GRAPHIC MIS - THE MISSING LINK TO EFFECTIVE MANAGEMENT

THE PROBLEM, A SOLUTION AND A TUTORIAL

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ABSTRACT

A major contributing factor to reduced productivity is in the form, age and content of management operations performance and status information necessary for to head off catasrophies. To correct this situation, a synergism of many disciplines is required: Computer science, database design, graphics, charting, statistical analysis, cybernetics, behavioural psychology, epistemology, education, information theory and management in both systems and analytical approaches. "Performance and Status Charts (P&SC) Graphic MIS," is the result of such a synergism. PS&C is a balance of alpha-numeric and graphic information to meet the requirements of both right and left brain capabilities and of the systems and analytical approaches to management. It restores an overview both to single or multi-level management, with the capability to track to the source, at any level, developing catastrophes in time for correction. It allows management to decide for itself what is important and what is not in less time than it is currently spending trying to assimilate inadequate operations management information. Graphic MIS can be a major factor in turning any company or economy around simply by getting timely information to management at all levels.

THE MANAGEMENT PROBLEM

Reduced overall productivity is a general U.S. malady. One major contributing factor is the lack of an effective technique for a timely operations overview. This has not only become an increasing problem as companies and government agencies became larger, more complex and spread out geographically, but ironically enough, also partly due to the uses we have put the computer to.

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Another way of saying this is that we have no management techniques nor computer software tools for an effective day to day systems approach to management.

Management is lacking an early warning system to locate and handle problem areas before they become departmental, divisional or corporate catastrphes in the private sector, or alternatively, national or agency-wide catastrphes in the public sector.

We don't sufficiently know what is going on in our organizations to effectively manage them for profit or for efficient, cost effective service.

If we don't know what is going on in our own organizations to manage productively and profitably - who is to blame? Well, it seems our educational institutions are turning out too many specialists on the one hand and the generalists without the necessary specific skills on the other.

DOES THE PROBLEM REALLY EXIST?

First of all, is it really true that management, both in the private and public sector, lost the overview of its operations? Isn't management in control now? Doesn't management have timely data to manage by?

The specific question that has to be honestly answered is: "Does management generally know what is going on in its organization, in all its different divisions, departments, sections on such a timely basis that no catastrophe can occur? If the answer to this question is anything but a resounding "YES", for the Fortune 500 down to businesses with not more than ten employees, from the largest government bureau to the smallest local agency, then there is a problem which is at least costing every one of us a reduced standard of living.

The solution to the problem could be the proverbial bootstrap which could reverse

the national recession by increasing management productivity and thereby production productivity, profits and production itself. Broadly applied, it could increase the standard of living, reduce the national debt, interest rates, government spending, and the unemployment rate.

The extent to which large organizations are run without proper, timely operating data should be frightening. Business, industry and government are in many ways running like the Titanic. But the Titanic's fate is not necessary for today's business and governmental organizations. We have the technologies, we simply have not put them together and used them.

With a synergism of the technologies of the computer, relational DBMIS, graphics, charting, cybernetics, behavioural psychology, epistemology, education, management and information theory used for the timely transfer of operating data to the executive, the manager, the man at the helm of whatever kind of organization it is he runs - this country could again be the leader in productivity, profitability and an expanding economy.

Graphic MIS restoring a timely overview and control to management may well be the prime key.

The criterion is this: If the overview that does exist does not pinpoint troublesome areas in such a manner that timely corrective action can be taken, then that overview is not really an overview, but a summary or generalization - but not an overview.

A true overview affords the location of areas needing closer attention and corrective action. A summary or generalization does not locate such areas - and so management does not have the necesary data for the corrective actions which are a major part of the management function.

To wait for the monthly profit and loss statement at the end of the month - or perhaps weeks after the end of the month - is not a timely overview - but a statement that the organization has been playing Russian Roulette and managing by the seat of its pants.

Many a company has gone bankrupt before realizing it was losing money because it was using its financial statements instead of a timely overview to operate by.

"Timely" in this context means that the flow of information is fast enough that corrective action can be taken so that no major catastrophe can occur.

The flow of information has to reach management in a form that management can understand in order to have a timely reaction that no catastrophe can occur.

Don't we have an adequate system with modern DBMIS, report generators, report summaries and computer graphics?

Lets start with computer graphics. Outside of special purpose demographic maps, "Computer Graphics" for business generally means the computer assisted drawing of the same old line graphs, bar and pie charts for a handful of variables, which have been around for ages. The only advantage to the manager is that he might get them a bit faster. It is the art department that is assisted with computer graphics.

Next, lets look at the case of an organization that has an elaborate DBMIS that is collecting data from all its different sections, not only from production, but financial, such as cash flow, sales activities, engineering progress, inventory control, etc. In other words, the ideal operation that really knows what is going on and has collected this data in a computerized database. This data may be presented in the form of rows and columns of figures, which then is analyzed by a data analyst who writes reports and summaries and who may graph some items that management may have requested or that he thinks might be of interest. A report generator might even be used.

The information which is reported might be only the most negative and the most positive, according to such philosophies as "Management by Exception."

A report that only indicates emergencies or wild successes, does not provide an overview, the whole picture of what is going on in the operation. It does not give the telltale clues of what preceeded a catastrophe in area "X" as a result of what happened in area "Y" and "Z" which were not directly reported, as in themselves taken individually they were not catastrophic enough to be reported.

A written report that tries to cover all bases becomes so long that it is not read. If it is summarized it becomes a generalization that does not point out the areas that need management attention. Neither reports nor report summaries provide an operating overview anymore than a written report or summary to the captain of a ship tells him in time what lies dead ahead in coastal waters.

So, if reports are not adequate to give an overview of what is going on, what about the computer print outs of rows and columns of figures - the stacks of them which we

have all seen gathering dust. These are generally used after a catastrophe has occured. Eventually one number out of thousands of numbers is pointed to and some hapless manager is confronted with "See, it was all here three months ago - you should have taken action then". Again, this is no means of locating areas needing immediate management attention - but only of fixing blame after catastophes have occured.

HOW THE MANAGEMENT OVERVIEW GOT LOST

Has there ever been a situation, pre-computer, where man had an overview of his organized efforts?

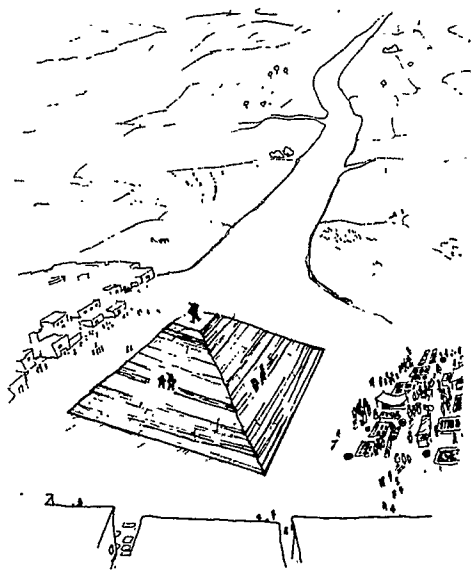


Figure 1 Example of "Primitive" Management Information System: OVERVIEW & PHYSICAL CLOSE-UP INSPECTION

Figure 1 is an example of an early management information system (MIS). In "primitive" cultures, such as found in various parts of Latin America, pyramid structures, close to the market square and overlooking the agrarian society were used to gain literally an over view of what was going on. When something did not look right, a party was sent down to the suspicious area for handling or inspection.

In Europe and Asia towers and castles served a similar prupose. Even in the colonial south, the plantation overseer on a Tennessee walking horse had both the overview and the capability of rapidly getting to any area needing attention.

Figure 2 shows a more modern society MIS, with rooms plastered with graphs, which were periodically updated manually. A very astute businessman might look at the picture these graphs make as a whole and

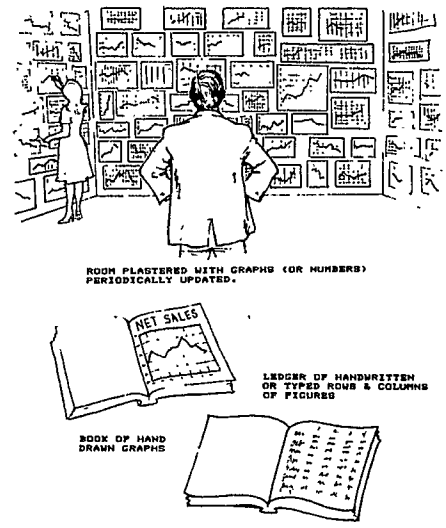


Figure 2 20th Century Manual Management Information System: OVERVIEW & CLOSE-UP INSPECTION OF MANY POSTED GRAPHS + Reports & Tables of Data

with close up investigation of those areas where a graph was going too horizontal or down.

When the computer was used to start drawing these graphs, Figure 3, it no longer was practical to put a whole lot of graphs up on the wall, as they would all have to be taken down for an update. Graphs then were used more selectiviely at a board meeting or to make a point in a report, or they might be availalbe at a computer terminal if the manager happens to know how to call up the data and make the computer plot it.

The overview and the ability to zoom in on areas that are not going right got lost with the advent of the computer and computer graphics. The result is seen in

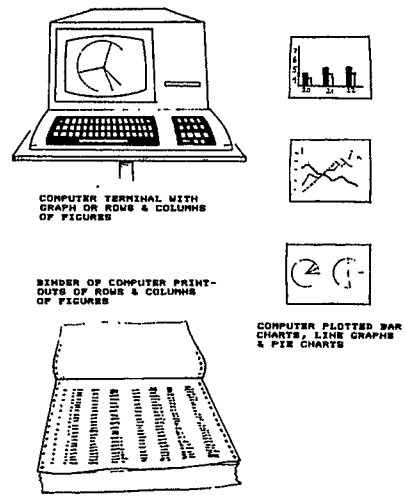


Figure 3 Late 20th Century Computerized Management Information System: NO OVERVIEW & CLOSE-UP INSPECTION

Figure 4, lowered management productivity. There are endless reports to read. There are stacks of computer print-outs gathering dust in the corner or neatly filed somehwere. There are report summaries which give an idea of what is going on but little clue to an effective managemet course of action.

The closest thing to an overview today is the annual, quarterly or monthly financial statement, which in most well run companies today, are either weeks or months late. They also do not contain all the information necessary for management intervention to prevent catastrphes or to alter the course of the operation.

Figure 4 RESULT of Computerized MIS: LOWERED MANAGEMENT PRODUCTIVITY

INFORMATION VERSUS LEFT AND RIGHT BRAIN

If we have a closer look at the actual interface between the data contained in the computer and the manager who has to utilize the data to set an optimum course, we find an attempt of fitting round pegs in square holes.

Since reports and report summaries are the chief vehicle of transmitting the overview, the overview has to be received in the analytical left brained mode from reading - a linear function, instead of in the parallel graphic mode, where many things can be grasped simultaneously.

The detail analysis, on the other hand, may be presented in "Computer graphics", that is, in line graphs, bar charts or pie charts for the visual analysis of three or four variables.

Where the graphics are really needed, in the overview, they are lacking. Where they are helpful in the analysis of a handful of variables, they are available. Computer graphics therefore also is not the answer to providing management a timely overview of its operations.

HOW GRAPHIC MIS CAN BE THE SOLUTION

If the problem is an inadequate management overview and subsequent inadequate operations control, how is a graphic MIS the solution?

Graphic MIS is the solution as it affords a method of organizing and presenting data into a human assimiable format all the way from a systems overview down to any specific area pinpointed for a detail analysis.

Another way of saying this is "Graphic MIS makes it possible to present large volumes of periodic numeric information in a format fully utilizing the human right brain and left brain cognitative capabilities."

Or "Graphic MIS makes it possible to present an overview of operating or status data with the capability of inspection, in gradients of detail, any area covered by the overview."

Or "Graphic MIS is to the systems approach what computer graphics are to the analytical approach."

Or "Graphic MIS handles a large number of variables where graphs show only one to five variables."

The computer generated, modern graphic, relational DBMIS can and should be the modern day tapestry of daily and historic events.

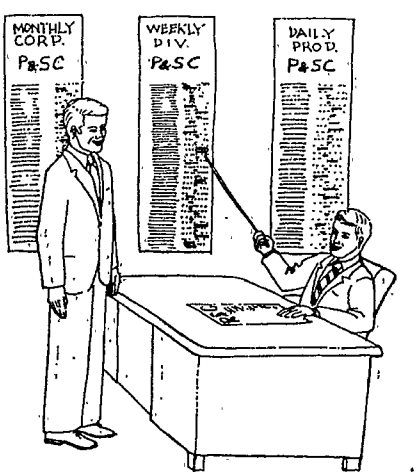


Figure 5 P&SC GRAPHIC MIS RESTORES MANAGEMENT OVERVIEW & COMMUNICATES OPERATIONS DATA

It can be looked at from close up and afar, telling its story in graphic and alpha-numeric detail including clear descriptive written headings and actual legible numbers.

It is easy to learn to read and use.

One has to be able to simultaneously look at many variables and see what they are doing at a given time interval, be it a month, week, day or shift.

Figure 5 shows how a graphic MIS might be used not only as an information assimilation device, but also for communicating operating data.

APPLICATIONS FOR A GRAPHIC MIS

The following large volume numeric data applications would commumicate information better in the format of a graphic MIS:

1. Corporate statements.

2. Divisional, departmental, section operating data.

3. Economic indicators.

4. Periodic industry statistics

5. Investment portfolios.

6. Tracking an economy vs. an econometric model.

7. Comparing statements and ratios of two similar companies.

8. Tracking performance in conjunction with Management by Objectives.

9. Implementing the systems approach to management.

REQUIREMENTS FOR A GRAPHIC MIS

TO RESTORE THE MANAGEMENT OVERVIEW

Data has to be presented graphically in such a manner that the parallel, graphic spacial capabilities of the mind are utilized, otherwise there is no overview. It is best to have the graphic MIS lay in full view on the desk, or wall or be projected on a screen, though several 8 1/2" x 11" pages are also effective.

You have to be able to look at the graphic MIS and observe from the graphics what is in a favorable or unfavorable range. Then you want to know how favorable or unfavorable a variable is compared to its own past performance.

You want to be able to look at each variable, say in a department, and compare it to all the other variables in that department for that time interval. You further need to know whether there is just an acute drop in a statistic, or whether this is part of an overall trend which needs more drastic corrective action.

You also need to know how does this compare to a similar period, say, a year ago. You would like to have a projection into the future i.e., if things keep going the way they are, what is it going to be next week, so a double exponential smoothed curve projection would be in order for the short term projection. The trend generally would give a long term direction. There are also other weighted techniques.

On any one chart, you would like to compare items of comparable importance. You would not want the gross corporate profit and the number of hot dogs sold in the canteen on the same chart. This is information of a different order of magnitude. Nonetheless, it may be of importance to keep track of how many hot dogs are sold in the canteen, so what we do is have a graphic MIS chart for the canteen, and we have one for each section and each department and each division on up to the corporate level.

Not only does the corporate level want to know that something has gotten into the unfavorable range, but what is causing it. The happenings down in a small section are pertinent to what is happening on the corporate level.

For example, nothing is getting shipped of a particular item, because last week all the packaging machines for that item broke down and have not yet been fixed. So, the number of units packaged could be a vital piece of information. The capability should be there to track down an unfavorable statistic on the corporate level, all the way down through the divisional, departmental and sectional levels to the actual cause of no shipments. How is this accomplished?

The graphics MIS should generate certain indeces for each chart. It should generate a performance, a stability and a trends index for each section, department or division. These indexes can then be projected on the next higher level chart, i.e. the department indexes would be reported on the division charts.

If a division has four departments, it would have the indexes of these four departments charted on the divisional graphic MIS chart. And so on up through the corporate chart. In this way, not only does management have the overview, but the control all the way down the line, which tells it where and how something has gone wrong.

What we have now covered, by analogy, is to say that a jet airliner should be fully instrumented, and that the instruments should be there for the crew (executives and managers) to see directly. You would not want to fly an airliner that has no instruments directly available to the crew. The crew should not have to ask someone for a report on what the instruments tell - verbally or in writing.

Unfortunately, companies and government agencies are still run without an integrated instrument panel. If it is both desireable and feasible to have a graphic MIS corporate instrument panel, using computer, statistical, database, and graphic techniques available today, what kind of numbers should be on this graphic MIS?

There should be no operation or function that, if dropped out, could cause a catastrophe at any level that is not monitored either by a direct measure or indirect measure.

This means there could be a production number, or a ratio, such as output over input, which would give you productivity, or it could be a more complex equation, used to determine whether a certain activity, product or quantity is in the right proportion to other activities, products or quantities. For instance, an inventory index could be a function of sales, orders booked and time factors for delivery of raw materials, manufacture and cash flow.

On a broad basis, there are three catagories, each beginning with the letter "P", which should be monitored for each area, namely, 1) actual production, 2) productivity, and 3) profit oriented figures, such as ROI for that area. These three "P's" are interrelated and vital to the survival and prosperity of the section, department, division and the whole organization.

By giving the executive the capability of having an overview of his operation that he can take in at a glance, with the ability to zoom in on those areas which are causing a lessening of production, productivity or profit, you are giving the manager a vital tool for the control of his area of responsibility. In other words, you are giving him the possibility of his performing his job, the way it should be, not by the seat of his pants, but by timely, pertinent information in a quickly assimiable form that he can act on.

A TUTORIAL:

Before looking at some actual graphic MIS charts, let us look at a more or less conventional graph with its trend line, and see how the information in it can be graphically condensed to tell the same story. The graphic condensation will become the building block of the graphic MIS chart.

Figure 6 is a graph of "Crude Oil Refinery Runs" for a year with a compacted graphic MIS element at the bottom.

The time axis in the graph runs from top to bottom, instead of from left to right as we learned in school for manually produced graphs. The reason for this is that the criteria is not what is easiest for a right handed person to draw, but how can a computer printer plot a graph best covering any time span while maintaining legible time and numeric values for each point. With the time axis in the direction of the paper feed, the graph can be as long as necessary. It is not limited by the width of the page. (For the example in this paper, the length of the graph was limited to the length of the page.)

If desired, the graph can be turned on its side for viewing with the time axis running from left to right.

There is another reason for plotting with the time axis running from top to bottom, and that is for the construction of the graphic condensation of the graph which will become an element of the graphic MIS chart. Such a graphic condensation can be seen at the bottom of the graph in Figure 6.

The graph and the graphic condensation both have three zones, running top to bottom. The first zone, on the left, in the graph contains the actual values and time of the points plotted, and for the condensation, the description of what the graphic element is about.

The second zone goes from the "0" of the Range Scale to "M", the mean value of the data on the graph. This we shall call the "Unfavorable Range", as, from the systems point of view, the points falling bellow the mean are lowering the production, productivity and profit as the case may be.

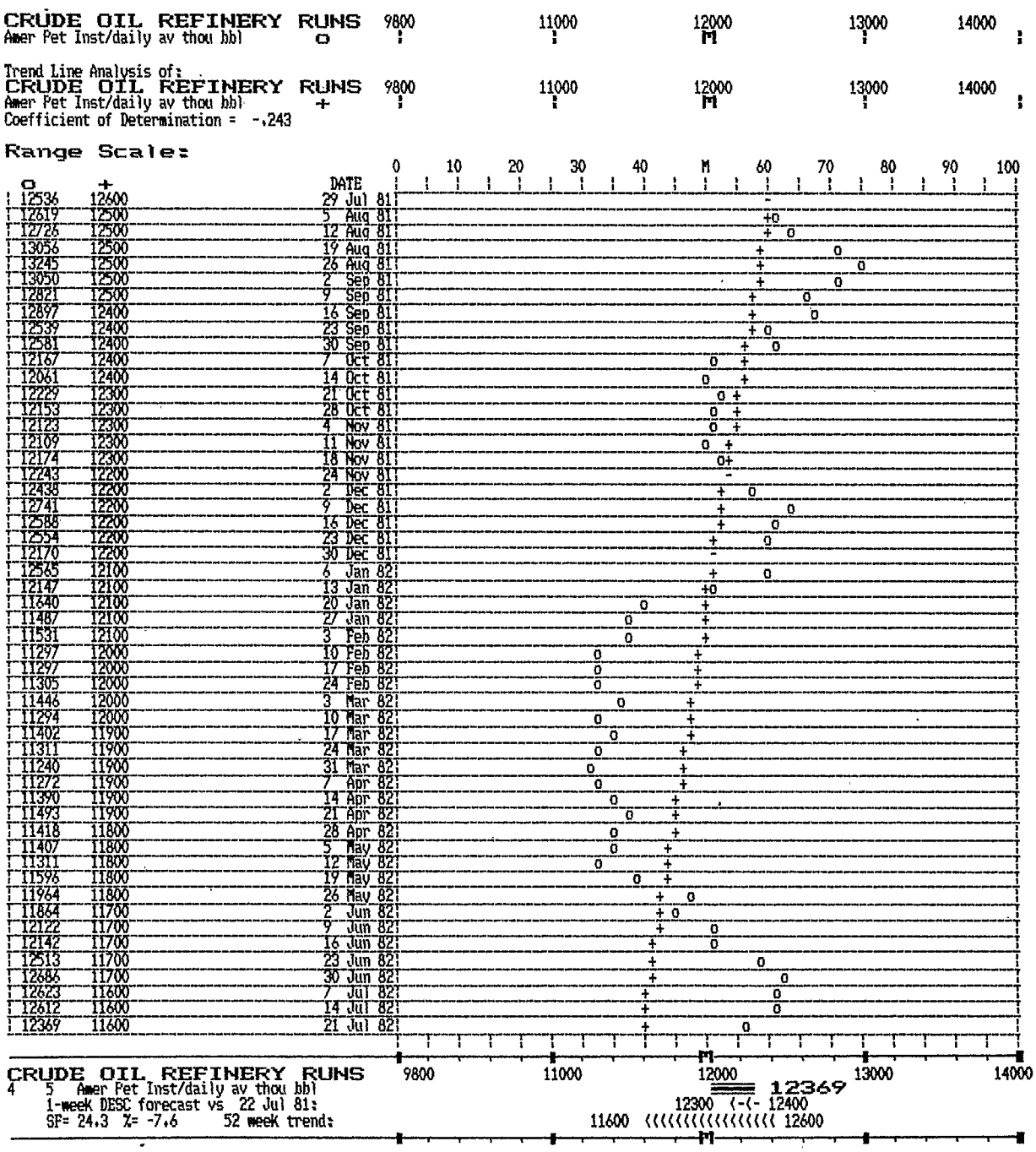
The third zone is from "M" (mean), to the right side of the page. This we will call the favorable zone. If all points were to fall in this area, there would be a continuing improvement or expansion.

The scales for both the graph and the condensation, or element, are the same. The actual value at the bottom of the graph for the last point is "12369", as it is on the bar going from the "M" or mean to the

Figure 6

Selected Graphs from 29 Jul 81 to 21 Jul 82:

DATABASE - U.S. ECONOMIC INDICATORS FROM 'BUSINESS WEEK'



right on the condensed graphic element. The bar not only shows what the value is, but the extent of the deviation from the mean for Crude Oil Refinery runs in the U.S. for the week ending 21 July 1982.

From the systems point of view, that the value for the week was statistically slightly higher than the mean for the year in this case, is of as great significance as the value itself.

The trend line at the top of the graph goes from "12600" to "11600" at the bottom. A falling trend. This is of significance, and is shown on the element on the bottom as "<<<<<<<<<<", showing both the direction of the trend and the starting and finishing

values of the trend. Comparing the weekly value of "12369" to the trend value of "11600" tells us that the current value is above the mean as well as above the declining trend. If the values from here on out were to be in the favorable zone, the declining trend would eventually reverse.

The question in such a situation that normally comes up is: "Is this a seasonal fluctuation in the statistic?" To answer this question, there is on the bottom of the element another graphic representation, "<-<-<-<-<". The tail end of the arrows has the number "12400". This is the rounded value of this statistic a year ago, or actually 53 weeks ago, to get it the closest to the same week a year ago. Everything else on the graph is based on 52 weeks, so this figure, to show the seasonal effect, is one time frame earlier than is shown on the graph.

We see that the current value is about the same that it was a year ago, so it might well be a seasonal fluctuation. Since the trend line is declining 7.6%, if there were no other more dire matters requiring our attention on the graphic MIS, we could request a five year graph with trend plot to see if we are indeed just witnessing a seasonal fluctuation.

One other bit of information we can project from the graph is that if nothing much is done to change the condition that the statistic measures, it will probably go down slightly next week. To show this on the graphic MIS element, a double exponential smoothed curve projection is done and plotted on the head end of "<-<-," which shows that next week is projected to be betwen the current value and the mean for the year.

So, we have graphically and alpha-numerically condensed all the vital information of a graph taking up a whole page to about 3/4 of an inch.

There is one other bit of information which we might want on the condensed graphic element, and that is an idea of the scatter of the points. This is given numerically on the bottom left of the element as "SF = 24.3". "SF" stands for "Stability Factor", on a range of 0 to 100. "0" would mean a very unstable graph, i.e. a cloudlike scattering of points, while "100" would mean that all the points fall exactly on the trend line. The Stability Factor tells us exactly what the name implies, how stable that statistic is from one time interval to the next.

Figure 7 is a graphic MIS chart of some national economic indicators. Here we have put a series of these graphic elements together, to form a graphic MIS chart, which in this case, gives us an overview of some of the weekly national economic indicators you may be familiar with from the rows and columns of figures reported in "Business Week." (This has been shortened to one page in this paper due to space limitations. It can be as many pages long as desired.)

We see quite different types of items on this graphic MIS chart. There are production figures for the week, such as for the first six items. There are prices, as for the next fiveitems, and a status figures, "Free Reserves".

The graphic MIS does all the figuring and presents all the data in context to the variables own past and in relationship to all the other variables for the same week. It shows which are in the favorable range - i.e. doing better than the average for the year - and which are doing worse.

There is one value judgemet that has to be done, though, for each variable, and that is: "Is it better for the whole (that this variable is a part of), if this variable increases or decreases?" In the case of the prime commercial paper rate, for instance, there would probably be no argument that it is not good for it to go up. So the scale for this variable is reversed. When the rate goes up, the bar goes into the unfavorable zone; and when it goes down, it goes into the favorable zone.

There are other variables which can be more controversial as to whether they should have normal or reversed scales. One such variable is "Inventory" (not on any of these charts). Depending on whether it is too large or too small, it ccould be desirable that it should be decreasing or increasing. In such a case, there might be a normal scale for a status or size of the inventory, and one or more other variables showing how desirable the level of inventory is, such as a deviation from an ideal inventory, or a ratio or function relating inventory to those factors determinig what the size of inventory should be.

The last three variables on the graphic MIS chants are the "Performance", "Stability" and "Trends" Indexes. These are a summary of what all the variables on the graphic MIS chart are doing.

The Performance Index measures what percent of the variables are above their own mean values. The Stability Index, how wildly the variables for the week are scattered about; The highest stability would be when a straight line could be drawn from top to bottom through all the current values. The Trends Index shows what percentage of the trends are rising.

Figure 7 — SELECTED UNITED STATES ECONOMIC INDICATORS — 21 Jul 82

P&SC: — from data reported in 'Business Week'

With Moving Averages, Double Exponential Smoothed Curve (DESC) Forecast and 52-week Trend Plot 29 Jul 81 to 21 Jul 82

Number of items on Performance & Status Chart = 12; Time Interval used: week; No. after item = data reported approx No. weeks late
Number of weeks used to compute scale points, moving scale average or mean 'M' and trend = 52
Each item value for 21 Jul 82 is charted as a favorable ' ═══ ' or unfavorable '■■■■■■■■' deviation from 'M'
Double Exponential Smoothed Curve (DESC) projection: 'L)-)-)-) F' or 'F (-(-(-(L' where 'L' is the actual value for 22 Jul 81
'F' is the value forecast for 1 week after 21 Jul 82. Trend of items for 52 weeks from 29 Jul 81 to 21 Jul 82 charted
as 'A)))))))))) B' = Trend moving in a favorable direction or 'B ((((((((((A' = Trend moving in an unfavorable direction
where 'A' = starting value of trend and 'B' = ending value of trend.
SF = Stability Factor of item from 29 Jul 81 to 21 Jul 82; Range is from 0 (no stability) to 100 (total stability).
% = Percent increase or decrease (-) for last 52 weeks from Trend analysis from 29 Jul 81 to 21 Jul 82

RANGE SCALE: : - - UNFAVORABLE - - : - - FAVORABLE - - :
-50 -40 -30 -20 -10 0 +10 +20 +30 +40 +50

R A W S T E E L
1 1 Am Iron&Steel Inst/thou net tons
1-week DESC forecast vs 22 Jul 81:
SF= 91.4 %= -45.4 52 week trend:
490 1100 1800 2400 3100
1246
1220 (-(-(-(-(-(-(-(-(-(-(-(-(-(-(-(2320
1260 (((((((((((((((((((((((((((((((((2310

A U T O M O B I L E S
2 2 Ward's Automotive Reports
1-week DESC forecast vs 22 Jul 81:
SF= 4.2 %= 19 52 week trend:
94 50000 100000 150000 200000
94801
85000 (-(-(-(-(-(- 112000
91800))))))) 109000

ELECTRIC POWER
3 4 Edison El Inst/millions KW hours
1-week DESC forecast vs 22 Jul 81:
SF= 10.8 %= -7.6 52 week trend:
32000 38000 44000 50000 56000
48644
50400 (-(-(- 52100
42300 ((((((((((((((45800

CRUDE OIL REFINERY RUNS
4 5 Amer Pet Inst/daily av thou bbl
1-week DESC forecast vs 22 Jul 81:
SF= 24.3 %= -7.6 52 week trend:
9800 11000 12000 13000 14000
12369
12300 (-(- 12400
11600 ((((((((((((((((12600

BITUMINOUS COAL
5 6 Energy Dept/thousands net tons 1
1-week DESC forecast vs 22 Jul 81: 6950
SF= 16.8 %= -18.2 52 week trend:
7100 12000 17000 22000 26000
8733
(-(-(-(-(-(-(-(-(-(-(-(-(-(-(-(- 16700
15100 ((((((((((((((((18400

RAIL FREIGHT TRAFFIC
6 10 Assn Am RRs, billions ton-miles 1
1-week DESC forecast vs 22 Jul 81:
SF= 38.3 %= -22 52 week trend:
8.8 13 17 21 25
11.9
10.8 (-(-(-(-(-(-(-(-(-(-(-(-(-(-(-(17.8
14.6 (((((((((((((((((((((((18.8

G O L D
7 18 Wed Final/London/$ troy ounce
1-week DESC forecast vs 22 Jul 81:
SF= 77.1 %= -28.9 52 week trend:
550 470 380 290 210
366.5
412 -)-)-) 386
443))))))))))))))))))))))))))))))) 315

FINISHED STEEL COMPOSITE
8 13 Iron Age, cents per pound
1-week DESC forecast vs 22 Jul 81:
SF= 40.3 %= 2.6 52 week trend:
26 26 25 25 24
25.297
25.3 (-(-(-(-(-(-(-(-(-(-(-(- 24.5
25.5 ((((((((((((((((((((((24.9

WHEAT/#2 hard/Kansas City
9 16 Grain MarKet Review, bushels
1-week DESC forecast vs 22 Jul 81:
SF= 14.9 %= -5.1 52 week trend:
4.9 4.6 4.2 3.9 3.5
3.74
4.21)-)-)-)-)-)-)-)-)-)-)-)-)-) 3.7
4.33)))))))))))))) 4.11

INDUSTRIAL RAW MATERIALS
10 11 13 Commodities/BLS spot index 1
1-week DESC forecast vs 22 Jul 81:
SF= 96.4 %= -20.2 52 week trend:
330 300 260 230 190
237.1
291)-)-)-)-)-)-)-)-)-)-)-)-)-) 238
290))))))))))))))))))))))))))))))))) 231

PRIME CML PAPER RATE
11 19 dealer, 91-119 days, Fed. Res. 1
1-week DESC forecast vs 22 Jul 81:
SF= 21.8 %= -16.1 52 week trend:
20 17 14 11 7.9
13.69
17.2)-)-)-)-)-)-)-)-)-)-) 13.4
15.4)))))))))))))))) 13

FREE RESERVES/Fed. Res.
12 24 millions $ 1
1-week DESC forecast vs 22 Jul 81:
SF= 1.4 %= 22.7 52 week trend:
-2600 -1700 -730 200 1100
-92
-1160 -)-)-)-)-)-)-)-)-)-) 1.4
-826))))) -639

PERFORMANCE INDEX - BB
13 43
1-week DESC forecast vs 22 Jul 81:
SF= 4.4 %= -10 52 week trend:
21 36 51 67 82
58.3
58.3 -) 59
48.7 ((((((((54.1

STABILITY INDEX - BB
14 44
1-week DESC forecast vs 22 Jul 81:
SF= 8 %= -15.3 52 week trend:
17 35 54 73 91
36.5
33.8 (-(-(-(-(-(-(-(-(-(-(-(59.9
49.5 ((((((((((58.5

TRENDS INDEX - BB
15 45
1-week DESC forecast vs 22 Jul 81:
SF= 3.4 %= -8.7 52 week trend:
21 36 51 66 81
50
41.7 -)-)-)-)-)-) 51
48.8 (((((((53.4

-50 -40 -30 -20 -10 0 +10 +20 +30 +40 +50

When structuring the graphic MIS charts to correspond to the organization chart, these indexes are projected on the next higher echelon graphic MIS chart.

When a closer inspection is called for because of a down "Perfomance Index", of the Accounts Receivalbe Department on the Financial Division graphic MIS chart, the graphic MIS chart of "Accounts Receivable Department" is called for. The down elements on the "Accounts Receivalbe" chart can then be inspected more closely by viewing the corresponding actual graphs the elements are a condensation of.

In this manner, all areas contributing to an overall reduced Performance Index can be pinpointed, no matter how many organizational levels there are.

Figure 8 shows sample headings for a single level graphic MIS chart for a small manufacturing firm. There are a hundred items on this list, covering the main heading from the financial statement to number of service calls, engineering drawings completed and number of schedules met.

Figure 9, shows sample headings for a two level graphic MIS chart. The corporate graphic MIS chart contains the information of immediate interest to the chief executive officers. There are all the indeces of the administrative, sales, finance/purchasing/inventory, engineering, production and quality control & customer service departments. From the indeces of the different divisions, the CEO can immediately spot the divisions whose graphic MIS charts he should look at and what specific graphs he should look at, all the way down the line.

The decision as to what is important and what is not important, again becomes that of the CEO, not someone in the data processing department who is not responsible for the overall operation of the company.

Figure 10 is an example of a graphic MIS chart to track white collar productivity in a quality control division of a software house. There are two types of statistics on this graphic MIS chart:

Production figures in terms of points earned is one. The points are weighted for different types of activities and subproducts produced.

The second type of statistic is a weighted average of all outstanding bugs. This is a negative statistic which measures whether there is a backlog and how urgent it is getting. The Quality Control Division Indeces are projected on the corporate graphic MIS chart.

Since this chart is based on a 26 week moving average, the seasonal factor drops out. There is therefore one less line per element. The functions of the trend line and double exponential smoothed curve projection are combined into an "End Weighted Trend," in which the latest trend point is the average of the 26, 13 and 7 week trends. This gives a pretty good prediction in terms of long, medium and short term trends as to where each statistic is going. There are many variations of the theme possible.

Figure 11 is an example of a graphic, relational DBMIS chart of a small service company.

Many of the statistics charted are derived from several statistics and are automatically computed in the relational DBMIS. One statistic which might be of interest is the tenth one down, "Power Factor". This is a function of production, productivity and net profit. In this week there was a net income of 160. The range of the power factor is designed so that a fractional positive number results when the net dwindles, but is still positive. When the net becomes negative, so does the power factor.

A very handy way of comparing the performance of two similar companies is by putting their financial statements on a graphic MIS and comparing them item for item.

Another use of graphic MIS charts is in conjunction with econometric models, to compare the actual progress of the model subject with the values predicted by the model.

WHAT SIZE COMPUTER IS NEEDED?

No big IBM mainframe is needed, not even a minicomputer. In fact, a large, expensive system is undesirable. The reason for this is that with printed graphics, you immediately become locked in to specific printers. With massive statistical manipulations required, hardware is required which will do such computations fast. With the large amount of numbers that have to be accessed from the databsase, fast input/output times are required. That calls for fast, low cost equipment that can be used as a dedicated turnkey system.

With a complex statistical/graphics software package which needs a relational database designed with special features for fast access and to prevent the database getting filled up and everything crashing in a few years, it does not become practical to adapt the software to the many mainframes and minis with their respective

Figure 8 Example of P&SC Single Level Variables

1 GROSS INCOME
2 NET INCOME
3 GROSS SALES
4 NET SALES
5 CURRENT ASSETS
6 CURRENT LIABILITIES
7 NET WORKING CAPITAL
8 TOTAL OPERATING EXPENSES
9 OPERATING RATIO (8/4)
10 CURRENT RATIO (5/6)
11 CASH
12 MARKETABLE SECURITIES
13 A/C AND NOTES RECEIVABLE
14 QUICK ASSETS RATIO [(11+12+13)/6]
15 LONG TERM DEBT
16 CAPITALIZATION
17 DEBT-TO-EQUITY RATIO (15/16)
18 SHAREHOLDERS' EQUITY
19 PROFITS-WORTH RATIO (2/18)
20 NET PROFIT
21 NET PROFIT TO NET SALES RATIO (2/18)
22 RETURN ON INVESTMENTS (ROI) IN ASSETS (2/23)
23 TOTAL ASSSETS
24 COST OF GOODS SOLD
25 AVERAGE INVENTORY
26 INVENTORY TURNOVER RATIO (24/25)
27 NET PROFITS OVER TANGIBLE NET WORTH [20/(5+41+47)]
28 NET PROFITS OVER NET WORKING CAPITAL [20/(5-6)]
29 NET SALES OVER TANGIBLE NET WORTH [4/(5+41+47)]
30 NET SALES OVER NET WORKING CAPITAL [4/(5-6)]
31 COLLECTION PERIOD - DAYS
32 NET SALES OVER INVENTORY (4/25)
33 FIXED ASSETS OVER TANGIBLE NET WORTH (41/(5+41+47))
34 CURRENT DEBT OVER TANGIBLE NET WORTH (6/49)
35 TOTAL DEBT OVER TANGIBLE NET WORTH ((6+15)/49)
36 INVENTORY OVER NET WORKING CAPITAL (25/(5-6))
37 CURRENT DEBT OVER INVENTORY (6/25)
38 FUNDED DEBTS OVER NET WORKING CAPITAL
39 GROSS INCOME OVER NO. OF EMPLOYEES (1/53)
40 NET PROFIT OVER NO. OF EMPLOYEES (20/53)
41 FIXED ASSETS (42+44+50)
42 LAND
43 PATENTS
44 PLANT
45 CAPITALSTOCK
46 RETAINED EARNINGS
47 LONG TERM INVESTMENTS
48 WORKING CAPITAL (5-6)
49 TANGIBLE NET WORTH (5+41+47)
50 EQUIPMENT
51 ADDITIONS TO PLANT AND EQUIPMENT
52 PAYMENT OF DIVIDENDS
53 NO. OF EMPLOYEES
54 COST OF GOODS SOLD
55 SELLING EXPENSE
56 GENERAL AND ADMINISTRATIVE EXPENSE
57 DEPRECIATION EXPENSE
58 INTEREST EXPESNE
59 TAXES ON INCOME
60 DIVIDENDS PAID
61 INCREASE IN WORKING CAPITAL
62 INVENTORY
63 INCREASE IN GROSS INCOME
64 PAYMENT INTO MANAGEMENT RESERVES
65 A/C RECEIVABLE 0-30 DAYS
66 A/C RECEIVABLE 31-60 DAYS
67 A/C RECEIVABLE 61-90+ DAYS
68 A/C PAYABLE
69 NO. OF SALES
70 CREDIT COLLECTED
71 TOTAL ASSETS
72 NO. OF TROUBLESHOOTING ACTIONS
73 NO. OF SERVICE ACTIONS
74 NO. OF DETAIL DRAWINGS COMPLETED
75 NO. OF LAYOUTS COMPLETED
76 NO. OF ENGINEERING HOURS LOGGED
77 TOTAL NO. OF DRAWINGS COMPLETED
78 DWGS COMPLETED OVER ENG HRS ((74+75)/76)
79 NUMBER OF SCHEDULES MADE
80 NO. OF SCHEDULES MET
81 SCHEDULES MET OVER SCHEDULES MADE (80/79)
82 NO. UNITS MACHINED
83 NO. OF UNITS ASSEMBLED
84 NO. OF UNITS INSPECTED
85 NO. OF REJECTS
86 PERCENT UNITS PASSED FIRST TIME
87 NO. OF PERSONNEL TRAINING HOURS
88 NO. SALES CALLS MADE
89 NO. OF LETTERS TYPED
90 PERCENT SALES CALLS CLOSED
91 NO. OF PROMOTIONAL MAILINGS
92 NO. POTENTIAL CUSTOMERS REACHED BY PR & ADS
93 SALES TO NEW CUST:NEW CUST REACHED (94/92)
94 NO. NEW CUSOMERS SOLD
95 DOLLAR SALES TO NEW CUSTOMERS
96 DOLLAR SALES TO REPEAT CUSOMERS
97 SALES TO NEW CUSTOMERS OVER TOTAL SALES (95/3)
98 SALES TO REPEAT CUSTOMERS OVER TOTAL SALES (96/3)
99 PILFERAGE
100 PERCENT YIELD

operating systems. The conversion, redesign of error trapping, debugging and making user friendly can be easily one to two years of programer time per conversion. It is not like converting an accounting package that can be done in a couple of months.

A sophisticated graphic, statistical, relational database management information system by its very nature, therefore, becomes hardware dependent, which of course is contrary to the current desire, if not the trend, of hardware independence.

It is not contratry to ROI, however. If programer time is available, it should be used for dump programs from the main database to the graphic MIS database.

The North Star computer systems were selected as the hardware for the Performance and Status Chart graphic, relational DBMIS. The origins of these computers were connected to statistical work. Bench mark and practical tests have borne out the desirability of the hardware for the application. North Star Z80 microcomputers with quad floppy discs will hold 500 weekly items for two years. With up to 72 megabytes of hard disc storage available, there is no practical limit to the size of the database.

The North Star computers are excellent at number crunching, with a DOS designed for fast disc access, with the possibility of doing the math in hardware rather than software, and with a compiled high level language available. Add to that an alpha-numeric/graphics printer such as the Anadex 9501, and you have a very adequate, low cost, dedicated turnKey graphic MIS system which can be operative the day it is installed.

The hardware cost can be as low as $6,000 to do the job. Complete turnKey systems are available now starting under $14,000. With Performance and Status Charts being generated in the first few weeks, the system can pay for itself in that time by averting just one catastrophe. The ROI could be the difference between existence and non-existence. Time is of the essence, and that is what a dedicated turnKey system

= CORPORATE =

1 +NET PROFIT
2 +NET SALES
3 +NET PROFIT:NET SALES RATIO (1/2)
4 +CURRENT ASSETS
5 -CURRENT LIABILITIES
6 +WORKING CAPITAL (4-5)
7 +CASH ON HAND
8 +PAYROLL
9 +INVENTORY
10 +INVENTORY TURNOVER RATIO
11 +FIXED ASSETS
12 -LONG TERM DEBT
13 +RETAINED EARNINGS
14 +DIVIDENDS PAID
15 +SHAREHOLDERS EQUITY
16 +ADMINISTRATIVE PERFORMANCE INDEX
17 +ADMINISTRATIVE STABILITY INDEX
18 +SALES PERFORMANCE INDEX
19 +SALES STABILITY INDEX
20 +FINANCE PERFORMANCE INDEX
21 +FINANCE STABILITY INDEX
22 +ENGINEERING PERFORMANCE INDEX
23 +ENGINEERING STABILITY INDEX
24 +PRODUCTION PERFORMANCE INDEX
25 +PRODUCTION STABILITY INDEX
26 +QUAL CONTL/CUST SVC PERF INDEX
27 +QUAL CONTL/CUST SVC STAB INDEX
+CORPORATE PERFORMANCE INDEX
+CORPORATE STABILITY INDEX

= ADMINISTRATIVE =

1 +NET SALES
2 +# EMPLOYEES
3 -OPERATING EXPENSE
4 +NET SALES:#EMPLOYEES RATIO (1/2)
5 -OPERATING RATIO (3/1)
6 +PERSONNEL TRAINING HOURS
7 +# PERSONNEL HIRED
8 +TOTAL MAN HOURS
9 -ACCIDENTS
10 -CASH SHORTAGES
11 -THEFT AND PILFERAGE
12 -# SECURITY INCIDENTS
13 -TOTAL ABSENTEEISM
14 -OVERTIME HOURS
15 -EMPLOYEE DISPUTES
16 +% EMPLOYEES ABOVE AVERAGE PERF.
+ADMINISTRATIVE PERFORMANCE INDEX
+ADMINISTRATIVE STABILITY INDEX

= SALES =

1 +NET SALES
2 +# SALES CALLS MADE
3 +SALES CLOSED:SALES CALLS MADE
4 +% DELIVERIES MADE AS PROMISED
5 +% SALES FORECAST VS. NET SALES
6 +NEW CUSTOMER SALES
7 +REPEAT SALES
8 +ADVERTIZING & PR PRODUCT EXPOSURE
9 +# PROMOTIONAL MAILINGS
10 -# CUSTOMER COMPLAINTS
11 -SELLING EXPENSE
12 +NET PROFIT OVER NET SALES
+SALES PERFORMANCE INDEX
+SALES STABILITY INDEX

= FINANCE, PURCHASING AND INVENTORY =

1 +CURRENT ASSETS
2 +CASH ON HAND
3 +PAYROLL
4 +A/R CURRENT
5 -A/R 31 - 60 DAYS
6 -A/R 61 - 90+ DAYS
7 +10-DAY DISCOUNTS PAID
8 +A/R CURRENT COLLECTED
9 +A/R 31 - 60 DAY COLLECTED
10 +A/R 61 - 90+ DAY COLLECTED
11 +CURRENT INVENTORY
12 +AVERAGE INVENTORY
13 +CURRENT LIABILITIES
14 +COST OF GOODS SOLD
15 -CUR LIAB:INVT RATIO (13/11)
16 +NET WORKING CAPITAL (1-13)
17 +INVENTORY TURNOVER (14/12)
18 +PLANT & EQUIPMENT
19 +LAND
20 -LONG TERM DEBT
21 -ACCOUNTS PAYABLE: CURRENT
22 -ACCOUNTS PAYABLE: PAST DUE
23 -NOTES PAYABLE
+FINANCE PERFORMANCE INDEX
+FINANCE STABILITY INDEX

= ENGINEERING =

1 +# DRAWINGS RELEASED FOR MFCT
2 +# DETAIL DRAWING COMPLETED
3 +# ASSEMBLY DRAWINGS COMPLETED
4 +# DRAWINGS CHECKED
5 +# ENGINEERING HOURS LOGGED
6 -ASSEMBLY DWGS COMPLETED:HOURS
7 -DETAIL DWGS COMPLETED:HOURS
8 +# ITEMS SCHEDULED
9 +% SCHEDULES MET
10 -# MACHINE SHOP QUERRIES RE DWGS
11 -# FAILURES: FAULTY ENGINEERING
12 -# DWGS BACKLOGGED OVER 10 DAYS
+ENGINEERING PERFORMANCE INDEX
+ENGINEERING STABILITY INDEX

= PRODUCTION =

1 +VALUE ASSEMBLIES READY
2 +# ASSEMBLIS READY
3 -% ASSEMBLIES FAILING INSPECTION
4 -VALUE OF SCRAPPED ASSEMBLIES
5 +VALUE "A" ASSEMB READY
6 +VALUE "B" ASSEMB READY
8 -VALUE "A" ASSEMB:"A" MANHOURS
9 -VALUE "B" ASSEMB:"B" MANHOURS
10 +TOTAL MANHOURS
11 +"A" TOTAL MANHOURS
12 +"B" TOTAL MANHOURS
13 +TOTAL NUMBER OF ITEMS MACHINED
14 -% REJECTS OF ITEMS MACHINED
15 -VALUE REJECTS/# ITEMS MACHINED
16 +# CATEGORY "X" ITEMS MACHINED
17 +# CATEGORY "Y" ITEMS MACHINED
18 +CATEGORY "X" MACHINE SHOP MANHOURS
19 +CATEGORY "Y" MACHINE SHOP MANHOURS
20 -# "X" ITEMS/"X" MANHOURS
21 -# "Y" ITEMS/"Y" MANHOURS
22 +% ITEMS ON SCHEDULE
+PRODUCTION PERFORMANCE INDEX
+PRODUCTION STABILITY INDEX

= QUALITY CONTROL AND CUSTOMER SERVICE =

1 +% PERSONNEL FULLY TRAINED
2 +# UNITS INSPECTED
3 +# UNITS PASSING INSPCTN FIRST TIME
4 +# CORRECTIONS TO REJECTS
5 -# UNITS FAILED IN CUSTOMER SERVICE
6 +# UNITS SVC'D TO CUST SATISFACTION
7 +# CUSTOMER TESTIMONIALS
8 +# CUSTOMER REFERALS
+QUAL CONTL/CUSTOMER SVC PERF INDEX
+QUAL CONTL/CUSTOMER SVC STAB INDEX

Figure 9 Example of P&SC Multi-Level Variables

presents - not one or two years from now, maybe, but a working graphic MIS in the next few weeks for certain.

Today, a graphic MIS can be the missing link in the effective management of any type or size operation.

P&SC:

Figure 11

A B C SERVICE COMPANY

12 May 82

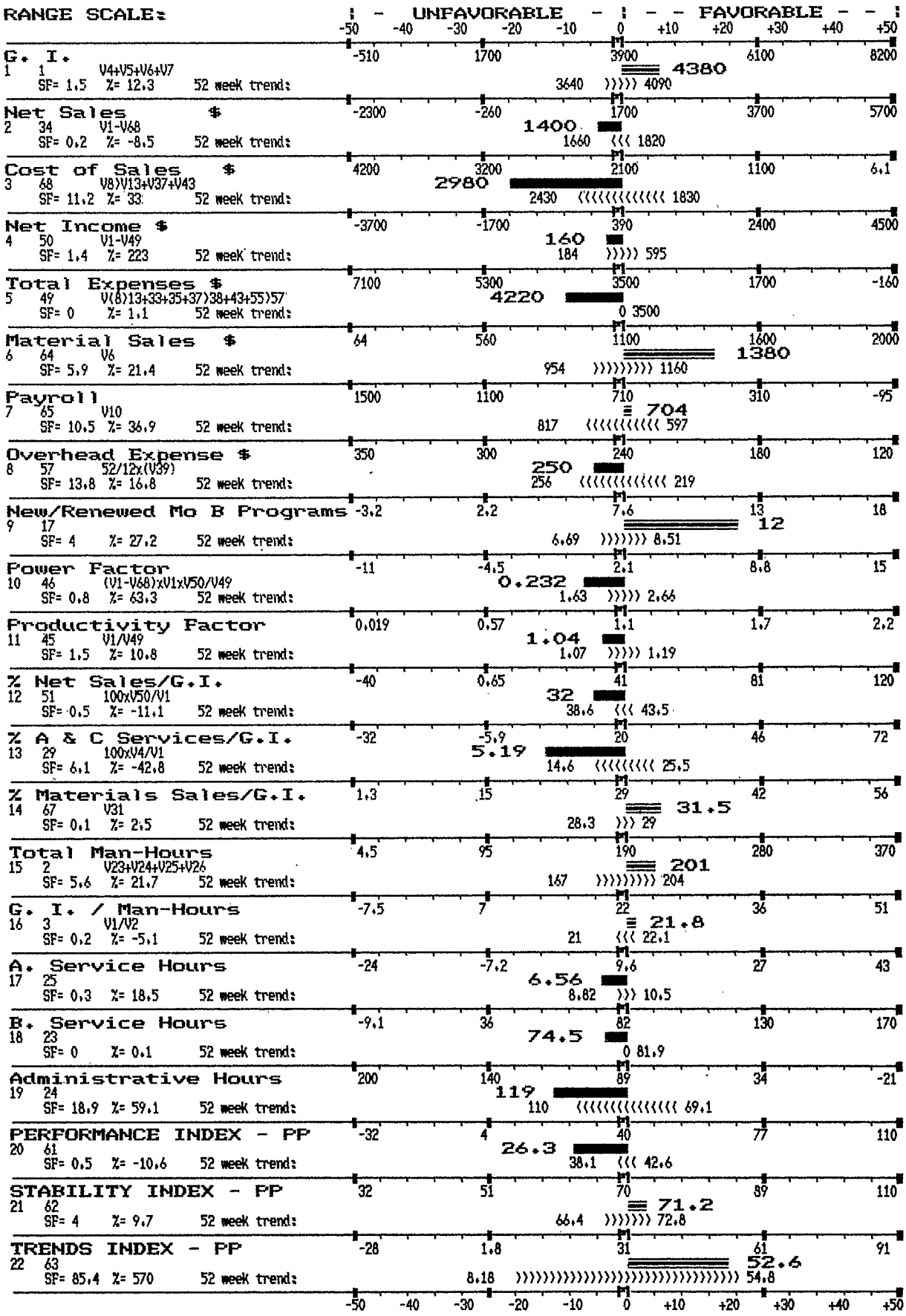


Figure 10

P&SC:
With End-Weighted Trends

XYZ SUPERIOR SOFTWARE COMPANY

27 Mar 80

QUALITY CONTROL DIVISION

Number of items on Productivity Profile = 13; Time Interval used: week; No. after item = data reported approx No. weeks late
Number of weeks used to compute scale points, moving scale average or mean 'M' and trend = 26
Each item value for 27 Mar 80 is charted as a favorable ` ═══ ` or unfavorable ` ═══ ` deviation from 'M'
End-Weighted Trend values for 27 Mar 80 are the averages of the last 26, 13 and 7 week trend values from 4 Oct 79 to 27 Mar 80
as 'A')))))))))) 'B' = Trend moving in a favorable direction or 'B' (((((((((('A' = Trend moving in an unfavorable direction
where 'A' = starting value of trend and 'B' = ending value of trend.
SF = Stability Factor of item from 4 Oct 79 to 27 Mar 80; Range is from 0 (no stability) to 100 (total stability).
% = Percent increase or decrease (-) for last 26 weeks from Trend analysis from 4 Oct 79 to 27 Mar 80

RANGE SCALE: ; - - UNFAVORABLE - - ; - - FAVORABLE - - ;

-50 -40 -30 -20 -10 0 +10 +20 +30 +40 +50

VP QUALITY CONTROL DIV
1 1 Points
SF= 1.4 %= -8.6 26 week EW-Trend: 180 ((((((197

30 120 165 210 290 380

ASST VP QUALITY CONTROL
2 2 Points
SF= 30.9 %= 91.3 26 week EW-Trend: 11)))))))))))) 21.1

-13 2.5 16.5 18 34 50

QUALITY ASSURANCE MANAGER
3 3 Points
SF= 19 %= 27 26 week EW-Trend: 65.8)))))))))) 83.6

3.2 41 70 80 120 160

INTERNAL SUPPORT MANAGER
4 4 Points
SF= 0.4 %= 13.3 26 week EW-Trend: 49)))))))))))) 55.6

23 36 50 56 63 77

IN-HOUSE DIBOL SUPPORT
5 5 Points
SF= 0.6 %= 105 26 week EW-Trend: 1.86)))))) 3.82

-12 -5 0 2.3 9.7 17

FIELD SUPPORT MANAGER
6 6 Wgt'd Av Age all Outstandg Bugs
SF= 0.6 %= -10.1 26 week EW-Trend: 44.2))) 39.8

110 76 48 42 7.9 -26

FIELD SUPPORT MANAGER
7 7 Points
SF= 13.3 %= 86 26 week EW-Trend: 626)))))))))))))) 1170

-870 13 890 1587 1800 2700

DIBOL-11 SUPPORT
8 8 Wgt'd Av Age all Outstandg Bugs
SF= 2.4 %= -12.8 26 week EW-Trend: 55.3)))))) 48.2

110 82 58 51 21 -9.8

DIBOL-11 SUPPORT
9 9 Points
SF= 17 %= 81.2 26 week EW-Trend: 91.2)))))))))))) 165

-140 0.62 92 140 280 410

ASST DIBOL-11 SUPPORT
10 10 Points
SF= 0.2 %= 31.9 26 week EW-Trend: 56.6)))) 74.6

-160 -49 61 90 170 280

CS COBOL SUPPORT
11 11 Wgt'd Av Age all Outstandg Bugs
SF= 0 %= 49.2 26 week EW-Trend: 29.3 ((((((((19.6

71 46 46 20 -5.7 -31

CS COBOL SUPORT
12 12 Points
SF= 2.6 %= 17.4 26 week EW-Trend: 211))))) 248

-140 48 240 351 430 610

DIRECTOR, FIELD SERVICE
13 13 Points
SF= 3.1 %= 61.4 26 week EW-Trend: 409))))))))) 661

-780 -140 500 1054 1100 1800

PERFORMANCE INDEX - SA
14 14
SF= 2.7 %= 10.3 26 week EW-Trend: 47.9)))) 52.9

-24 14 38.5 53 92 130

STABILITY INDEX - SA
15 15
SF= 1.1 %= -1.1 26 week EW-Trend: 64.8 ((65.6

42 55 60.5 67 79 91

TRENDS INDEX - SA
16 16
SF= 3.9 %= 26.2 26 week EW-Trend: 58.6)))))))))))))))) 73.9

22 42 62 82 84.6 100

-50 -40 -30 -20 -10 0 +10 +20 +30 +40 +50