BUSINESS GRAPHICS

AN EFFECTIVE MEANS OF
IMPROVING MANAGERIAL PRODUCTIVITY

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I. INTRODUCTION

The market for business computer graphics products is expected to grow at 59% per year over the next five years. In part, this growth is a result of the increasing interest in managerial productivity and the realization that computer generated graphics is a tool that can be employed today to improve the effectiveness of management decision making.

Functional managers and professionals in finance, marketing, manufacturing, personnel and accounting are seeking better ways of defining and analyzing problems as well as communicating their findings to other decision makers. These managers are looking to their data processing departments for advice and recommendations on how to develop computer graphics systems. Data Processing managers will play a very important role in improving managerial productivity in the future.

This paper will describe some of the historical trends in Office Productivity, and then explore the role of management in todays organizations. Emphasis will be placed on how graphics can help managers in the decision making process. The conclusion also offers a brief discussion of the implications and opportunities that these trends have for data processing professionals.

II. A HISTORICAL PERSPECTIVE OF OFFICE PRODUCTIVITY

In this century enormous strides have been made in increasing the productivity of industry and agriculture. Technological innovations have greatly improved not only output per capita, but also the standard of living. Until relatively recently however, very little attention has been given to office productivity. This lack of concern is very apparent in the low capital investments and low productivity improvements made in the office in the last decade for the average worker in the United States.

	Capital Investment	Productivity Gains[1]
Office Worker	$ 2,000	4%
Industrial Worker	$25,000	90%
Farm Worker	$35,000	185%

At the same time, it is interesting to note some of the other trends that are taking place in business organizations and specifically in the office:

o In the United States, over 240 billion pages of computer printout was created in 1980, up 25% over 1979.[2]

o Office workers are becoming a larger percentage of the total labor force as the U.S. becomes more of a service

oriented economy from 22% in 1980 to 30% in 1990.[3]

o Electronics and memory costs are dropping between 20%
  and 40% per year, while labor costs are rising at
  7%.[1]

o The total cost of producing a letter in the United
  States is estimated at $6.63.[4]

These facts all bear witness to what has commonly become called
"The Information Explosion". As Alvin Toffler, the well known
futurist points out in his book, The Third Wave, we have tried to
automate our offices the way we automate factories in a
routinized manner that increases the quantity of output but not
necessarily the quality. This approach has not yielded commensu-
rate productivity gains. More data is not always better.

The advent of electronic word processors is evidence of the
economic incentives to automate the office. It is clear that
there is vast room for improving the manner in which we handle
documents. Time savings may be quantified and document creation
costs reduced. What is not so measurable however, is management
productivity. How does one measure a manager's productivity?
The number of decisions made? The quanity of memos written? The
length of meetings attended? Clearly these are not very good
measures. And yet, when examining   office productivity one
needs to put secretarial and clerical vs. managerial and profes-
sional productivity in perspective.

o 75% of the $640 billion spent on direct labor costs in
  U.S. offices goes towards management and professional
  salaries and benefits.[5]

o 80% of one U.S. insurance company's office costs went
  toward management and professional salaries.[1]

One needs to ask, why we are not looking more closely at improv-
ing managerial productivity . In fact, this process has begun.

The result has been a high degree of interest in tools to make
managers more efficient and more effective: electronic mail,
teleconferencing, decision support tools and graphics. Before
exploring managerial productivity further one needs to define
exactly what is meant by management and what managers do in the
decision making process.

III. WHAT IS MANAGEMENT?

Managing means many things to many people. In fact, there are probably as many definitions of management as there are management styles. In any case, several key ingredients invariably appear in a description of management:

o   Planning, organizing and controlling

　　-key elements in management.

o   "Getting things done through other people"

　　-clearly communicating goals, providing incentives to motivate employees and delegating responsibility

o   Making Decisions

　　-one of the main purposes of managers is to take relevant information and determine the best course of action or allocation of resources to maximize or minimize occurences that conform to their organizations objectives.

From these definitions of management, one observation is very clear. If managers and business professionals primary function is decision making, then information is their most important resource. Note the distinction between data and information. There is an excessive amount of untimely and irrelevant data available to most managers today which explains the reason so many computer printouts go unread. Information on the other hand may be a summary of only the most important elements that affect a managers sphere of influence.

What type of information do managers need?

o   Relevant information

　　- unrelated data will only be time-consuming and distracting

o   Timely information

　　- obsolete data in todays competitive environment is usually worthless information

o   Accurate information

　　- unreliable data may mislead a decision maker; however, spending excessive time accumulating and verifying it may make it untimely.

o   Summarized information

　　- although some levels of decsion makers need details, most managers need to see the "big picture". Managers can ill afford to spend time reading about an operation or division that only affects 1 or 2% of their sales, profits, costs, etc.

o   Well formatted information

　　- nothing is worse than pertinent information that is buried in long listings of hundreds or even thousands of variables. Key facts, trends and relationships should stand

out so that managers can quickly grasp their meaning and proceed in their analysis.

With these information needs in mind, it is very interesting to observe how managers really do spend their time on a day to day basis.

IV.   HOW CAN GRAPHICS HELP MANAGERS SPEND TIME MORE EFECTIVELY?

Many theories have been postulated and estimates made of how managers spend their time. There have even been a number of professional studies. One of the most comprehensive surveys was conducted by recording the activities of 300 managers and profesionals in 15 organizations every 20 minutes throughout their working day. [6] The results were very revealing:

MANAGERIAL ACTIVITY PROFILE
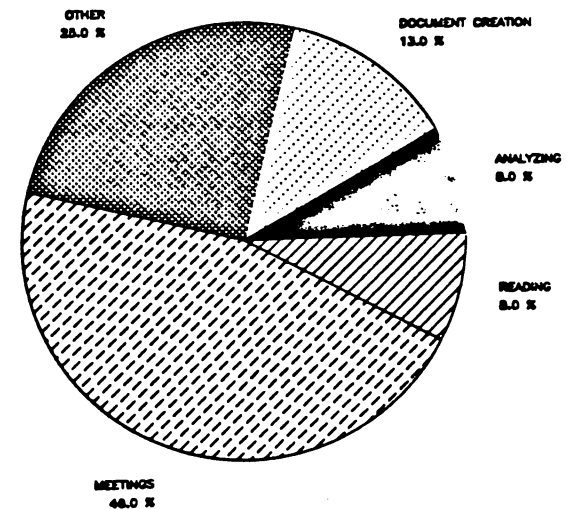
This vividly illustrates the role of meetings in the management process. Being able to convey information succinctly as well as understanding the presentations of others is essential for success. Any significant contribution to managerial productivity must address this communication intensive joint decision-making process.

Meetings

Electronic mail may reduce the need for some meetings and teleconferencing may reduce the travel time and expense of others, but graphics can make meetings more <u>effective</u>. Using visual aids such as charts and graphs:

o   Ideas can be conveyed more rapidly using colors and textures in a visual format -- reducing meeting time. It is interesting to note that 35% of managers thought meetings were too long and 34% thought they were unproductive[6]

o   Information can be displayed in a more interesting format -- keeping the attention of participants

o   Concepts are more easily retained by listeners because humans are more accustomed to storing visual images. This improves the results of the meeting. For a physiological explanation of why graphs and visual images are more easily retained by the human brain see [7].

The most relevant data can be presented in a summarized format -- focusing attention on the key points of discussion.

Document Creation

Document creation which consumes 13% of the average manager's time consists of composing, creating, editing, designing, and drawing documents. This activity has enjoyed some productivity improvements with the advent of less expensive dictation equipment and word processing. Graphics can also make a contribution in this activity by providing managers with the tools to more effectively communicate their ideas and influence other decision makers. In realization of this fact, the Harvard Business School recently created a new course on the use of business graphs.

Reading

Reading which accounts for 8% of managers and professionals time would benefit greatly if document creators used graphics since readers would be able to more quickly grasp key ideas. In fact, the analysis of [7] indicates that the Human brain is able to absorb between 48 and 72 million words per minute in visual images vs about 600 to 1200 words per minute for the average reader.

Aside from these activities, professionals and managers spend about 25% of their time on less productive activities that should frequently be performed by support personnel: filing, copying, seeking information, seeing people, scheduling, organizing work,

waiting, etc. Electronic filing, electronic mail, and intelligent copiers will help to improve productivity in this area in the future. Traditional business display graphics are not very relevant to these activities although some software packages will provide capabilities to create organizational charts, Gant charts, and Program Evaluation and Review Techniue charts, (PERT). Some professionals will use these specialized tools, quite frequently but support personnel will probably prepare these charts because of their routinized nature.

The last activity which takes up an average of 8% of a managers time is analysis. This is probably the one activity that people most closely associate with managing and decision making. Before discussing the very important role of graphics in analysis and the decision making process one last point needs to be made.

Management styles are different just as managers' jobs vary from one organization to another. The amount of time spent on different activities varies from one manager to the next. In the chart below, it is apparent that professionals and lower level managers spend more time on less productive tasks probably because they do not have supporting staffs. It is also clear that they spend more time doing analysis and document preparation than upper level managers. At the same time, senior managers spend considerably more time in meetings.
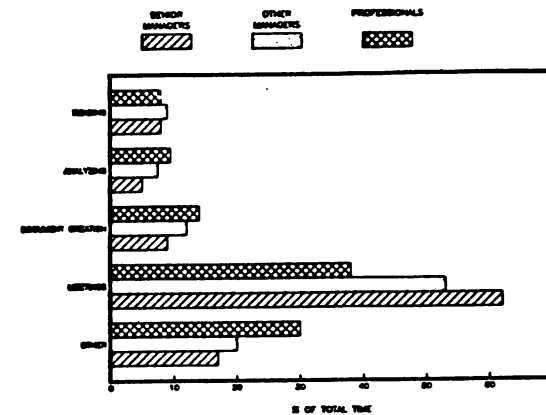
From these observations a picture begins to emerge of lower level managers collecting and analyzing data, generating solutions and communicating these solutions to upper level managers who review them. It also brings up the question of the type of data that is desired by different managers.

Typically lower level managers deal with data internal to the organization (orders, shipments, inventories, etc.) while senior level managers deal with both internal and external data (inflation rates, interest rates, industry growth, etc.). These lower level managers and professionals may need graphs produced from data resident on an existing data base while senior managers may want to use their own data.

In fact, Computerworld magazine estimated that "top managers spend less than 2% or 3% of their time dealing with computer printouts, terminals, or intelligent stations".[8]

This has important ramifications for the decision making process as we will see in the next section.

V. HOW DOES GRAPHICS HELP MANAGERS MAKE BETTER DECISIONS?

With this basic understanding of how managers spend their time and the ways graphics can make them more productive, it is instructive to look even more closely at how an individual manager might go through the decision making process. Specifically, I will use Hewlett-Packard's Decision Support Graphics/3000 as an example of a powerful computer graphics package that can help managers make· better decisions.

Although there are a multitude of ways to make decisions ranging from the basic scientific method to sophisticated operations research models, there are usually several steps that are common to all techniques. The schematic below illustrates some of the main steps in any decision making process.

Figure 3

THE DECISION MAKING PROCESS
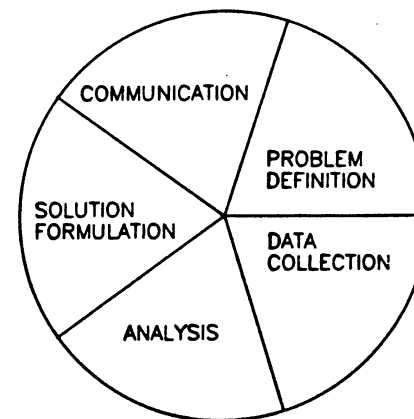
Problem Definition: Before launching into any type of analysis,
the decision maker needs a clear understanding of the problem at
hand, perhaps even further defining it. In some cases, objec-
tives need to be set and assumptions stated. In others, the
decision maker may need to question the basic premise of whether
a problem even exists or what the decision criteria are.

A good example of how a graph can help define a problem is shown
below. A manager looking at this sales data might be very con-
cerned about the decline in sales. However, by displaying last
years data next to this years, it is apparent that there may not
even be a problem, rather, sales are seasonal and one can expect
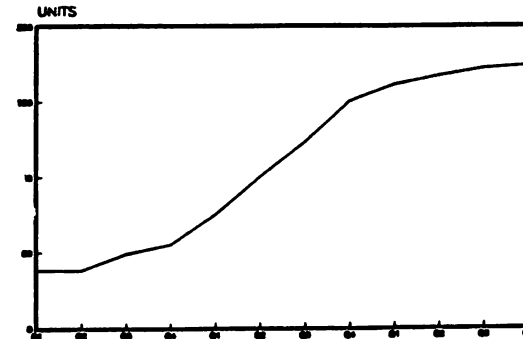a decline during certain months.

Figure 4
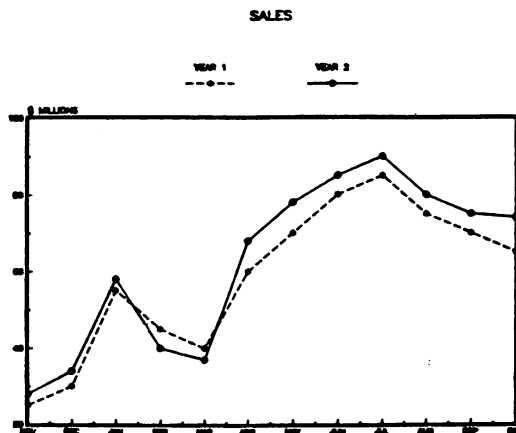
SALES

The next example shows sales of a product over several years. By
looking at a column of numbers, it might be obvious that sales
have been growing. In the graph below however, something else
emerges: sales grew at a rapid pace the first three years but
have almost leveled off in the last year.

Figure 5

SALES GROWTH

Data Collection: Once the problem is defined, the decision maker
can proceed to gather data that is relevant to the decision.
This data may reside in file cabinets, in reports, with other
people or hopefully, in a computer data base where it can be
quickly retrieved.

DSG/3000 was specifically designed with data retrieval in mind. If data originates from a managers own information base (external to the organization), this information can be entered quickly by filling in a menu. If the data is in an IMAGE data base, Query may be used to retrieve the data for a graph. Other tabular MPE files may also be used. Below is an example showing how data can be entered in the DSG/3000 data prompt menu.
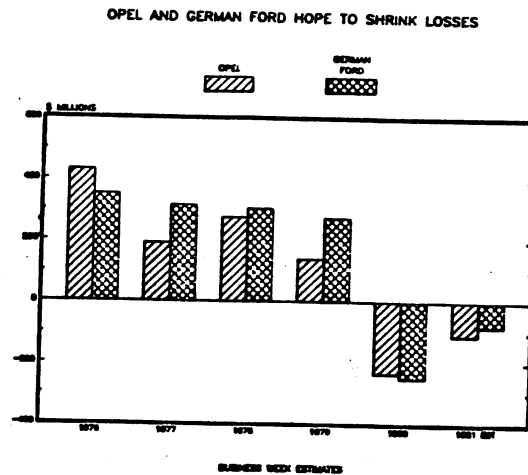
Figure 6

Thus, DSG/3000 is ideal for periodic reporting where the same chart is used month after month since it can be updated automatically with the most recent data. At the same time, however, customized graphs can be created with manually entered data for special presentations. This flexibility is important to consider when designing a graphics system. Since senior managers often deal with external data that is not resident in the organization's information systems.

Analysis: With the appropriate data in hand, the decision maker can proceed to determine what is relevant, how accurate it is, and then begin analysis. Frequently, this is the longest step in the process because the data must be prepared and formatted so it can be manipulated. Most business managers and professionals then perform some combination of the following analyses:

o   extrapolating trends over time

o   studying relationships between variables

o   making comparisons between entities

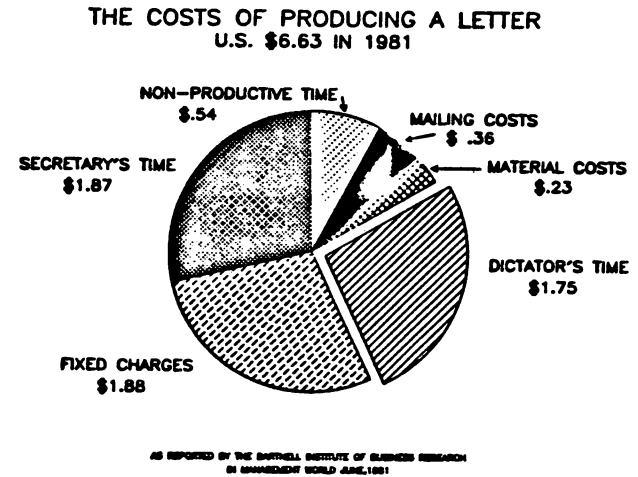o   looking for exceptions and variances

These four types of analyses lend themselves to visual portrayal. Trends as we saw in the example of sales over time are usually displayed in a line chart or a series of bars in a bar chart as shown below.

Figure 7

OPEL AND GERMAN FORD HOPE TO SHRINK LOSSES

Figure 8

THE COSTS OF PRODUCING A LETTER
U.S. $6.63 IN 1981

Relationships can also be displayed in line charts like the previous example where we saw the relationship of sales in the different periods. Clustered bar charts like the example above vividly show the relationships of two variables over time. Pie charts like the one below are ideal for comparing the relative sizes of individual parts of a whole.

Graphics are also very valuable in showing exceptions and variances. This is an essential analysis for those managers who manage by objective or manage by exception. Charts see frequent applications in budgeting where forecasts are compared with actual results. The chart below shows how different departments within one division have performed on both a monthly and yearly basis. The bars depict what % of the forecast each department has achieved. At a glance, it is clear that departments two and three have reached or exceeded their goals. Department one has had a poor month, meeting only 50% of its goal but is still almost on target for the year. Department four, on the other

hand is considerably below expectations both for the month and
the year to date.

Figure 9

SALES TO DATE
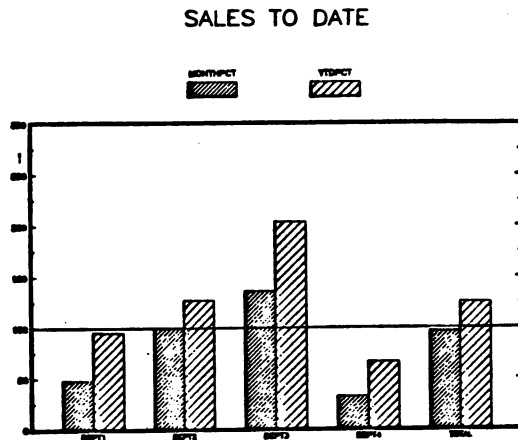
Solution Formulation: After completing analyses, the decision
maker may have enough understanding of the problem to generate
several alternative solutions. If so, the decision maker can
choose the alternative that best fits the decision criteria or,
if the problem is not fully understood the decision maker can
redefine the problem, collect more data, and do more analyses.

In generating alternative solutions, a manager may choose to ma-
nipulate data in several ways. To accomodate this activity, DSG/
3000 has built in transformation capabilities: cumulations to
give totals up through a given time period; moving averages to
smooth out irregularities in trends; logorithmic scaling to dis-
play variables which have values very far apart; and several
others. Manipulations of the data can be performed within DSG/
3000 by simply filling in one menu -- there is no need to exit or
write special programs. Below is an example of some cumulated
data:

Figure 10

GERMANY'S CUMULATIVE DEBT
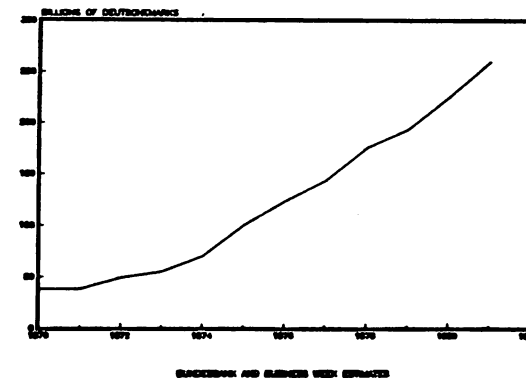
Communication: Once the best solution has been determined, the answer can be communicated to those who need to act upon it. Quite often this step is overlooked in the decision-making process and yet it is probably one of the most important. How often do senior managers redefine problems, ask for more data or request additional analyses? These activities often set the whole process in motion again which explains the extremely iterative nature of the decision making process. This points out the necessity of being able to easily update and create graphs manually, as well as using them for periodic reporting.

In fact, very few managers make decisions by themselves, most often they must seek approval from higher levels. This in part explains why managers spend 46% of their time in meetings and top level managers spend only 2 - 3% of their time dealing with computers.

As we discussed earlier, business graphics are very valuable in meetings and presentations. They can reduce the amount of time spent in meetings or make the time spent more productive by rapidly conveying the most relevant information in a concise and interesting format that will maintain the listeners interest as well as improving their retention of key points. DSG/3000 provides presentation quality graphs and slides appropriate for reports and meetings. In fact all the graphs I have shown you today were created with DSG/3000. One major consumer package goods company in the United States found they were able to reduce the cost of producing presentation slides by 50% using DSG/3000.

The ability to store the data and chart information separately allows users to update graphs on a periodic basis without recreating all of the chart specifications. Arrows, text, and lines as well as color selection can be employed to highlight the most important information. The ability to put multiple graphs on one page is also very valuable since it allows you to show relationships between various elements of your data. The two examples below demonstrate the amount of information content that can be placed in a graph.
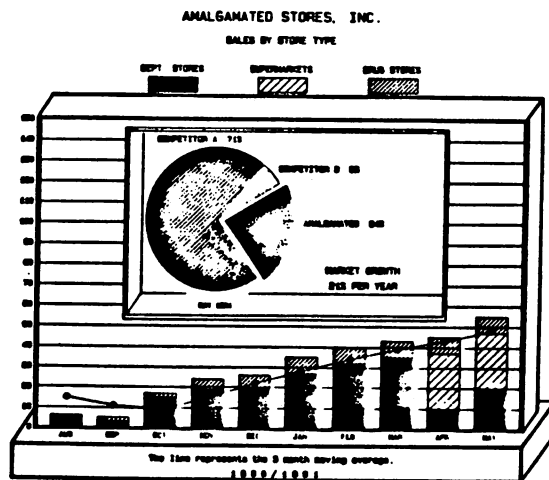
Figure 11

AIR CONDITIONER PLANT #8   DAYTON, OHIO
PRODUCTION COST ANALYSIS
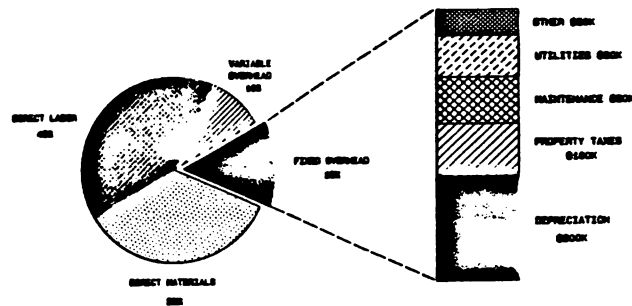
SOURCE: AMALGAMATED STORES, INC. 1981 ANNUAL REPORT

Figure 12

VI.   CONCLUSION

The trend toward office automation will continue at an accelerating pace as word processing and data processing systems are integrated over the next decade. In addition to productivity improvements for secretaries and clerical personnel, more sophisticated tools will be made available for managers and professionals. Some of the technologies that will come into widespread use are electronic mail, teleconferencing, personal support tools for scheduling and calculating as well as sophisticated decision support tools.

Graphics are already playing a major role in improving managerial productivity today because of their applicability in the decision making process. In the future, charts will become an integral part of business reporting because of their exceptional abiity to cummunicate trends, relationships, comparisons and variances.
Lets quickly review why this is true.

Graphics is an especially useful tool to managers because of:

> Information needs --
> Graphics can provide concise summaries of the most relevant information in a visually appealing format that is easily understood by others.

Daily Activities --

Graphics can assist managers in communicating to others in meetings (46% of their time) and in creating documents (13% of time). The ability to understand material when reading (8% of time) and do sophisticated analysis (8% of time) is vastly enhanced with the use of graphics.

Decision Making Process

Graphics can help all steps of decision making by focusing attention on the most important facts during <u>problem definition</u>. Computer graphics with data base access expedites the <u>collection of data</u> in a highly <u>accurate</u> manner. Graphics is probably most valuable in <u>analysis</u> because it quickly shows <u>trends</u>, <u>relationships</u>, <u>comparisons</u>, and <u>variances and exceptions</u>. Combined with some simple statistical tools, graphics can be invaluable in exploring alternative solutions and visually displaying "what if" analyses. And last, but probably most important, it can <u>communicate</u> information to others very effectively.

How can Graphics Help Management?

<u>Planning, organizing and controlling</u>-- These key ingredients of management are each a series of interrelated decisions. Planning for example asks the questions who will do what, where, at what cost, etc.? Budgeting is an excellent example of planning in which many people may be involved in making many interrelated decisions. Graphics can be a valuable resource in this iterative process.

Thus, managers with graphics at their fingertips, despite their differing management styles and job descriptions will have access to more relevant data, in a more concise fashion, in an easy to comprehend format, that will let managers spend more time doing what they do best -- making decisions.

VII. IMPLICATIONS FOR DATA PROCESSING MANAGERS

Today senior managers are looking for better more timely information. They are looking to their management information systems personnel to improve their decision making capabilities. This means providing better information rather than just more data. It also means providing it in a more succinct, highly comprehensible format like graphics that can be easily understood by business managers.

In the future, those managers and professionals who use graphics will be able to more effectively manage their businesses. And those computer systems specialists who implement graphics on their systems will be able to provide higher quality information, not just data to their end user decision makers.

In fact, one observer pointed out that the role of DP directors in the future will change "from technician to management scientist. [3] But, it is up to you, the experts on computers and information systems, the professionals who are abreast of the latest technology to show managers throughout your organizations how they can be more productive using the tools and services you provide. They will not come to you because in most cases, they are successful now and they are not aware of many of the tools you have at your disposal. You need to be the agent of change and take the lead in improving your organizations management productivity.

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