*Factors inhibiting the development of planning-data systems are now being resolved in part by the availability of planning-oriented programming languages.*

*Discussed are types of planning and the processing of planning data. Emphasized is the use of a planning systems generator—a planning-oriented language facilitating data bank definition and data entry, logical computations, and formatting of statistical or graphical reports.*

# Planning-data systems

**by H. F. Lande**

The use of computers to process planning data has advanced from the occasional development of a computerized planning model to being a significant area of management involvement in data processing. In the past, the use of computers in planning has been handicapped by two factors:

- Access to the computer.
- The necessity to do programming.

The availability of computer systems (hardware) with remote Input/Output facilities has been solving the problem of access for the planner, and now the availability of suitable programming languages (software) is solving the problem of planning-data system development and maintenance. Thus with little additional training, the economist, industrial engineer, financial analyst, and others can be their own computer-model builders as they are when processing planning data manually.

The objective of this paper is to discuss the characteristics of planning-data systems, and planning systems generators so that the experiences of the past may become useful to those concerned with current applications and future developments. Literature is available arguing the benefits of adopting a systematic planning process as part of the management system, primarily dealing with sociopolitical, organizational and managerial issues.[1-7] The problems of processing planning data are usually not addressed.

## Planning-data processing

**types of planning**

Planning is performed for some managerial reason and, on this basis, may be classified into the following.

*Efficiency of performance.* Objectives such as sales quotas, production schedules, advertising programs, and construction-project awards, and resources such as manpower, facilities and money are known. The problem is to get the job done economically—that is, at the least cost. This type of planning is usually short term. In actual practice it may be termed *operational* planning, budgeting, or profit planning. The major decisions have been made; the problem is to translate them into actions within some procedural framework that allows monitoring of progress and measuring of accomplishment.

*Allocation of resources.* Objectives are given, but there is still a question of how to accomplish them. Assumptions have to be made about the efficiency or productivity of different resources to reach a decision regarding which resource or which combination of various resources to employ. This type of planning is often referred to as *tactical.*

*Establishment of objectives.* This type of planning, often referred to as *strategic*, deals with the question of goals. Resource constraints (availability and productivity) as well as market forces are estimated and included in the deliberations.

In practice, all these purposes of planning overlap, just as the three types of decisions to be made are part of the overall problem of managing. However, experience has shown that the data needed for planning differ substantially depending upon the planning purpose. Furthermore, a user's conceptual definition of data is of little help in designing a support system for the processing of this data. Conceptual definitions, such as revenue, cost and expenses, investments, cash flows, manpower, facilities, and so forth in the extreme lumped together as "all relevant data" tend to create a misleading impression about the real issue. The key question is not what major data classes, but how many data classes and how much detail in each class. The ability to use data in the planning process depends on the data processing methods employed. To strike a balance between the data to be used in planning and the methods used to process it is one of the most difficult and critical problems in planning-systems development.

In resolving this problem specifically, the computer plays an important role more as a neutral disciplinarian of operational procedures rather than as an efficient processor of data. Many corporations plan, either informally or systematically. If they plan systematically, then computer usage suggests itself as a natural application. If informally, perhaps the benefits of a systematic approach could be demonstrated.

## Planning-data systems

Computer usage in processing planning data becomes meaningful only when an organization is actually engaged in some formal, systematic planning. The outward manifestation of this precondition can usually be ascertained by discovering whether or not planning data are actually being processed. Upon investigation, one usually finds that this data is processed by manual methods: columnar paper as source documents, pencils and typewriters as report generators, and desk calculators and slide rules as the processing units, while man functions as the system architect, programmer, and operator in one person.

When converting such a system to computer usage, it is important to recognize the key role of the individual planner who understands the theoretical concepts, academic disciplines, and has practical experience in planning and decision-making problems. In this work, professional judgments and clerical operations are so intertwined that separation and delegation of the clerical portion becomes impractical, if not impossible. Unless the planner is involved with the design and operation of the planning-data system, he will not be able to use it.

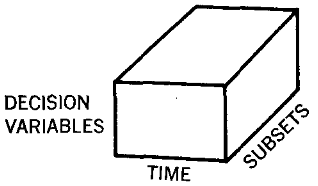
**planning data versus transaction data**

Most data processing applications deal with existing data that has previously undergone a thorough audit for quality and reliability and, once certified, does not change during processing. All this data represents business transactions—records of events deemed significant for purposes of accounting and control. Except for occasional reclassification because of changes in organizational structure requiring corresponding adjustments in the accounting structure, or for occasional changes in processing logic due to changes in rules of procedure, this data represents a rather stable view of current conditions. Because this data is reproducible, analysis does not have to be performed immediately; it can occur days, weeks, or months later.

Proficiency in the processing of transaction data—that is, competence in the design and development of transaction-data systems that perform the functions described above—may be a handicap in planning-data systems. The reason for this is the entirely different nature of planning data.

In principle, planning data does not exist. The planning-data system has, as its major objective, the ability to generate planning data. In addition, the future being uncertain and speculative, there is usually not just one set of planning data, but many such sets in existence at the same time. For example, the procedural logic in a transaction-data system for payroll preparation or bill of materials explosion is unique and completely defined. The logic for generating planning data, however, is varied, subjective, and often definable only through progressive experimentation.

Figure 1 Planning-data bank




Hence the methodology of transaction-data systems does not apply to planning-data. It is true that a system that stores the various sets of planning data for prompt sorting, analysis, reassembly, and display is not useless. However, it does not address the key issue of solving the planning-data generation problem—a problem that occurs not once, but many times during a business year with new data and, sometimes, new logic.

## Generation of planning data

The key problem, then, is how to generate planning data, not how to store and display it. There are two steps in this process.

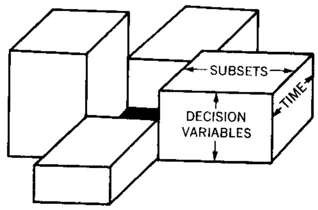
**planning-data bank**

The definition of decision variables relevant in a specific decision-making situation results in a planning-data bank of usually at least three dimensions as shown in Figure 1. The first dimension is that of the item descriptions for the *decision variables*, including unit of measure. In making the selection the analyst must keep in mind whether or not data for these variables can be found or generated by acceptable, reasonable methods. In this, the existence of a transaction-data system can be helpful, but it is not sufficient. Many decision variables would not be found in conventional transaction-data systems, and many decisions deal with problems for which no historic data are available. The second dimension is *time*, the horizon for which the planning data is needed. These two dimensions define a matrix, the format in which planning-data processing is usually addressed.

The third dimension, *subsets*, addresses the fact that a planning or decision-making problem rarely occurs in isolation. For example, a marketing problem may have geographic subsets or product line subsets; a manufacturing problem may have plant location subsets and warehouse subsets; and an overall resource allocation problem may have profit-center subsets. The same applies to studies of acquisitions and divestments. These subsets of planning data must be consolidated into a comprehensive total. Such consolidation is often the first application to be developed within a planning-data system.

One of the key problems in planning-data systems design is to contain the number of decision variables, time periods, and subsets within manageable bounds. The limiting factor for the size of the planning-data bank is not computing power and processing capabilities. It is, instead, manageability of the planning-data bank by the people who design, maintain, and operate the planning-data system. This is based on the fact that planning data created by the system require auditing, approval, and authentication by the users.

Figure 2 Four subsidiary planning-data systems




A fourth consideration is *coordination* of planning data developed independently by different functional organizations within different subset structures and degree of detail. Cross-referencing of this data is virtually impossible, because it would force every planning unit to carry data at the lowest common level of detail.

Each planning unit determines its own structure of planning data and assumes the job of maintaining an appropriate data bank. For example, the marketing and manufacturing data in a planning-data bank for use by corporate management is not the same as those used by the management of the marketing or manufacturing organizations. The reconciliation of the summary data between organizations at the same level and organizations at different levels of the management hierarchy, and the decision-making that follows, comprise the planning process itself.

In practice, the data in each of these planning-data systems will suit the needs of the planning units' management. Senior management reviews these and may also have their own planning-data systems. Figure 2 illustrates a four-sided space in which management may assess the summary displays from each of four subsidiary planning-data systems, each of which is backed up by its own subset structure. The illustration makes the simplifying assumption that the time dimension is the same; hence the walls are of equal width.

In reality, the time dimension usually is not the same since manufacturing may plan by month for two years, marketing may plan by quarter for one year, engineering and development may plan by year for ten years, and corporate management may wish to look fifteen years into the future. Furthermore, different planning problems may require different time dimensions. Frequently there is the temptation to seek a common denominator in terms of the longest time horizon and the shortest time cadence and to force everybody into that mold. The resulting data-base definitions, however, become unmanageable. This can be proven by multiplying out the number of data elements that each of these systems would contain. Also, the illustration shows the walls having different heights, thus incorporating different degrees of detail in each of the subsystems.

**planning-data entry**

Furnishing the data bank with planning data is the second step, and it is here that the difference between transaction data and planning data becomes most pronounced. Some data is entered; others are generated by some logical procedures from the entered data. In many cases, there are various data entry options that, in keeping with procedural logic, generate one of several time series of resulting planning data. As examples, a statement of future revenues for a given product in a given geographic area may be produced as a trend-line projection from past history; it may be produced as the product of future physical sales units and variable price assumptions, in which case a price elasticity assumption could also be taken into consideration; or the consumption volume data could be derived from population estimates, income levels, and other macro-economic data; or it may be produced as an application of subjective assumptions of growth rates by future time periods at the discretion of management; or it may be computed from estimated employment of sales personnel and respective productivity assumptions; or it may be produced as a quota allocation from an aggregate forecast of a higher-level planning unit. A substantial portion of the procedural logic is to sort out which input data have effectively been furnished for a given planning-data processing job and then apply the optional logic accordingly.

Of course, except for historic data, any assumptions that affect the generation of future data are subject to frequent change. One of the functions of planning-data systems is to facilitate the processing of speculative assumptions about future events on the part of planners without increasing the clerical workload. Many of these planning iterations may be made on a trial-and-error basis before they represent proposable objectives and resource-allocations requests.

Also, many comprehensive views of the future are usually developed in a systematic planning process before one of them becomes the accepted and approved plan. The documentation of each of the considered views consisting of the input assumptions and procedural logic may be retained for future reference together with the documentation of the approved plan itself. Again output volume becomes a problem in that efficient storage media must be used to provide the appropriate access to selected former as well as current planning data generated by the system.

## A planning systems generator

Because of the subjective nature of planning data and considering the fact that the major objective of a planning-data system is to produce planning data, there can be no general purpose planning-data system. While there are great differences in the data bank definitions and logic procedures of each specific system, there appears to be one common requirement in all of them—the planner must have access to the computer and he needs the capability of designing, programming, and maintaining his own system. Thus, assuming computer access is available, what the planner needs most is a planning-oriented programming language.

Such a planning-oriented language is not really a language nor an application. It is, in effect, a *planning systems generator*—a disciplined approach to the programming of planning-data processing applications.

The function of a planning systems generator is to create a computer usage environment for the planner so that he may develop applications for his own needs but, in doing so, will remain compatible with similar applications developed by others within the same environment. It is this environment which makes possible the gradual, evolutionary development of a planning-data system as a result of the efforts of many planners at different locations in an organization. This approach provides immediate benefits, gives the planner complete freedom regarding the structure of his own applications without isolating him and preventing him from integrating his efforts with those of others later on. It also avoids the necessity of having to work out a cumbersome and all-embracing master plan and the usual standard procedures for systems analysis, flow charting, feasibility studies and the like.

The primary objective of a planning-data system is to help the planner better perform his job as a result of better data processing methodology beyond the use of columnar work papers, pencils, and desk calculators. The function of a planning systems generator is to create this environment by simplifying the programming job to a level which a planner might be willing to learn.

By itself, a planning systems generator is a procedure—a discipline within which a user may:

- Specify a data bank and enter data values.
- Specify logical rules for the generation of additional data values by projection and/or correlation.
- Specify statistical or graphic reports for the display of data from the data bank.

Of course, a planning systems generator must handle the above functional requirements so that the user's programming becomes neither cumbersome nor restrictive. What is perceived as cumbersome or restrictive depends upon the user and, therefore, the degree of standardization of procedures imbedded in a planning systems generator will inevitably seem to be too cumbersome or too restrictive to some users. The architectural design problem is then to find a reasonable balance between programming load and programming restrictions to appeal to a broad spectrum of planners.

Another performance characteristic is flexibility. As in most languages, a planning systems generator contains problem-oriented procedures (grammatical rules) and vocabulary (commands or macroinstructions). Otherwise general-purpose high-level languages would perform equally well in the planning-data processing environment. However, any specific set of procedures and vocabulary will inevitably become a limiting factor as the user's requirements become more sophisticated and complex. Hence, a planning systems generator must also allow for the expansion of procedural rules and vocabulary within a given user environment.

**PSG II**

To more clearly identify the characteristics of a planning systems generator in its various performance areas, a discussion of the program product, Planning Systems Generator II (PSG II), follows.[8-10]

The most straightforward approach to the design of a planning systems generator would be the establishment of one multidimensional data bank (matrix) and a single instruction set for report generation, logic specification and data entry. The approach used in PSG II deliberately separates these three functions to provide flexibility.

Report generation is independent and may be used by itself to create forms for manual data processing. Reports or charts with headings, line-item descriptions, and specifications for numbers of decimal places to be printed, line spacing, and so forth are handled by 80-character input records.

Logic specifications are packaged as FORTRAN subroutines and, therefore, open-ended into the entire FORTRAN arithmetic and logical instruction set, supported by a library of macroinstructions addressing typical planning calculations. The standard FORTRAN instruction set applies. These FORTRAN subroutines, however, do not address any input/output or other housekeeping requirements. Only arithmetic and logical FORTRAN instructions are involved. In addition to designing his own application subroutines, the user may also add his own macroinstructions to the system.

The entry of data values into respective work spaces is accomplished by a third set of 80-character input records. Values are specified in fixed-field or free format.[9,10]

The coordination of these three sets of instructions is accomplished by a seven-character code consisting of a two-digit program number, a two-digit subset number and a three-digit line number. Work spaces or data banks are assigned by subset number within program number; hence, 10,000 such workspaces can be specified within one planning-data system. Each workspace consists of 3600 data elements, which can be organized from 900 lines with 4 columns to 200 lines with 18 columns. The maximum capacity is 36 million data elements.

Any data line can be transferred from one subset within a program to another subset within the same or another program. The corresponding transfer instruction results in the automatic entry of the transferred data values into the workspace of the receiving subset.

In addition to the workspace of 3600 data elements for purposes of storing input data values, two additional work areas of equal size are assigned during execution for storing the results of computations and for storing the consolidations across subsets. Whereas the input data bank can be permanently stored, the auxiliary workspaces of results of computation and consolidation are erased after report generation.

The system provides for the careful separation of input assumptions from the derived data values since a change in one input data value may, through the complexity of planning logic specified, affect many of the computed results and consolidations.

In report generation because data locations are separately identified by a four-character code (workspace name and line number), the system allows for extensive labeling of data within major subheadings and minor line-item descriptions to produce the most legible output reports. The significance of this can be illustrated by the fact that a certain time series of data such as "gross income of product line X" may in one report appear under the heading "gross income" with the line description "product X" and in another report under the heading "product line X" with the line description "gross income." If data locations and descriptive labels are combined into one expression or mnemonic code, it soon develops that the mnemonics become too long and unintelligible.

## Development of planning-data systems

In a larger, multidivisional corporation, planning-data systems can be developed at the corporate level or in any of the divisions or within a division in any of the conventional business functions such as manufacturing and marketing. The closer an orga-

Figure 3 Report-generating instructions

```
1DATE  JAN. 1970     ** VALUES FOR YEARS 1970 TO 1972 PROJECTED, NOT ACTUAL **
2LIST NONE
REPORT 60-1                   CONSOLIDATED STATEMENT OF OPERATIONS60115
GROSS INCOME FROM                                                 60159
   SALES, SERVICE AND RENTALS        M$                           60150 B011
NET EARNINGS BEFORE INCOME TAX       M$                           60150 B021
U.S. AND FOREIGN INCOME TAXES        M$                           60150 B031
NET EARNINGS                         M$                           60150 B041
                 PER SHARE           $                            60152 B043
CASH DIVIDENDS                       M$                           60150 B051
                 PER SHARE           $                            60152 B053
STOCK DIVIDEND AND SPLITS                                         60159
                 PERCENT             %                            60151 A101
                 SHARES ISSUED      000                           60150 A102
SHARES SOLD                         000                           60150 B110
AT END OF YEAR:                                                   601593
---------------                                                   60159
NUMBER OF SHARES OUTSTANDING        000                           60150 B120
NET INVESTMENT IN PLANT, RENTAL                                   60159
   MACHINES AND OTHER PROPERTY       M$                           60150 B131
LONG-TERM DEBT                       M$                           60150 B141
WORKING CAPITAL                      M$                           60150 B151
NUMBER OF STOCKHOLDERS              000                           60150 B125
NOTE: ADJUSTED FOR STOCK DIVIDEND AND SPLITS                      601213
                                    ***** END OF PUBLISHED REPORT 601212
FORMAT *****                                                      60122
ADDITIONAL ANALYTICAL DATA:                                       60159
---------------------------                                       60159
CHANGE IN GROSS INCOME               %                            60151 B012
PRETAX NET TO GROSS INCOME           %                            60151 B022
EFFECTIVE TAX RATE                   %                            60151 B032
AFTER TAX NET TO GROSS               %                            60151 B042
DIVIDEND PAYOUT                      %                            60151 B054
OPERATING INVESTMENT                 M$                           601503B161
OPERATING EQUITY                     M$                           60150 B171
FIXED TO TOTAL INVESTMENT            %                            60151 B132
DEBT TO TOTAL INVESTMENT             %                            60151 B142
COST+EXPENSES/INVESTMENT            RATIO                         60153 B162
EQUITY PER SHARE (ADJUSTED)          $                            601523B173
RETURN ON EQUITY                     %                            60151 B174
                                                                  601903
REPORT 60-2                         PERFORMANCE INDEX (1965=100)  60217    3
GROSS INCOME                         M$                           60270 B011
NET AFTER TAX EARNINGS               M$                           60270 B041
OPERATING INVESTMENT                 M$                           60270 B161
                                                                  602903
                                                                  60999
```

nizational unit's planning problems are to actual operating practices, the more specialized and tailor-made will be the respective planning-data system. For example, the marketing planning at the product-line level may use different input options (variables), logic specifications, and report generation even within the same corporation. But even at the more abstract levels of organization such as divisional staff or corporate staff, there is a great deal of subjective diversification, which makes it impractical to design a general purpose financial model. This will be evident from the following illustration of a hypothetical top-level module of a corporate planning-data system tailored after the IBM Corporation's 1972 Annual Report, specifically, the consolidated statement of operations.[11] The process of planning-data generation is illustrated by moving back in time, taking the years 1970 to 1972 as if they were future years.

The report-generating instructions, shown in Figure 3, produce the consolidated statement, expanded to show additional analytical ratios and an index chart. The logic specifications for projecting and analyzing the data are incorporated into a FORTRAN subroutine, shown in Figure 4, containing both standard PSG II macroinstructions, plus user-written macroinstructions, TREND

Figure 4 Logic specifications

```
      SUBROUTINE PSGLOG(NPROG)
      IF (NPROG.NE.60) RETURN
C
C                    IBM CONSOLIDATED STATEMENT OF OPERATIONS
      COMMON A(450,8),B(450,8),C(450,8),NSUBST,NVIEW
C
C                    GROSS INCOME INTERPOLATED TO MEET A GIVEN OBJECTIVE
C                    AND/OR EXTRAPOLATED PER HISTORIC COMPOUND GROWTH RATE
      CALL FILL (3,1,11,11)
      CALL EXTEND (2,2,11,11)
C                    PRETAX NET INTERPOLATED TO MEET A GIVEN OBJECTIVE
C                    AND/OR TRENDED TO GROSS PER LAST FOUR YEARS RECORD
      CALL FILL (3,1,21,21)
      CALL TREND (4,2,11,2,21,21)
C                    COST + EXPENSES
      CALL MOVE (2,11,-1,21,25)
C                    TAX RATE CONTINUED PER LAST GIVEN RATIO
      CALL PCT (1,31,1,21,32)
      CALL EXTEND (0,2,32,32)
C                    TAXES AND NET EARNINGS
      CALL MOVE (2,21,-3,32,31)
      CALL MOVE (2,21,-1,31,41)
C                    DIVIDENDS PER SHARE CONTINUED PER LAST GIVEN AMOUNT
      CALL EXTEND (0,1,53,53)
C                    SHARES SOLD PER HISTORIC COMPOUND GROWTH
      CALL EXTEND (2,1,110,110)
C                    SHARES OUTSTANDING YEAREND
      B(120,1)=A(120,1)
      DO 6001 K=2,8
 6001 B(120,K)=B(120,K-1)+B(110,K)+A(102,K)
C                    SHARES ADJUSTED FOR STOCK DIVIDENDS AND SPLITS
      B(101,8)=1.0
      DO 6002 N=1,7
      K=8-N
 6002 B(101,K)=B(101,K+1)*(1.0+A(101,K+1)*.01)
      DO 6003 K=1,8
 6003 B(122,K)=B(120,K)*B(101,K)-B(110,K)*A(111,K)*.01
C                    CASH DIVIDENDS
      DO 6004 K=1,8
      B(51,K)=A(51,K)
 6004 IF (B(51,K).EQ.0) B(51,K)=B(122,K)*B(53,K)*.001
C                    NET INVESTMENT AND WORKING CAPITAL
C                    TRENDED TO COST + EXPENSES
      CALL TREND (4,2,25,1,131,131)
      CALL TREND (4,2,25,1,151,151)
C                    LONG TERM DEBT CONTINUED PER LAST GIVEN AMOUNT
      CALL EXTEND (0,1,141,141)
C                    TOTAL INVESTMENT AND EQUITY
      CALL MOVE (2,131,151,0,161)
      CALL MOVE (2,161,-1,141,171)
C                    STOCKHOLDERS CONTINUED PER PAST COMPOUND GROWTH
      CALL EXTEND (2,1,125,125)
C
C                    ANALYTICAL RATIOS
C                    GROSS INCOME GROWTH
      CALL YGR (2,11,12)
      B(12,1)=A(12,1)
C                    PRETAX NET TO GROSS
      CALL PCT (2,21,2,11,22)
C                    AFTER TAX NET TO GROSS
      CALL PCT (2,41,2,11,42)
C                    DIVIDEND PAYOUT
      CALL PCT (2,51,2,41,54)
C                    NET EARNINGS PER SHARE (ADJUSTED)
      CALL RATIO (2,41,2,122,43,1000.)
C                    COST+EXPENSES/INVESTMENT TURNOVER
      CALL RATIO (2,25,2,161,162,1.)
C                    FIXED TO TOTAL INVESTMENT
      CALL PCT (2,131,2,161,132)
C                    DEBT TO TOTAL INVESTMENT
      CALL PCT (2,141,2,161,142)
C                    EQUITY PER SHARE (ADJUSTED)
      CALL RATIO (2,171,2,122,173,1000.)
C                    RETURN ON EQUITY
      CALL PCT (2,43,2,173,174)
      RETURN
      END
```

and MOVE. All explanations are included as comments in the FORTRAN routine. The data values for the past years and certain future goals are specified in appropriate data statements as depicted in Figure 5.

Figure 5 Data statements

```
8VIEW 0001IBM PLANNING DATA SYSTEM1965PAST FOUR YEARS TREND EXTENDED
6000999   11                        CORPORATE TOTALS
6000011 3572.825,4247.706,5345.291,6888.549,7197.295
6000012 10.3
6000021 959.902,1054.130,1297.500,1864.498,1978.873
6000031 483,528,646,993,1045
6000051 210.767,230.671,243.173,292.646,407.826
6000053 1.95,2.10,2.17,2.60,3.60
6000101 2=50,2.5,100
6000102 2=17646,1363.7,56230.4
6000110 176.655,1577.301,302.356,623.670,749.699
6000111 6+=54
6000120 35224.9
6000131 2303.509,3098.619,3496.307,3415.039,3863.461
6000141 398.850,458.872,521.460,545.091,554.821
6000151 698.653,723.096,916.383,1770.070,1814.120
6000125 275.650,328.427,359.495,501.390,549.463
8VIEW 0002IBM PLANNING DATA SYSTEM19651972 GROSS AND NET GOALS GIVEN
6000999   11                        CORPORATE TOTALS
6000011 8=10000
6000021 8=2500
6000053 6=4.00,5.00,6.00
PSGEXIT
```

The following figures show the resulting output of this module for two hypothetical projections, View 1 (Figure 6) and View 2 (Figure 7). In Figure 6, the years 1970–1972 are based on gross income to grow at the compound growth rate for the last four years (19.1 percent) and pretax net to continue at the respective average rate to gross (26.2 percent). All other data are trended against these two major variables.

In Figure 7, arbitrary goals are introduced for 1972, that is gross income at \$10 billion and pretax net at \$2.5 billion. Between 1969 and 1972, gross income and pretax net are interpolated with an implicit growth rate of 11.6 percent. Also, dividends per share are raised to \$4, \$5, and \$6 beginning in 1970. In addition to these particular examples, many other different assumptions can be tried within the projection logic of this module, or data can be entered for all years.

To save the reader time, the following is the comparison of these two views of 1970–1972 from the 1969 vantage point with what has since happened:

| | 1970 | 1971 | 1972 |
|---|---|---|---|
| Gross income (million \$) | | | |
| View 1 | 8574 | 10215 | 12170 |
| View 2 | 8031 | 8962 | 10000 |
| Actual | 7504 | 8274 | 9533 |
| Earnings per share (\$) | | | |
| View 1 | 9.27 | 10.92 | 12.80 |
| View 2 | 8.84 | 9.45 | 10.05 |
| Actual | 8.92 | 9.38 | 11.03 |

**Figure 6 First projection**

IBM PLANNING DATA SYSTEM VIEW 1 PAST FOUR YEARS TREND EXTENDED

SUBSET 0 CORPORATE TOTALS

REPORT 60-1 CONSOLIDATED STATEMENT OF OPERATIONS

| DESCRIPTION | TERM | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|---|
| GROSS INCOME FROM | | | | | | | | | |
| SALES, SERVICE AND RENTALS | M$ | 3573 | 4248 | 5345 | 6889 | 7197 | 8574 | 10215 | 12170 |
| NET EARNINGS BEFORE INCOME TAX | M$ | 960 | 1054 | 1297 | 1864 | 1979 | 2243 | 2673 | 3184 |
| U.S. AND FOREIGN INCOME TAXES | M$ | 483 | 528 | 646 | 993 | 1045 | 1185 | 1411 | 1681 |
| NET EARNINGS | M$ | 477 | 526 | 652 | 871 | 934 | 1059 | 1261 | 1503 |
| PER SHARE | $ | 4.40 | 4.71 | 5.81 | 7.71 | 8.21 | 9.27 | 10.92 | 12.80 |
| CASH DIVIDENDS | M$ | 211 | 231 | 243 | 293 | 408 | 411 | 416 | 422 |
| PER SHARE | $ | 1.95 | 2.10 | 2.17 | 2.60 | 3.60 | 3.60 | 3.60 | 3.60 |
| STOCK DIVIDEND AND SPLITS | | | | | | | | | |
| PERCENT | % | | 50.0 | 2.5 | 100.0 | | | | |
| SHARES ISSUED | 000 | | 17646 | 1364 | 56230 | | | | |
| SHARES SOLD | 000 | 177 | 1577 | 302 | 624 | 750 | 1076 | 1544 | 2217 |
| | | | | | | | | | |
| AT END OF YEAR: | | | | | | | | | |
| NUMBER OF SHARES OUTSTANDING | 000 | 35225 | 54448 | 56114 | 112968 | 113718 | 114794 | 116338 | 118555 |
| NET INVESTMENT IN PLANT, RENTAL | | | | | | | | | |
| MACHINES AND OTHER PROPERTY | M$ | 2304 | 3099 | 3496 | 3415 | 3863 | 5024 | 5985 | 7130 |
| LONG-TERM DEBT | M$ | 399 | 459 | 521 | 545 | 555 | 555 | 555 | 555 |
| WORKING CAPITAL | M$ | 699 | 723 | 916 | 1770 | 1814 | 1892 | 2254 | 2685 |
| NUMBER OF STOCKHOLDERS | 000 | 276 | 328 | 359 | 501 | 549 | 653 | 776 | 922 |

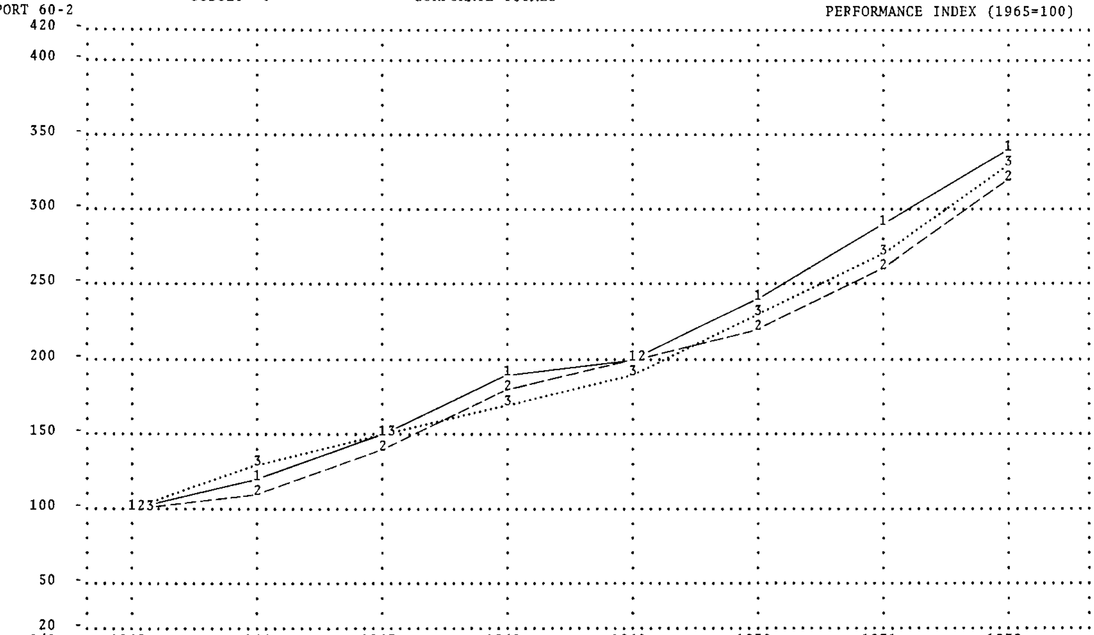
NOTE: ADJUSTED FOR STOCK DIVIDEND AND SPLITS

***** END OF PUBLISHED REPORT FORMAT *****

| ADDITIONAL ANALYTICAL DATA: | TERM | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|---|
| CHANGE IN GROSS INCOME | % | 10.3 | 18.9 | 25.8 | 28.9 | 4.5 | 19.1 | 19.1 | 19.1 |
| PRETAX NET TO GROSS INCOME | % | 26.9 | 24.8 | 24.3 | 27.1 | 27.5 | 26.2 | 26.2 | 26.2 |
| EFFECTIVE TAX RATE | % | 50.3 | 50.1 | 49.8 | 53.3 | 52.8 | 52.8 | 52.8 | 52.8 |
| AFTER TAX NET TO GROSS | % | 13.3 | 12.4 | 12.2 | 12.7 | 13.0 | 12.3 | 12.3 | 12.3 |
| DIVIDEND PAYOUT | % | 44.2 | 43.8 | 37.3 | 33.6 | 43.7 | 38.8 | 33.0 | 28.1 |
| | | | | | | | | | |
| OPERATING INVESTMENT | M$ | 3002 | 3822 | 4413 | 5185 | 5678 | 6915 | 8239 | 9815 |
| OPERATING EQUITY | M$ | 2603 | 3363 | 3891 | 4640 | 5123 | 6361 | 7684 | 9260 |
| FIXED TO TOTAL INVESTMENT | % | 76.7 | 81.1 | 79.2 | 65.9 | 68.0 | 72.6 | 72.6 | 72.6 |
| DEBT TO TOTAL INVESTMENT | % | 13.3 | 12.0 | 11.8 | 10.5 | 9.8 | 8.0 | 6.7 | 5.7 |
| COST+EXPENSES/INVESTMENT | RATIO | .870 | .836 | .917 | .969 | .919 | .916 | .916 | .916 |
| | | | | | | | | | |
| EQUITY PER SHARE (ADJUSTED) | $ | 24.03 | 30.13 | 34.67 | 41.07 | 45.05 | 55.69 | 66.52 | 78.91 |
| RETURN ON EQUITY | % | 18.3 | 15.6 | 16.7 | 18.8 | 18.2 | 16.6 | 16.4 | 16.2 |

SUBSET 0 CORPORATE TOTALS

REPORT 60-2 PERFORMANCE INDEX (1965=100)




| DESCRIPTION | TERM | REF. | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|---|---|
| GROSS INCOME | M$ | 1 | 3573. | 4248. | 5345. | 6889. | 7197. | 8574. | 10215. | 12170. |
| NET AFTER TAX EARNINGS | M$ | 2 | 477. | 526. | 652. | 871. | 934. | 1059. | 1261. | 1503. |
| OPERATING INVESTMENT | M$ | 3 | 3002. | 3822. | 4413. | 5185. | 5678. | 6915. | 8239. | 9815. |

PLANNING SYSTEMS GENERATOR II ** VALUES FOR YEARS 1970 TO 1972 PROJECTED, NOT ACTUAL ** JAN. 1970

**Figure 7 Alternative projection based on different input assumptions**

IBM PLANNING DATA SYSTEM VIEW 2 — 1972 GROSS AND NET GOALS GIVEN

SUBSET 0 — CORPORATE TOTALS

REPORT 60-1 — CONSOLIDATED STATEMENT OF OPERATIONS

| DESCRIPTION | TERM | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|---|
| GROSS INCOME FROM | | | | | | | | | |
| SALES, SERVICE AND RENTALS | M$ | 3573 | 4248 | 5345 | 6889 | 7197 | 8031 | 8962 | 10000 |
| NET EARNINGS BEFORE INCOME TAX | M$ | 960 | 1054 | 1297 | 1864 | 1979 | 2139 | 2313 | 2500 |
| U.S. AND FOREIGN INCOME TAXES | M$ | 483 | 528 | 646 | 993 | 1045 | 1130 | 1221 | 1320 |
| NET EARNINGS | M$ | 477 | 526 | 652 | 871 | 934 | 1010 | 1091 | 1180 |
| PER SHARE | $ | 4.40 | 4.71 | 5.81 | 7.71 | 8.21 | 8.84 | 9.45 | 10.05 |
| CASH DIVIDENDS | M$ | 211 | 231 | 243 | 293 | 408 | 457 | 578 | 704 |
| PER SHARE | $ | 1.95 | 2.10 | 2.17 | 2.60 | 3.60 | 4.00 | 5.00 | 6.00 |
| STOCK DIVIDEND AND SPLITS | | | | | | | | | |
| PERCENT | % | | 50.0 | 2.5 | 100.0 | | | | |
| SHARES ISSUED | 000 | | 17646 | 1364 | 56230 | | | | |
| SHARES SOLD | 000 | 177 | 1577 | 302 | 624 | 750 | 1076 | 1544 | 2217 |
| AT END OF YEAR: | | | | | | | | | |
| NUMBER OF SHARES OUTSTANDING | 000 | 35225 | 54448 | 56114 | 112968 | 113718 | 114794 | 116338 | 118555 |
| NET INVESTMENT IN PLANT, RENTAL | | | | | | | | | |
| MACHINES AND OTHER PROPERTY | M$ | 2304 | 3099 | 3496 | 3415 | 3863 | 4675 | 5276 | 5951 |
| LONG-TERM DEBT | M$ | 399 | 459 | 521 | 545 | 555 | 555 | 555 | 555 |
| WORKING CAPITAL | M$ | 699 | 723 | 916 | 1770 | 1814 | 1760 | 1987 | 2241 |
| NUMBER OF STOCKHOLDERS | 000 | 276 | 328 | 359 | 501 | 549 | 653 | 776 | 922 |

NOTE: ADJUSTED FOR STOCK DIVIDEND AND SPLITS

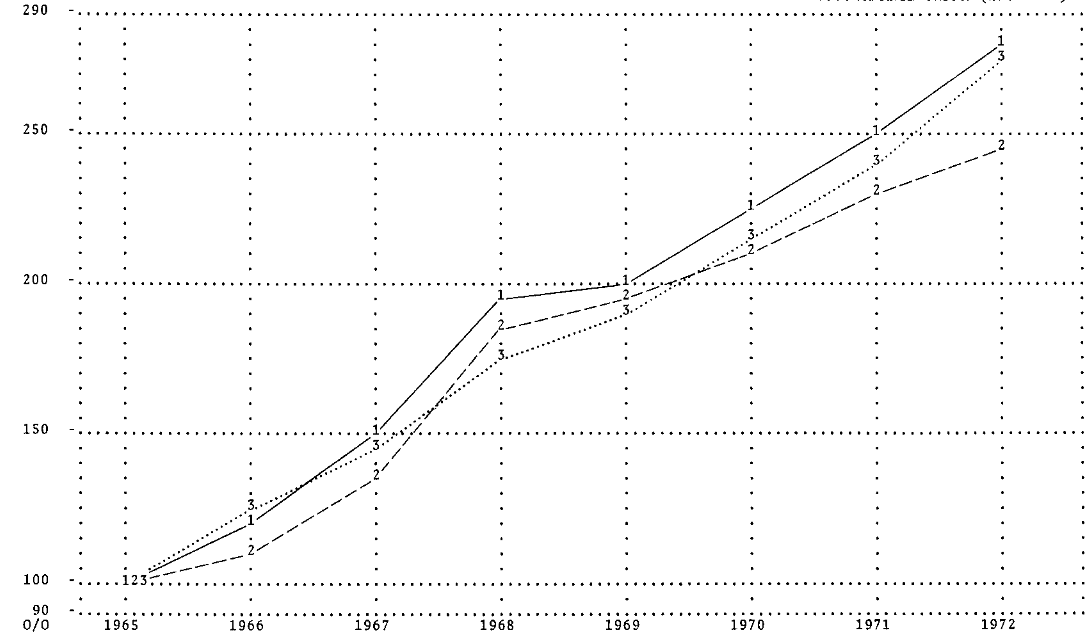
***** END OF PUBLISHED REPORT FORMAT *****

ADDITIONAL ANALYTICAL DATA:

| DESCRIPTION | TERM | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|---|
| CHANGE IN GROSS INCOME | % | 10.3 | 18.9 | 25.8 | 28.9 | 4.5 | 11.6 | 11.6 | 11.6 |
| PRETAX NET TO GROSS INCOME | % | 26.9 | 24.8 | 24.3 | 27.1 | 27.5 | 26.6 | 25.8 | 25.0 |
| EFFECTIVE TAX RATE | % | 50.3 | 50.1 | 49.8 | 53.3 | 52.8 | 52.8 | 52.8 | 52.8 |
| AFTER TAX NET TO GROSS | % | 13.3 | 12.4 | 12.2 | 12.7 | 13.0 | 12.6 | 12.2 | 11.8 |
| DIVIDEND PAYOUT | % | 44.2 | 43.8 | 37.3 | 33.6 | 43.7 | 45.3 | 52.9 | 59.7 |
| OPERATING INVESTMENT | M$ | 3002 | 3822 | 4413 | 5185 | 5678 | 6436 | 7263 | 8192 |
| OPERATING EQUITY | M$ | 2603 | 3363 | 3891 | 4640 | 5123 | 5881 | 6708 | 7637 |
| FIXED TO TOTAL INVESTMENT | % | 76.7 | 81.1 | 79.2 | 65.9 | 68.0 | 72.6 | 72.6 | 72.6 |
| DEBT TO TOTAL INVESTMENT | % | 13.3 | 12.0 | 11.8 | 10.5 | 9.8 | 8.6 | 7.6 | 6.8 |
| COST+EXPENSES/INVESTMENT | RATIO | .870 | .836 | .917 | .969 | .919 | .916 | .916 | .916 |
| EQUITY PER SHARE (ADJUSTED) | $ | 24.03 | 30.13 | 34.67 | 41.07 | 45.05 | 51.49 | 58.07 | 65.08 |
| RETURN ON EQUITY | % | 18.3 | 15.6 | 16.7 | 18.8 | 18.2 | 17.2 | 16.3 | 15.4 |

SUBSET 0 — CORPORATE TOTALS

REPORT 60-2 — PERFORMANCE INDEX (1965=100)




| DESCRIPTION | TERM | REF. | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|---|---|
| GROSS INCOME | M$ | 1 | 3573. | 4248. | 5345. | 6889. | 7197. | 8031. | 8962. | 10000. |
| NET AFTER TAX EARNINGS | M$ | 2 | 477. | 526. | 652. | 871. | 934. | 1010. | 1091. | 1180. |
| OPERATING INVESTMENT | M$ | 3 | 3002. | 3822. | 4413. | 5185. | 5678. | 6436. | 7263. | 8192. |

PLANNING SYSTEMS GENERATOR II — ** VALUES FOR YEARS 1970 TO 1972 PROJECTED, NOT ACTUAL ** — JAN. 1970

Such a consolidated statement of operations, representing a summary of summaries, ordinarily is not used directly for the purpose of developing plans. In an actual planning-data system, each of the input lines in this statement usually would be transferred from other modules which prepared the respective analysis and projection in much more detail, perhaps by division and within division by product line.

## Concluding remarks

Planning and planning data can be categorized, according to managerial objectives, as operational, tactical, and strategic. The use of a computer to process planning data can be aided by the use of a planning systems generator such as PSG II, a programmed discipline that allows the business and/or financial planner to specify a data bank and enter data values, to set up rules for additional data generation, and to format statistical or graphical reports containing planning data. The resulting system is a planning-data system that is ready to assist the subjective, decision-oriented environment of a company's planning unit.


CITED REFERENCES

1. M. C. Branch, *The Corporate Planning Process*, American Management Association, Inc., New York, New York (1962).
2. H. W. Henry, *Long- Range Planning Practices in 45 Industrial Companies*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (1967).
3. H. F. Lande, *How to use the computer in business planning*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (1969).
4. N. W. Chamberlain, *Private and Public Planning*, McGraw-Hill, Inc., New York, New York (1965).
5. G. A. Steiner, *Top Management Planning*, The Macmillan Company, New York, New York (1969).
6. D. W. Ewing, *Long-Range Planning for Management*, Harper and Brothers, New York, New York (1964).
7. R. N. Anthony, *Planning and Control Systems*, Harvard University Press, Boston, Massachusetts (1965).
8. *Planning Systems Generator II General Information Manual*, Form No. GH20-1035, IBM Corporation, Data Processing Division, White Plains, New York.
9. *Planning Systems Generator II Program Reference Manual (System/360 and System/370 DOS)*, Form No. SH20-1174 IBM Corporation, Data Processing Division, White Plains, New York.
10. *Planning Systems Generator II (PSG II) Program Reference Manual (System/360 and System/370 OS)*, Form No. SH20-1042, IBM Corporation, Data Processing Division, White Plains, New York.
11. *IBM Annual Report 1972*, IBM Corporation, Armonk, New York.

GENERAL REFERENCES

N. W. Chamberlain, *The Firm: Micro-economic Planning and Action*, McGraw-Hill, Inc., New York, New York (1962).

P. P. LeBreton and D. A. Henning, *Planning Theory*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (1961).

B. W. Scott, *Long-Range Planning in American Industry*, American Management Association, Inc., New York, New York (1965).

E. W. Walker and W. H. Baughn, *Financial Planning and Policy*, Harper and Row, New York, New York (1961).

E. K. Warren, *Long-Range Planning: The Executive Viewpoint*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (1966).