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Gordon L. Murray
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by Gordon L. Murray
Partner, Executive Office

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In the announcement of this meeting I saw that the topic is Current Targets For Management Attention. It is a little difficult recalling just what this title was intended to cover. You know how it is: You agree to give a talk and the next thing you find out they have a program chairman and a publicity chairman, with deadlines, and they want to know your subject. You don't really have any subject at that point but you have to think of something and I thought of "Current Targets For Management Attention."

It turns out that I really intend to talk about management techniques—newer techniques for making management decisions and planning and controlling a business. When I speak of new techniques I should qualify the term, because some of these techniques may not be especially new in concept but rather are new in their application to business problems, particularly in their more general application. It makes but common sense that management draw a bead on those areas where more scientific and proven approaches offer particularly attractive possibilities.

Planning and Organization

Managing a business is obviously a very complex job. There is a wide spectrum of functions to be performed, and management success depends on achieving harmony—or optimizing the total result, as the management-science people term it. One reason this is difficult is that the objectives of each function of the business do not necessarily coincide with the total objective of the enterprise. Obvious examples are a marketing management pressing for a large inventory so they can give immediate delivery to customers; a financial management striving to minimize cash tied up in inventory; and a production management wanting a level rate of production for ease in scheduling and for economical production operations even though inventories are required to meet swings in customer demand. This is only one example, but the point is that if you were running an operation solely devoted to marketing, or banking, or production, or engineering, you would act differently than when these functions are an integral part of a whole enterprise.
The manager's job is not unlike that of the conductor of an orchestra. The conductor too has the objective of directing a variety of players toward a harmonious result. He has developed a very formalized procedure for achieving this result. First, a musical composition is created or selected, representing the plan. Next, this musical composition is arranged in a score. The score is quite definitive, specifying not only how the musical composition is to be performed but the precise role each participant is to play. It is an organization structure. While each musician may be a soloist in his own right, once he elects to participate in an orchestra he sacrifices his individual objectives to that of the group; he accepts the restrictions of the organization structure. The actions expected of each participant are made crystal clear through the common language of the score. His performance is monitored by the conductor or manager. Results, as in a business, are evaluated in terms of the total effect produced.

Unfortunately no comparable degree of precision has been achieved to govern planning, organization, and performance within a business. In part this is due to the environment in which a business operates. There are very real limits to what the individual business can do to govern actions of its competitors, customers, suppliers, unions, and government. I need not add that the government generally frowns on cooperative ventures by businesses to control their environment.

Environment and lack of precision notwithstanding, business managers have available to them the concepts of management control and profit planning. The techniques for applying these concepts are quite highly developed. The advantages are sufficiently well established that a management should feel under compulsion to offer reasons why these techniques are not applied in their operations rather than feel that reasons must be offered why they should. Yet many businesses fail to adopt even simple budgets, let alone fully developed systems of control and profit planning.

To the manager the significance of these advances is that he now has more alternative courses of action to consider. The formula for solving business problems consists essentially of four steps:

- Definition of the problem and objectives;
- Determination of the alternatives that apply to the problem—identification of the various possible courses of action;
- Evaluation of alternatives in terms of the objectives previously
defined and within the limitations peculiar to the specific situation;

• Selection of that alternative most nearly meeting the requirements of the objective.

The manager who is unaware of some new alternative technique or is ineffective in applying it is at a disadvantage and stands to lose position relative to his competition.

The availability and application of new techniques also, in a sense, moves the goal posts. In those areas where new techniques are available we should expect to find the various factors evidencing the quality of management performance to meet tighter standards and to find those factors varying within narrower limits. An awareness by investors, analysts, and others engaged in evaluating a company's performance, of the opportunities for applying new approaches to management problem-solving opens up additional avenues for identifying the causes for differentials in performance. Managements are also open to criticism where they are unaware of these advances or are inept in their application.

The application of the concept of management control calls for:

• Identifying the key factors in the business operation in need of control to achieve a given over-all result;

• Specifying the basis to be used for establishing standards of performance for each control factor—forecasts, budgets, standard costs, turnover ratios, lead times, and the like;

• Defining the information—accounting and operating data and statistics that must be accumulated to measure status and performance;

• Establishing a reporting structure and series of reports that identify performance in each control area, relate causes and effects, signal trends, and identify results by responsibility under the plan of organization.

The development of such a management-control system requires a careful dissection of the total operation into discrete components and a close scrutiny of each component in terms of its basic characteristics. Such analysis, by itself, will lead the discerning person to useful conclusions, whether a more complete and continuing system is adopted or not. A surprising number of managements have not been tempted to try this approach.

Such a management-control system leads logically to profit
planning. In its simplest terms profit planning is a structure and modus operandi for bringing together the sales forecast, a production plan designed to meet this demand (converted to production costs) and planned or budgeted engineering, distribution, and administrative expenses necessary to support this sales and production activity. The result is planned profit, earnings per share, and return on investment. Generally, the scope of the structure is extended to encompass cash requirements, inventory levels, capital-asset plans, and other factors, dependent on planned profits, as well as the elements of sales and production underlying a profit result.

This type of approach to control and profit planning is more than a structure; it is a corporate way of life; it represents a philosophy for running a business. It is not a matter of singular concern to accountants. Rather, it is a programmed approach to decision-making and for ordering the affairs of a business.

Once the answers on profit-control decisions are approved at the top the action is concluded by providing all those expected to make decisions with the results of this process. This process supplies the manager with something approaching the common language of the musical score available to the conductor of an orchestra, and has been demonstrated to produce harmonious results.

Recently *Time* magazine, reporting on General Motors' 1962 results, reported in part as follows:

"In a free economy, profit has always been the essential measure of business success. Lately, U.S. business has been finding it harder and harder to keep its profits up, and rare indeed is the firm that can boast of raising its profits faster than its sales. Last week, reporting the largest sales and earnings ever made by a corporation, General Motors astounded the business world with its profits increase. While its sales climbed a respectable 28% over 1961 to $14.6 billion, its earnings rose an extraordinary 63% to $1,459 billion. The question in many an impressed businessman's mind: How in the world does G.M. do it?

G.M.'s secret is as simple as it is difficult to duplicate: The corporation is one of the tightest-run, most cost-conscious firms in all of industry, and it budgets for profits. . . .

The article goes on to point to the features of a planning and control system, forty years in the making and only adopted in varying degrees by the rest of the industry since World War II. During 1962, G.M. earned 10% on sales after a 28% increase in sales and a 63%
increase in profit. Ford turned in 6.8% on sales after a rise of 21% in sales but only 17% in profit. I was not going to mention Chrysler but perhaps I should. Chrysler’s sales were up to 12% and profits were up 489%, which is only to be expected, as the new president of Chrysler—Mr. Townsend—is a CPA, as is Mr. Donner, Chairman of General Motors.

The laws of profits call for considerable leverage once the break-even point in sales is exceeded. All too often this increased profit is not achieved, a circumstance pointing to a considerable void remaining to be filled by effective application of a management-control, profit-planning system.

**SCIENTIFIC APPROACH**

When you attempt to catalog the newer and improved techniques being applied to solving business problems during the past ten years or so, a pattern begins to emerge. Running through techniques for sales forecasting, inventory control, production scheduling, capital-asset decisions, and the like is evidence of business management’s adopting a more scientific approach. The great entrepreneurs of the last century, held in awe in that age for their intuitive shrewdness, are passé. The professional manager of today finds he has to grub pretty hard to squeeze an inflated profit dollar out of his operation and to grub even harder to earn an after-tax dollar. Generally, he is highly educated and frequently, nowadays, has a liberal arts, scientific, legal, or accounting background. He is more and more aware of the basic approaches applied in the physical sciences, the behavioral sciences of psychology, sociology, anthropology, and in the field of mathematics. As he struggles with the problems of his business he is prone to experiment to see what these other fields might offer.

This progressive yet circumspect approach has merit, for the mathematician and others have a contribution to make in business, provided they recognize the practical limitations inherent in business situations. Business is obviously not a laboratory occupation. The economic environment cannot be excluded; measurement is not very precise; some elements cannot be measured but must be estimated; historical data are spotty; time factors are likely to be critical; unpredictable problems that concern people enter the picture.

Such limitations notwithstanding, a more scientific approach, higher degree of quantification, and establishment of mathematical relationships among variables produces attractive results—results
that usually can be expected to extend to recognizing more variables in a problem, placing the whole problem and individual factors in better perspective, and providing a sounder point of departure for applying the manager's judgment. What generally cannot be expected is an absolute answer expressed in absolute terms precluding the need for applying judgment. This is another way of expressing the view that the scientist and mathematician harnessed to a computer, or the computer alone, are not about to take over management of business.

The mathematical formulas and symbology found in the literature of operations researchers and management-science people can be quite imposing. Frequently the mathematics are offered in proof of a rule or relationship. In no sense do I mean to convey the impression of a penchant for debunking the need for, or desirability of, mathematical approaches in certain situations. Much can often be gained, however, through practical, common-sense applications of the principles the mathematician develops, without requiring a manager to have equivalent competence in the underlying mathematics. Further—and this is an important point—the major gains in solving business problems generally come from getting in the ball park rather than from striving for a high degree of precision. Frequently, the added improvement from an extra ounce of precision is not worth the pound of effort required. It also seems illogical to devote effort to achieve extreme accuracy in one of several variables in a problem when other equally important factors can be only roughly approximated.

**ELECTRONIC DATA PROCESSING**

The development that permits a more scientific approach to be practicable in a business situation is the Computer. The developments in electronic data-processing equipment provide both the capability to process the business data required for more scientific systems and the incentive to devise more sophisticated techniques.

Business is only now beginning to learn to use EDP equipment effectively. Initially the target was clerical cost reduction. Essentially, the approach was to use this type of equipment to do what was already being done, faster and at less cost. There are exceptions, of course, but generally net cost reduction via the Computer has proved to be elusive.

More and more, companies are coming to realize that electronic
data-processing equipment should be used to get better answers to management questions; to enable the company to handle more complex problems; to allow routine decisions to be handled electronically, reserving the exceptions for personal attention; to allow application in practice of theories that, although they may have been known, were heretofore impractical.

We might review the high spots of a few situations from my experience where a more scientific approach, perhaps utilizing a computer, illustrates the basic point I have been making.

**INVENTORY CONTROL**

Inventories are a good example of what I am talking about. Most businesses have inventories of one kind or another either to feed production and supply customers or for use within an organization to support an activity like maintenance.

Some look on inventories as an asset—at least that is where they show up on the balance sheet. Others look on inventories as a cost—they tie up capital and space, involve insurance and obsolescence, and must be counted and accounted for. Of course if you need an item and don't have it, this costs money too—and this could be the major element of cost.

What management wants to do in an inventory problem is to arrive at the "right" quantity of inventory—not too much, not too little, but just the "right" amount.

This problem is quite complex. Among the factors are: the cost of acquiring inventory—the more frequently orders are given, the higher the cost of acquisition; the cost of holding inventory—perhaps running from 15% to 30% of the inventory value per year; the unit cost—it may take many dollars to buy a small supply, or a few dollars may buy a large supply; the outage cost—what might the penalty be for being out-of-stock; lead time—how long does it take to obtain a new supply; replenishment quantities—what is the economical quantity to re-order? Adding to the complications is a need to deal with each item of inventory; it is the old story all over again—for want of a nail the shoe was lost, for want of a shoe the horse was lost, etc., etc.

There is a tremendous array of systems in use today. Some depend on a warehouseman in a blue shirt to notice when a bin is empty or low. Others appear at first glance to be highly sophisticated, computerized systems that really only spew out detailed
tabulations of historical data so a stock clerk in a white shirt can say: "I guess we had better get a couple of hundred more of these."

Managers are finding out that modern techniques make this inventory problem quite manageable. The keys are, first, to classify items in an inventory not by vendor, or part number, or assemblies, or engines, or the like—but by usage characteristics; then to develop decision rules for each class to answer the questions of when to order and how much to order; then to install a data-processing system that keeps track of the flow, automatically decides what and when to order when usage is within certain limits, and signals when an item gets out of limits and equilibrium is lost.

Let's take a case from my experience. It concerns an airline with $13,000,000 invested in 37,000 parts, classified out of a larger number in terms of their characteristic of being maintenance items, not subject to planned usage. A distribution of items from high to low in terms of annual dollar usage showed 6% of the items accounting for 85% of usage. Another 19% of the items accounted for 12% of usage, and 75% of items accounted for only 2% of usage. (Such a distribution is typical of inventories.)

For an airline, the cost of a shortage is almost impossible to ascertain but it can be enormous. When a plane is grounded for want of a part there is a delay or cancellation, and perhaps loss of the revenue for that flight; perhaps there is also loss of many other revenues when the passenger swears off your line for future trips. Why not carry enough to be sure this doesn't happen? Pretty quickly you learn that to provide 100% protection against a stock-out is an infeasible solution in this as in most inventory situations. You can, however, test your inventory-decision rules in terms of the probability of stock-out, using statistics of probability, and then make a policy decision.

The solution provided for quite exquisite decision rules for the 6% of the inventory causing 85% of the problem, with a built-in statistical predictor of demand and frequent read-outs of exceptions for human attention. Looser rules were applied to the intermediate group, and the great mass of items in the lowest group were processed almost entirely without human decision. Why get fancy with the large-bulk, small-dollar group, for a miss does not cost very much and you can afford to be safe rather than sorry. So out of 37,000 items, close attention was applied to only 2,300, representing the real area for pay-off.

We cannot go into all the details here except to say that to
balance and recognize all factors, mathematical formulas were used in drawing up the decision rules. All inventory transactions are processed on a computer each night, so the buyers in the purchasing department have a deck of cards each morning telling them what to order and exception reports on each items requiring investigation. The buyer must order what the computer says, unless he has knowledge concerning the item that is not in the system; in that event higher approval is required. Generally, attempts to second-guess the system end in failure and result in being out-of-stock or overstocked.

What is this system worth? This work was started at the end of the piston era and straddled the beginning of the jet fleet build-up, so the comparisons of cost and performance get a little cloudy. It can be demonstrated, and even the client agrees, that the cost of operating the system is no more than before—there are fewer people but a higher proportion of them work at the judgment level than at the clerical level. Further, the inventory today is $5,500,000 to $6,000,000 lower than it would have been—one jet's-worth of cash freed-up, so to speak. Planes still get delayed and occasionally don't fly for lack of a part, but hopefully this is discovered before take-off; however, it happens less frequently than before.

Another type of inventory in an airline consists of items like superchargers, altimeters, and generators—items that are not expendable but are installed on an airplane and may be removed at any station owing to failure or time limitations. These items go back to the shops for inspection or overhaul, or both; then to the storeroom, back to a station, back on an airplane, and so forth. Some of these items are subject to time limitations and must be removed after so many hours in accordance with civil air regulations and company policy.

How many of these items should you own and where should they be?

The traditional practice was to send a station a new item when an old one was received at the overhaul base. This meant substantial safety stocks at each station to cover transit time and surges in usage. It also meant that overhaul shops would generally have only a first-in, first-out priority to guide them in scheduling work which might or might not supply what was needed at the moment.

This problem also yielded to analysis by use of a computer. The bulk or safety stock is now kept at the base where it can be dispatched in any direction as needed. Removals are reported to the overhaul
base by teletype immediately and a new part is sent on its way. The computer keeps time records, monitors all movement, and reports items due at and from each point. Cycle time is reduced—fewer items are needed. By anticipating arrivals at the base, shop loads, schedules, and priorities are decided in advance and manpower is adjusted accordingly. Usage is accumulated by codes indicating cause of failure or defect and calling for action with engineering designers or with vendors. The solution also extends to determining how many of an item to allocate and stock at each station on the line. This is a function of correlating, statistically, arrivals and departures of each type of aircraft with a number of other factors.

So much for inventory problems. An outstanding economist, speaking to a group of our partners, recently made the point that improvement in inventory management is beginning to have an impact on the economy. Inventory build-ups and trends are among the factors carefully studied by the economist in evaluating an industry and the economy. One impact of more effective inventory management is to lessen the disruptive effect of inventories on the business cycle.

SALES FORECASTING

Sales forecasting is a factor in many inventory problems because the center of interest is the demand to be made on an inventory of goods for sale. Forecasting is important for other reasons too—in profit planning, in establishing sales quotas, in determining market strategy and emphasis, in evaluating the life cycle of products, and for other purposes.

There are many methods for forecasting sales, running from a simple polling of salesmen’s opinions through market research and correlation techniques. All of these may have their place in a particular situation and more than one may be applied—so one method can be used to check on the validity of another.

Techniques for sales forecasting are receiving their share of attention and are continually being improved. For example, in every situation except that of a new product there are historical sales data. In situations where a continual prediction of sales is desirable—where it is used to schedule production, for instance—past sales may be the best available indicator of future sales. How is the most intelligence derived from such historical data?

The simplest situation is to assume that what happened last
period will happen next period. Moving averages are usually an improvement over this simple, prior-period sales quantity, for they obviously reflect conditions over a longer period and also reflect average fluctuations. A moving average may, however, lag behind trends and may not be sufficiently sensitive to changing sales patterns.

Much has been accomplished by applying statistical forecasting techniques directed toward overcoming shortcomings in the moving average. Exponential smoothing techniques provide a special kind of weighted moving average. By weighting past sales data mathematically, a quite reliable predictor of future sales can frequently be developed. These techniques can be applied in various ways to differing demand situations, whether demand be relatively constant, include significant fluctuations, or be subject to slow or rapidly developing trends.

Again, let me say that many such techniques are not particularly new, except in the sense that they are moving out of the laboratory and out of the hands of the academician and researcher and are being modified and applied to business situations.

SCHEDULING

Scheduling problems arise from the need to find means for getting actions accomplished in the most effective manner and means for predicting when things can be accomplished so that advance commitments can be made. Penalties for improper scheduling can be severe, ranging from the simple loss of a sale to out-of-pocket damage when a contractual obligation is concerned.

One traditional tool of the scheduler has been the Gantt Chart, in which the various component elements going together to make up a completed something-or-other are plotted against a time scale to indicate decisions on when to start on each component and when to expect completion.

The space age has brought considerable sophistication to such scheduling techniques, and the word today is PERT—meaning Program Evaluation Review Technique. PERT is credited to the U.S. Navy as an outgrowth of its planning for the Polaris program; the technique and variations of it are finding wider and wider application and acceptance in business.

Essentially, and considerably oversimplified, the PERT approach consists of breaking down any over-all project into the individual tasks or events and activities required: diagramming these events
into a network of sequential relationships; and applying time factors to activities to determine when each event can be expected to occur. Generally three time estimates are used—that is, optimistic, most likely, and pessimistic—and these are reduced statistically to a single expectancy with a statistical variance. The critical path is then found through the network, representing the series of events that are critical and that limit the over-all time required. Slack, or extra time available for non-critical events, can be computed, indicating where management has options in timing, possibly leading to reduced costs or other benefits. The application of a PERT approach may require a computer to handle a very large and complex problem, although many simpler situations do not.

As with other such techniques one of PERT's main contributions is a disciplined, systematic, logical approach to a complex problem. It requires that the best minds with the best information apply their judgment, and it supplies a structure to which such judgments can be applied to obtain definitive answers.

Once a PERT network has been built, reasonably reliable commitments can be made, and when accompanied with a system for monitoring actual events, exceptions can be noted and control applied. Originally, PERT systems dealt with time factors only, but they have been extended to cover cost factors and are now being stretched to cover reliability or quality factors as well.

Not all scheduling problems require a PERT-sophisticated system. Such developments, however, illustrate the more orderly and scientific point of view now being applied to an increasing degree by businessmen.

CAPITAL-ASSET DECISIONS

Let us look at capital-asset decisions for just a moment. Such decisions are among the most important that a management faces—for instance, whether to invest in a capital asset or not or which of several alternative investment opportunities to select.

It was not too long ago that such decisions were largely decided intuitively or by simple long division; that is, the investment was divided by the projected savings to get the pay-back period. Apply to this result a neat rule of thumb, such as: Don't invest in anything where the pay-back is over five years. Frequently this approach is all that is required. In more complex situations, however, we now find more sophisticated approaches being applied which recognize
additional economic factors. For example, a discounted cash-flow approach or a present-value method recognizes the time value of money. They are based on the premise that a return on an investment in the fifth year, for example, is worth less than the same dollar return in the first year, because the first year's return is available sooner for reinvestment. Thus, in comparing one opportunity for investment against another, the time of investment as well as the amount of return is equated with the return over the longer period being discounted to present value. Companies are searching to identify more of the elements contributing to sound capital-asset decisions and to improve their ability to measure these elements.

STATISTICAL SAMPLING

Although there are any number of other areas that could be discussed, I should like to close by mentioning only one other—statistical sampling. Sampling operations have been employed in business for a long time, as in statistical quality control in the factory. Now these techniques are finding more rapid acceptance in the office.

The cost of all the checking and verification work that goes on in our offices is tremendous. Some of the things these efforts are directed toward proving could be proved as well or better, at far less cost, by statistical sampling.

In an airline, for example, there is the huge task of accounting to and settling with other lines for all trips where more than one company performs service. Each company has its procedure for accounting for all tickets sold and all coupons lifted, for settling with other lines for moneys due, and checking settlements received from others. Much of this process could be satisfied quite reasonably on a sampling basis. I know of one airline where a statistician has been determining interline settlements statistically on a memorandum basis for several years and compares his results to that of official settlements made on a detailed accounting, ticket-by-ticket basis. The differences are insignificant, yet in the next room a large scale computer is being installed to do a more accurate revenue accounting job.

Railroads have the same problem; they maintain large revenue departments which check the work of other roads as well as compute detailed settlements of their own for the other roads to check. Here, again, cooperation among the various companies, perhaps through the American Association of Railroads, would eliminate a
sizeable economic waste and help the industry maintain its solvency. This consolidation of parallel functions has been discussed but not achieved.

There are other potential applications for sampling in all our businesses. In our Firm we have conducted intensive research into the adaptation and invention of statistical techniques for application in our auditing work. These techniques have been the subject of comprehensive training of our staff and are now applied in certain areas of that work and are being continually expanded to others. Our objective, of course, is not alone reduction in time but, more important, increasing our degree of confidence in the reliability of a client's data. This approach, along with others of similar character, has contributed to the impetus that has resulted in a decided shift in the pattern of growth of our professional staff over the last ten years or so. Today, we find a much higher proportion in the top-experience group of partners and principals, fewer at the lower, detailed-work level, and the whole process more analytical, judgmental, and yielding a better result.

CONCLUSION

Today's manager has an opportunity to consider new alternatives in selecting techniques by which to solve his problems, and we have, of course, only touched on a few of them. The more scientific approach is becoming the proven approach. The results of finding the most suitable techniques will increasingly show up in the relative performance of companies within an industry and between industries. This trend toward the scientific can be expected to accelerate as the colleges and universities continue to re-direct curriculum in this direction and feed into the pipeline potential executives with the necessary skills and this point of view.