables are ample to reflect the key aspects of the client organization’s activities.

Grouping of Variables

There are questions to be asked in deciding whether an account should be a single variable or part of a group.

- How relevant is it?
- How does it behave? (What affects it? What interacts with it? How can the relationship be described? Does it change based on its own history over time, or is it linked to volume or to a preplanned schedule or to some other variable in the model?)
- How is information classified, grouped, or aggregated? (For example, a company may have ten inventory categories and ten purchase accounts for these categories, but if usage or purchases for each is not reasonably accurate, there is little point in trying to predict interim inventory levels for each of the ten categories. A single inventory variable called “total inventory” will use all of the information presently at hand. Conversely, if there is adequate information about levels, stock turns, and buying policies for the several categories, and if inventory management is really the emphasis of the engagement, it is possible that ten separate variables for inventory will be required. However, even in these circumstances it is likely that the number of meaningful categories can be condensed.)
- How closely related, for planning purposes, is it to other accounts? (It is customary, for example, to carry a separate ledger account for each type of payroll tax and fringe benefit. For general corporate planning such as envisioned in a model, it is more important to know that the total of taxes, pension costs, and other payroll-related costs is currently 22 percent of payroll than to know just what items constitute the 22 percent. Therefore, one variable will often do the job.)

Bases for Selecting Assumptions

In decreasing order of preference, the following bases for selecting assumptions are suggested.

1. *Client’s definitive plans*. For example, if there is a five-year capital budget already worked out, this becomes the logical starting point for projecting plant additions and replacements.

2. *History*. If an analysis (or graphic plot) of a variable indicates a consistent rate of growth or consistent relationship to another vari-
able, it is logical, in the absence of conflicting information, to select that historical pattern as an indicator of future behavior. Typically, however, there will be a somewhat erratic pattern, which regression analysis can smooth into a straight line or curve. A good check on the assumption is to predict a variable from a point (for example, twelve months earlier) to the current period and validate the statistical significance of the relationship. There is no guarantee that past history is a reliable indicator of the future, but at least it provides a basis for discussing with the client how this variable may behave during the projected period.

3. **Client judgment.** In the absence of a marketing plan, and in view of erratic recent history, a client manager may feel that volume is hard to predict and suggest using an average annual volume growth of 12 percent, for example. The practitioner may believe that the more conservative 10 percent is safer, and he may have heard that a local competitor is targeting 15 percent. The practitioner would consider capacity constraints, pricing levels, marketing expenditures, and general economic conditions in evaluating the client’s expectations. In circumstances where data is not available the practitioner may research appropriate external data to assist the client in developing assumptions.

4. **Practitioner’s judgment.** Clients have been known to mistrust past history as an accurate indication of interest rate trends; they will often ask the practitioner for his suggestion and then give it their consideration. The practitioner may have to do just that based on discussions with colleagues and bankers and a look at current trends.

**Other Aspects of Modeling**

The mechanics of turning assumptions into equations of the model are generally, but not entirely, independent of the modeling language being used. Many modeling languages have a capability to reach forward or backward one or more time periods to select a value of a variable (either the present variable or another one) to use as a basis. Some languages have built-in statistical routines. Awareness of such capabilities and their use can lead to wiser decisions on how best to project values.

One aspect of the mechanics involves the decision either to supply certain values as given data or to let the model calculate them. As an example, long-term indebtedness and payments can be handled in various ways.

- Initial balance, amount of periodic payment, and interest rate are given as data. The arithmetic of calculating interest, deducting periodic interest from each payment, and reducing principal by the
remaining portion of the payment can be built into the equations of the model.

- Another approach is to calculate remaining balances due separately from the model (by table or calculator), then to supply the string of debt balances to the model as data along with the periodic payments. The model arithmetic then is reduced merely to applying the periodic difference in balances to the total payment and assigning the remaining portion to interest expense.

- A third, probably more cumbersome, approach is to input all of the pertinent dollar values from the debt amortization schedule into the model as data and have no equations relating to debt in the model itself.

**Sequence of Model Programming**

The sequence of model programming is described below.

1. Define accounts, variables, and time periods. Various modeling languages have different means of supplying the numerical data to drive the calculations. Many languages allow the user to define a worksheet in which the columns are the time periods and the rows are the variables or accounts to be used. The computer program displays a table consisting of the columns and rows so defined, with all of the table values set to zero until otherwise instructed.

2. Define variable initial values. Any data to be initially set into the table will be the next order of processing. These are the givens of the assumptions and may consist of dollar values, rates, physical quantities, ratios, or any of the given numbers. Beginning balance sheet figures are also initial values. The model may also include one or more periods of operating history for comparison or computation.

3. Define logical relationships between variables and time periods. Following the data, a section for the calculation rules or equations comes next. This may be called the rules section, the procedures section, the logic section, or a similar name. The original equations may, of course, contain numeric values or names of variables or constants. It is a matter of judgment which of these values should be embedded in the equations and which should be given variable names with the values supplied as data. In case of any doubt as to whether the value may change on subsequent runs of the model, the number should be set up as a variable and the value supplied as data. This approach provides greater flexibility. In short, the practitioner is advised to learn as much as he can about what makes the numbers fluctuate and which numbers depend on others.
Validation of the Model

In the final analysis, it is the passage of time that permits ultimate validation of the model. Only then can it be determined if the financial statements for the period projected come reasonably close to the predicted results.

Before releasing the final version to the client, the practitioner can take measures to increase the likelihood of the model's validity. Some suggested techniques are—

1. Review working papers that analyzed client history for any new insights that may result from subsequent model development and testing.
2. Use historical data as input to determine if projections were accurate when compared with current data.
3. Compare various interim runs of the model to see whether significant changes (particularly, "bottom line" changes) make sense in the light of the varying inputs. Do the runs make sense when compared with one another?
4. Perform sensitivity analyses, graphically or by computer, to verify the way that outputs behave as inputs have varied. Additionally, the following concepts may be useful to the practitioner and the client.
   
   **Marginal profitability.** From the planned levels, each additional dollar of sales can be expected to produce a net income of sixteen cents, even though the overall average net after tax is ten cents.
   
   **Marginal costs.** The additional cost to make each additional unit of output beyond the levels projected is $82. How much might we be able to sell an additional unit for?
   
   **Tax effects.** Each additional dollar of plant investment in 19X1 will affect after-tax interest costs in 19X2 by seven cents, considering interest rates, tax rates, and investment tax credit.
5. Consider the reasonableness of the model. Can management truly achieve this kind of growth rate, considering past performance of the company and present state of the industry? What effects would a growth rate 2 percent lower have? Would this be more reasonable?
6. Consider the repercussions. A scenario sometimes encountered is that of a client managementoptimistically planning for rapid growth, high turnover of assets, and high profitability. When these hopes do not materialize, it may be difficult to explain the reasons to a loan officer if funds are being sought. Given a choice, it is often preferable to project results that may be overachieved than those that have only marginal expectations of achievement.
7. Consider new information. Has historical data for a more recent period become available during the model development? Does it change anyone's thinking? Does it change any historical relationships?

Engagement Output

The output of a financial modeling engagement generally results from multiple runs of the model, based on differing initial assumptions and documentation and relating the runs to their corresponding output reports. In many cases the assumptions are contained in the computer program listing of the model, often with a separate listing of the data file. These will usually be translated for reporting purposes into a "plain English" version of the assumptions used, which will include—

- Initial data, such as beginning balance sheet (often incorporated by reference).
- Rates of growth or change.
- Relationships (Which variables are driven by others?).
- Timing (When do changes start and end?).
- Limits (for example, "If \( A \) is less than 25 percent of \( B \), then \( C \) is this; otherwise, \( C \) is that." \( C \) could be a number, a variable, or an entire set of equations).

Supplemental output may include copies of working paper analyses and charted presentations of cost/volume/profit relationships. There are instances when copies of the condensed and summarized data that have been used in developing regression analyses or time-series forecasts can be useful to the client, since his own record of the same data may be too detailed or too far-flung to be useful in pattern recognition. Thus, the CPA's analysis may well result in his presenting a view of the "forest" to a client whose records are in the form of "trees."

The model itself, with appropriate documentation and operating instructions, may or may not be part of the engagement results. This depends on whether the client is planning to use the model on a continuing basis.

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6. This practice aid does not encompass the use of the output in meeting engagement objectives when model preparation is only a segment of a broader engagement.
The excerpt below illustrates how engagement outputs might be described in a proposal letter if prospective financial statements are the engagement objective.7

1. A management report presenting the financial projections for the period or periods under consideration and the projection's underlying assumptions. The report will show results for the base case and will depict the impact of various other alternatives and the sensitivity analysis.

2. A listing of the computer model input, consisting of the categories (variables) used, the data supplied, the calculation equations, and of the resulting output, consisting of the three principal projected financial statements for each set of assumptions.

Additional material that will be provided at the end of the engagement will include copies of worksheets that show the statistical derivations of the trends, ratios, and planning equations.

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7. For engagements involving the reporting on prospective financial information, see appropriate AICPA professional pronouncements.
APPENDIX A

Model Development Task Outputs

The tasks and outputs illustrated here are not intended to establish engagement requirements, since each engagement is different. The chart serves only as a reference for developing the unique task and output requirements that in the practitioner’s professional judgment are appropriate for a specific engagement.

<table>
<thead>
<tr>
<th>Task</th>
<th>Output and Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine what questions the model is to answer and the problems to be solved</td>
<td>Initial statement of requirements. To provide a formal means of defining the scope of the project and to provide a document for continuing reference.</td>
</tr>
<tr>
<td>Determine planning horizon, the number of time periods, and the length of each period</td>
<td>Work program. To provide and record the plan for the project.</td>
</tr>
<tr>
<td>Determine tentative variables, internal and external</td>
<td>Memorandum on planning horizon. To fix the number of time periods and to identify known problems or questions relating to the time span selected.</td>
</tr>
<tr>
<td>Obtain historical data on variables</td>
<td>Variables list. Identifies those variables to be included in the model, subject to continuing revision during the model development process. Variables may include certain ledger accounts, aggregates thereof, rates, ratios, physical measures, and statistics.</td>
</tr>
<tr>
<td>Determine relationships among variables by reviewing and discussing client analysis and planning documents, performing statistical analysis, discussing with client, and applying professional judgment</td>
<td>Data worksheets. To develop values, totals, averages, patterns, and trends for use in the model.</td>
</tr>
<tr>
<td>Decide on initial model parameters</td>
<td>Tentative calculation rules. To define the equation(s) by which each variable will be projected over the time span chosen.</td>
</tr>
<tr>
<td>Lay out output formats</td>
<td>Data list. To quantify the formulas developed in the previous step.</td>
</tr>
</tbody>
</table>

Output layout. To determine physical layout of the model output. Note: Some modeling languages have the capability of automatically adjusting column width to the size of the numbers generated and of rounding results as specified.
<table>
<thead>
<tr>
<th>Task</th>
<th>Output and Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select means of implementation</td>
<td>Implementation notes. Choice of computer modeling language, computer equipment, storage media, and file names and locations are decided and described at this point.</td>
</tr>
<tr>
<td>Write the model</td>
<td>Program listing. To provide means of entering the model as a computer program. Variables, data, and calculation rules are conformed to the structural and syntax rules of the language selected. Formatting specifications for editing, spacing, underlining, titling, and so forth, are also coded.</td>
</tr>
<tr>
<td>Enter model, data, and output formatting instructions into computer files</td>
<td>Printer output—file listings. To provide means of checking spelling and data accuracy and of identifying needed corrections.</td>
</tr>
<tr>
<td>Initial run—review, modify, and repeat as required</td>
<td>Printer output—model results. To provide indication that the model runs as intended and provides results that appear appropriate.</td>
</tr>
<tr>
<td>Review initial results with client</td>
<td>Memo of client discussion. To document changes in assumptions or planning factors that are required to produce feasible and acceptable financial planning projections.1</td>
</tr>
<tr>
<td>Validate model and develop details of alternative assumptions, enter, and run, documenting each run as to parameters used and structural changes made, if any</td>
<td>Model change notes. To document details of the changes agreed on the previous step.2</td>
</tr>
<tr>
<td>Present appropriate output and accompanying assumptions to client</td>
<td>Report. To convey engagement results in a meaningful manner (e.g., financial projections).3</td>
</tr>
<tr>
<td>In some instances, train client personnel to maintain and update model</td>
<td>Training notes. To report progress of client personnel in accepting and using the model.</td>
</tr>
</tbody>
</table>

1. For engagements involving the reporting on prospective financial information, see appropriate AICPA professional pronouncements
2. Ibid.
3. Ibid.
APPENDIX B

Sample Variables

This list of sample variables should not be regarded as a suggested standard set of model variables. To do so would invalidate the underlying thesis of this practice aid: Make the model fit the situation.

Each practitioner, however, will probably adopt certain conventions in naming variables that hold constant from one situation to another. It will be noted that in this list of variable names, the more universal the variable, the shorter the variable name—and the name should be kept short. ("NET," "TAX," "SALES," and "CASH" will apply nearly universally in any small client financial modeling situation.) The names of variables with modifying adjectives are longer. Note that in the accompanying list, "D" as the first letter generally means period-to-period change or difference in some balance sheet variable (for the mathematically inclined, it can be read as "DELTA").

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Row Caption</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUNITS</td>
<td>Unit sales, industrial</td>
</tr>
<tr>
<td>CUNITS</td>
<td>Unit sales, consumer</td>
</tr>
<tr>
<td>IPRICE</td>
<td>Average price, industrial</td>
</tr>
<tr>
<td>CPRICE</td>
<td>Average price, consumer</td>
</tr>
<tr>
<td>ISALES</td>
<td>$Sales, industrial</td>
</tr>
<tr>
<td>CSALES</td>
<td>$Sales, consumer</td>
</tr>
<tr>
<td>PSALES</td>
<td>$Sales, parts, etc.</td>
</tr>
<tr>
<td>OSALES</td>
<td>$Sales, all other</td>
</tr>
<tr>
<td>SALES</td>
<td>$Sales, total</td>
</tr>
<tr>
<td>CGSI</td>
<td>Cost of goods sold, industrial</td>
</tr>
<tr>
<td>CGSC</td>
<td>Cost of goods sold, consumer</td>
</tr>
<tr>
<td>CGSP</td>
<td>Cost of goods sold, parts, etc.</td>
</tr>
<tr>
<td>CGSO</td>
<td>Cost of goods sold, all other</td>
</tr>
<tr>
<td>CGSTOT</td>
<td>Total cost of goods sold</td>
</tr>
<tr>
<td>GPROF</td>
<td>Gross profit</td>
</tr>
<tr>
<td>COMMIS</td>
<td>Selling expense, commissions</td>
</tr>
<tr>
<td>ADVER</td>
<td>Selling expense, advertising</td>
</tr>
<tr>
<td>SELOTH</td>
<td>Selling expense, all other</td>
</tr>
<tr>
<td>GAPROL</td>
<td>General and administrative expense, payroll</td>
</tr>
<tr>
<td>GAOTH</td>
<td>General and administrative expense, all other</td>
</tr>
<tr>
<td>INTXP</td>
<td>Interest expense</td>
</tr>
<tr>
<td>OIEXP</td>
<td>Other income and other expense, net</td>
</tr>
<tr>
<td>DEPN</td>
<td>Depreciation expense</td>
</tr>
<tr>
<td>PRETAX</td>
<td>Income before income taxes</td>
</tr>
<tr>
<td>TAX</td>
<td>Federal and state income taxes</td>
</tr>
<tr>
<td>NET</td>
<td>Net income</td>
</tr>
<tr>
<td>Variable Name</td>
<td>Row Caption</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CASH</td>
<td>Cash and cash equivalents</td>
</tr>
<tr>
<td>RECEIV</td>
<td>Receivables</td>
</tr>
<tr>
<td>INV</td>
<td>Inventories</td>
</tr>
<tr>
<td>OCURAS</td>
<td>Other current assets</td>
</tr>
<tr>
<td>PEQ</td>
<td>Property and equipment, cost</td>
</tr>
<tr>
<td>ADEP</td>
<td>Accumulated depreciation</td>
</tr>
<tr>
<td>PEQNET</td>
<td>Property and equipment, net of depreciation</td>
</tr>
<tr>
<td>OASST</td>
<td>Other assets</td>
</tr>
<tr>
<td>CURRL</td>
<td>Current payables and accruals</td>
</tr>
<tr>
<td>DEBT1</td>
<td>Mortgage payable</td>
</tr>
<tr>
<td>DEBT2</td>
<td>Term loan payable</td>
</tr>
<tr>
<td>DEBT3</td>
<td>Capitalized lease debt</td>
</tr>
<tr>
<td>DEBT4</td>
<td>Notes payable, stockholders</td>
</tr>
<tr>
<td>DEBT5</td>
<td>Short-term notes payable (current liability)</td>
</tr>
<tr>
<td>OLIAB</td>
<td>Other liabilities</td>
</tr>
<tr>
<td>EQUITY</td>
<td>Stockholders' equity</td>
</tr>
<tr>
<td>DCASH</td>
<td>Difference in cash and cash equivalents</td>
</tr>
<tr>
<td>DREC</td>
<td>Difference in receivables</td>
</tr>
<tr>
<td>DINV</td>
<td>Difference in inventories</td>
</tr>
<tr>
<td>DOCUR</td>
<td>Difference in other current assets</td>
</tr>
<tr>
<td>ADDPEQ</td>
<td>Property and equipment additions, net of reductions</td>
</tr>
<tr>
<td>DDEPN</td>
<td>Change in accumulated depreciation</td>
</tr>
<tr>
<td></td>
<td>(generally equal to depreciation expense, less reductions by reason of dispositions, if any)</td>
</tr>
<tr>
<td>DPQNET</td>
<td>Change in book value of property and equipment</td>
</tr>
<tr>
<td>DOASST</td>
<td>Change in other assets</td>
</tr>
<tr>
<td>DCURRL</td>
<td>Change in current payables and accruals</td>
</tr>
<tr>
<td>PRIN1</td>
<td>Principal payments, mortgage</td>
</tr>
<tr>
<td>PRIN2</td>
<td>Principal payments, term loan</td>
</tr>
<tr>
<td>PRIN3</td>
<td>Principal payments, capitalized lease debt</td>
</tr>
<tr>
<td>PRIN4</td>
<td>Principal payments, notes payable, stockholder</td>
</tr>
<tr>
<td>PRIN5</td>
<td>Net change in short-term debt</td>
</tr>
<tr>
<td>TPRIN</td>
<td>Total principal payments</td>
</tr>
<tr>
<td>CURPOR</td>
<td>Current portion of long-term debt</td>
</tr>
<tr>
<td>DOLIAB</td>
<td>Change in other liabilities</td>
</tr>
<tr>
<td>DEQ</td>
<td>Change in stockholders' equity</td>
</tr>
<tr>
<td>Variable Name</td>
<td>Row Caption</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>GRORAT</td>
<td>Sales growth rate</td>
</tr>
<tr>
<td>INFL1</td>
<td>Rate of inflation—cost group 1</td>
</tr>
<tr>
<td>INFL2</td>
<td>Rate of inflation—cost group 2</td>
</tr>
<tr>
<td>INFL3</td>
<td>Rate of inflation—cost group 3</td>
</tr>
<tr>
<td>RECTURN</td>
<td>Year-end receivables, ratio to annual sales</td>
</tr>
<tr>
<td>INVTURN</td>
<td>Year-end inventories, ratio to following year cost of goods sold</td>
</tr>
<tr>
<td>PAYTURN</td>
<td>Year-end payables and accruals, ratio to current year cost of goods sold</td>
</tr>
</tbody>
</table>

**NOTE:** No attempt has been made to list all subtotals that will be used at the practitioner's discretion in the model. Each subtotal included will become another variable of the model.
APPENDIX C
Sample Engagement Letter

CPA & Company
Certified Public Accountants
Ourtown, USA

October 12, 198X

Mr. James R. Broadview
Vice-President, Finance
The Practical Machine Company, Inc.
1234 West Fifth Street
Ourtown, USA 00000

Dear Jim:

It was good to discuss your company's financial planning needs with you and your associates in last Monday's meeting. You expressed a desire to link your several departmental planning documents together into an overall financial planning model.

This letter defines the scope and objectives of an engagement to develop such a model and describes our approach to accomplishing the work we discussed.

Engagement Objectives

The objectives of the engagement will be—

- To create, test, and run a computerized financial model of the Practical Machine Company's operations, financial condition, and cash flow for the five yearly periods ending 19XX, using assumptions that have been provided by company management.
- To test the results of several alternative sets of assumptions regarding corporate policies and environmental conditions.
- To provide sufficient documentation and training to enable company personnel to update the model annually, in the light of subsequent experience and planning.

Engagement Scope

We will develop a financial model for the Practical Machine Company according to the requirements developed in the approach. The engagement will be concluded with delivery of the items listed in the engagement output section.

The scope of the assignment will include the entire range of company operations and finances, based on the present accounting system and policies augmented by applicable statistical data, all appropriately condensed into a manageable but useful set of categories.

Engagement Approach

Our approach to meeting the objectives of the engagement will be—

- To analyze the trends, ratios, and volumes in the major areas of company activity, as reflected in the accounts and statistics for recent years.
• To select the appropriate categories and relationships to be included in the model.
• To construct, test, and run the model a sufficient number of times to meet the previously defined requirements criteria.
• To run the model x times to permit management to select a definitive set of planning assumptions.
• To train your personnel in the sources of planning data, the working of the model, and the manner of making changes to reflect subsequent history and revised planning factors in subsequent years.

Engagement Output
There will be two principal end products of this assignment:

1. A user-guide for the model, and when applicable, software documentation
2. A listing of the computer model input consisting of the categories (variables) used, the data supplied, the calculation equations, and the resulting output consisting of the three principal projected financial statements

Additional material deliverable at the end of the assignment will be copies of worksheets showing the statistical derivations of the trends, ratios, and planning equations.

Benefits
As a result of this engagement, the Practical Machine Company will have the ability to prepare a documented set of financial plans to serve as the basis for developing detailed budgets and for advising your board of directors and your bank of the status and results of management's broad financial planning.

Your company will also have a vehicle for updating the intermediate-range plans in the future.

Project Staffing and Schedule
We expect the project to require approximately six calendar weeks to complete. This permits time for management to review, discuss, and modify intermediate results. During the period, we would want to involve your people as much as possible—especially Joe Jackson (about 40 percent of his time) and yourself to some extent. The more your people can learn about the integration of department planning, and the more we can help them understand the interactions of the various planning segments, the more your company will benefit from our involvement.

The consulting engagement will be supervised by Paul Partner. Sam Senior will be in charge of the fieldwork and will utilize qualified consultants from our staff in the technical aspects of the work. Sam has personally conducted similar projects for clients in a variety of industries.

As we discussed with you, we plan to begin the engagement on ____________ 198X.

Fees and Billing Arrangements
We estimate the fees for our services will be between $XXXX and $XXXX. In addition, the out-of-pocket costs for computer time are estimated at $XXXX to $XXXX. This estimate is based on the assumption that you, Joe Jackson, and other employees will be reasonably available to work with us. If, for any reason, we find more time and thus expense is required, we will confer with you before
proceeding further. If less of our time is required than anticipated, charges for our services will be less.

We bill monthly for our management advisory services engagements at our standard monthly rates and for expenses at actual cost.

Please let me know if you have any questions. Your signature on one copy of this letter will serve as our authorization to commence the project.

Very truly yours,

CPA & Company

Accepted:

For the Practical Machine Company, Inc.

Date
Bibliography

Books


Periodicals


**Financial Modeling Software Source Guides**


Datapro. *Datapro 70*. Delran, N.J. This comprehensive hardware/software reference service contains seven sections—computers, peripherals and terminals, software, communications, suppliers, media and suppliers, and an index—along with feature reports. This is one of several reference services from Datapro. Other services include a directory on software, reports on office systems, reports on minicomputers, reports on banking automation, and surveys on point-of-sale devices.

International Computer Programs. *ICP Quarterly*. Indianapolis. This quarterly is a listing of available software programs.


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