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Marketing decision-information systems are composed of four key elements: a data bank, a model bank, a measurement-statistics bank, and a communications capability. If full advantage is to be taken of the new information technology, a coordinated, balanced growth of the system components must be achieved. The authors extend their initial information systems proposal to include further design concepts and practical examples.

Marketing Decision-Information Systems: An Emerging View

Recent years have witnessed an increasing interest in marketing information systems. It is currently fashionable for companies to have such systems under development and the professional and popular management literature abound with articles describing system developments. In the main, these systems have tended to emphasize data collection, storage, retrieval, and display functions of a marketing information system. Yet, if the full potential of the new information technology is to be harnessed for management use, it seems imperative to take a broader view of information systems. Information systems can be designed to assist managers directly in planning and decision making by combining management science, statistics, computer science, and market data into an integrated decision-information system.

The principal purposes of this article are: (1) to present a conceptual model for the evolutionary development of integrated marketing information systems, (2) to illustrate the need for a planned, coordinated growth of all components in the system, (3) to present design concepts relevant to the development of the components of the system, and (4) to identify new developments which will spur the evolution of marketing information systems and broaden the base of companies which may have access to the new technology. This article extends the analysis first presented in [14].

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A CONCEPTUAL MODEL OF A MARKETING INFORMATION SYSTEM

A marketing information system is composed of four major internal components: (1) a data bank, (2) a measurement-statistics bank, (3) a model bank, and (4) a communications capability. These internal components interact with two external elements: (1) the manager or user, and (2) the environment. (See the figure.)

The data bank provides the capacity to store and selectively retrieve data which result from monitoring the external environment and from internal corporate records. The manager will probably not be interested in the raw data per se. For decision purposes he will generally require the data to be processed. In the simplest case, he may require sales summaries or market share information. Thus the data bank must also provide the capacity to manipulate and transform data.

The data from the data bank may be displayed directly to the manager, but in many cases it will be analyzed by statistical methods. The measurement-statistics bank provides the capacity for more complex analysis of data such as multiple regression, cluster analysis, factor analysis, and multidimensional scaling. The measurement-statistics bank should also contain procedures for obtaining and evaluating subjective marketing judgment. For example, these judgmental measurements may be in the form of sales forecasts, forecasts of competitive promotion, or subjective utility assessments. Judgmental measurements have been and are likely to continue to be important inputs to marketing models. The judgmental data may be stored in the data bank for later use.

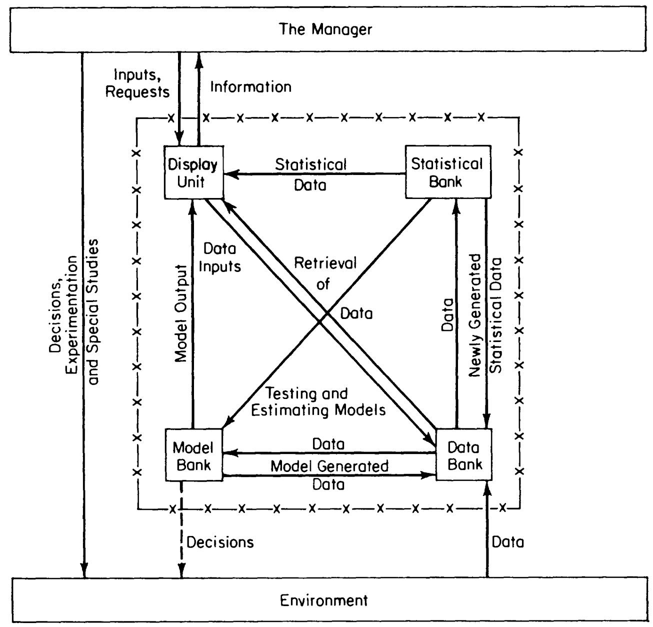
The model bank provides a variety of marketing models at different levels of complexity appropriate to the understanding and solution of marketing problems. Examples are budgeting models, new product planning models, and media selection models, which make use of the data from the data and measurement-statistics banks as well as direct user input and subjective measurements. The model bank interacts with the statistical component, since the adequacy of a model may be assessed by methods available in the measurement-statistics bank. In special cases models may interact with the environment, as when models are delegated authority to make routine decisions directly (e.g., as in certain inventory reorder systems and Amstutz' stock market model [3]).

The final system component is the communications capability. It gives a two-way link between the user and the system, a critical element since meaningful communication is necessary if the system is to be used.

THE DATA BANK-MODEL BANK INTERACTION

These brief sketches indicate some of the interdependencies between system components. Perhaps the most crucial one is that between the models in the model bank and the data retained in the data bank. Marketing models generally require data for use in model formulation, choosing among alternative market response relationships, and model testing. Market data relevant to the dynamics of the market place are generated over time, often with considerable lapses between observations. Thus at any point, the development of a marketing model is constrained by the data (perhaps judgmental) available. If important information is missing, development will have to rely heavily on judgment until the appropriate data develop. While this is not meant to demean the role of judgment and sensitivity analysis of judgmental inputs to models, management's faith in models and its willingness to use them does seem positively related to the model's exposure to actual market data. Consequently, decisions made today on what data to obtain and retain in the data bank have implications for future model development.

DECISION-INFORMATION SYSTEM STRUCTURE



Information System Boundaries —x—x—

Two recent examples from the experience of one of the authors will illustrate the point. The first example relates to a firm in the process of forming a multi-firm marketing information system in the pharmaceutical industry. One of the key elements in this new system is the development of models to assess the impact of competitive market communications. In this industry, these take three forms: journal advertising, direct mail to doctors, and details (sales calls) on doctors. Commercial data sources have existed for some time on each of these activities. Past use of the data has, however, tended to be for short-run assessment of the market. With old data discarded, data are available only back to 1967, which seriously limits the data base on which to formulate and test the dynamic measurement models. Now that models are being developed which require this data, more complete data retention in the future seems assured. The second example relates to a research study on a non U.S. market being done in conjunction with the international division of a large drug firm. In this international market, as well, much potentially valuable data (such as competitive detailing) has been discarded by its commercial supplier. Thus again, valuable raw material for model development has been lost because it was viewed as "current information" by the supplier, who gave no thought to the possibility of future model development.

These are not at all isolated examples. It is painful to contemplate the volume of potentially useful data discarded by both companies and commercial suppliers. The remedy seems clear. If a firm expects to become active in marketing models at any time in the next five years, it is imperative that it now assess something of the likely form of these models and their data requirements. This should then have an impact on decisions to obtain and retain data.

Further examples can be given of the interdependency between models and data. Models provide a framework for identifying what data should be collected and how it should be processed once obtained. In a recent paper Madansky [11] states ". . . that modeling has produced and will produce both the impetus within companies for an organized, unified, coherent data collection program and the spark for novel types of data to be collected." He cites an example in which a client, a multiproduct, multisales-area company, wanted a computer-based system to organize the vast volume of data it collected and purchased. The goal was to obtain useful information for advertising and sales promotion decisions. The first step was to structure a decision model based on variables for which data was already available or readily obtainable. The model identified additional data needs. It also prescribed the form of the data required for analysis. Thus it specified the manipulations and transformations required to provide the data in model-compatible form. In this case the transformation suggested a revision in the data collection procedure to make the data directly compatible with the model. In Madansky's words, ". . . we have gone from a decision model to a data bank organization scheme for the client." The Little-Lodish media selection model, MEDIAC, provides another example [9]. It utilizes only single media exposures and paired duplications of exposures in developing a media schedule. Hence, the model again specifies the data collection scheme—no triplication data, no quadruplication data, etc., are needed.

INTEGRATED SYSTEM IMPLICATIONS FOR ORGANIZATION OF SYSTEM DEVELOPMENT

These interdependencies between systems components, particularly the intimate relation between models and data, have significant implications in composing teams assigned to develop a marketing information system. The corporate groups generally responsible for the various activities subsumed in the information system are: (1) market research, traditionally concerned with the types of data collected and programs and methods for its analysis (the measurement-statistics bank), (2) computer system group, generally responsibile for maintaining computer-based data files and generating management reports (one aspect of the communications function), (3) operations research, usually responsible for models.

When the marketing information system is viewed as a data storage and retrieval system with some associated report generation and statisical analysis, the system development team will most likely be composed of representatives from marketing research and computer systems. This is not likely to lead to data and system design decisions which will serve future model development needs of the firm. What is needed is a system development team of representatives from all three functions to assure balanced system development. Perhaps the ideal would be a staff group (called something like marketing information services) with responsibility for the total system including marketing-operations research. It would have its own computer programming capability as well as access to computer hardware both internal and external to the firm. This latter point seems important in view of the frequent complaints from marketing personnel that they cannot get service from the corporate computer staff. Since most corporate computer staffs grew out of accounting type applications, large scale, routine data processing of billings, payrolls, and orders generally takes precedence over other applications. Consequently marketing will often have to access outside time sharing computer utilities and computers with remote batch processing capabilites.

THE DATA BANK

The data bank involves two primary aspects: (1) the data, and (2) computer-based and manual systems for data storage, retrieval, manipulation, and transformation. In the discussion of these two aspects, several emerging design concepts will be outlined.

The Data

An extensive discussion of appropriate data for the data bank is outside the scope of this paper, but careful consideration must be given to the specification of what data will be maintained within the system. See [14] for some examples.

Data specification must give forethought to future activities in marketing models for the reasons cited before. For example, the collection and maintenance of competitive market activity data will be increasingly important (as better models are developed to assess the impact of these activities) to support the development of better models. Many of the data categories will subsequently be related to achieve a better understanding of market response. For example, data on copy and format in company advertisements may be related to advertising performance measures in order to learn systematically how the market is responding to these characteristics of ads. Cox and Good [4] report that one large consumer goods company is doing precisely that, while Diamond [5] has developed an on-line model called ADFORS which utilizes the results of such analysis.

A key concept in the design of a data bank is to maintain data in its most elemental, disaggregated form. For salesmen's call reports, disaggregated data might be details such as person visited, time, place, sales aids used, etc. An aggregated form for such data might be simply the number of sales calls made by a salesman to accounts of a given type over some time period. Maintaining disaggregated data enhances the flexibility of its future use, to allow for organizing it differently for future, unknown purposes. Amstutz [3] discusses the benefits of future flexibility in his computerized portfolio selection system: "If initial data files had been structured to maintain information at the level of aggregation required when the system was begun, many operations of the present system would be precluded by data limitations."

Because of the high cost of physically storing disaggregated data, the data may not be maintained initially in computer disk storage, but on tapes, cards or even original work sheets. It is important, however, that it be preserved, to be accessed by model builders and managers when required.

The data bank should maintain information on who used which data and for what purposes. This should aid decisions on which data should be kept in high speed computer storage. Thus the data bank should gather information appropriate to adapting itself to better meet the needs of its users and developing specifications for the storage of disaggregated data.

Systems for Processing the Data

Two key issues in the development of the processing systems within the data bank are modularity and flexibility. Since the design of the data bank will be an evolving one rather than a one-shot, forever optimal system, the system must be readily adapted to change. Perfect foresight is not required if the system is flexible. Modularity in the processing systems (i.e., compartmentalization of the processing functions) will tend to minimize problems involved in adapting the processing systems to future requirements, since then existing moduals can be linked to meet the new demands.

Developing a variety of general commands to retrieve and manipulate data gives flexibility in data processing. These general commands may then operate on the data, whatever the data file may be. Although not specific to a particular data file, they greatly reduce the problems when a file is altered by additions, deletions, or reorganization. An example of an operational data handling system using such general commands is the DATANAL system developed by Miller [13].

Security Systems

The data bank must have security systems at both the processing systems and data levels. At the systems level the system itself must be protected from the user, to prevent inadvertent altering of the system programs. Such accidents can be costly and frustrating. A more interesting aspect is the need for data security systems. The problem here is who may have access to what. It is clear that individuals below a certain level in the organization should not have access to certain types of information. But there may be data which should not be conveniently accessible to, say, the marketing vice president. A case in point is given by Amstutz [2] in which a sales vice president was able to access very detailed information on sales results in individual territories which distracted him from his real assignment, providing overall market planning and strategy.

In addition to vertical security, there is a need for horizontal security systems. As Ackoff [1] notes, organizational harmony and efficiency are not necessarily enhanced by letting, say, marketing and production have complete access to one another's data files. Horizontal security between firms becomes important with the emergence of the multi-firm marketing information system.

Communication of Data

A data bank must be accessible to the manager. An interactive man/system operation is an important system design aspect, to be discussed later. However, the capability a remote terminal provides a manager does allow the data bank to carry out one more function, "data browsing," where the manager can look at various aspects of operations data to find problems before they are severe enough to get management's attention through standard means such as exception reporting.

Although the ability to access data in a relevant form is important, it is not enough. Information systems must digest, analyze, and interpret data so the managers can improve decisions. If the data bank is more emphasized than analysis and models, the manager may suffer a data overload and receive little help in decision making. The model bank and the measurement-statistics bank are designed to help the manager analyze and make sense out of data.

THE MODEL BANK

The model bank provides the marketing information system with a capability to assist directly in decision making. It should contain many models appropriate for purposes such as understanding market behavior, diagnosis, control, prediction, and strategy formulation, all likely to be frequently used. Models for analysis of one-time market situations will remain, but they will often be "back-of-the-envelope" models like Hess' price timing model [7]. Unless they have potential for recurrent use they will not be made permanent in the computerized model bank, although they may temporarily reside there.

Some Model Bank Design Aspects

The model bank should contain models of varying levels of detail within each class of models and for each marketing problem area, to reflect alternate model cost/benefit tradeoffs. More model detail is generally useful, but as more variables are included in the model, more phenomena are considered, and more disaggregation takes place, the time and financial costs of model development, input generation, operation, maintenance, and testing rapidly increase. The best level of detail in a particular application will depend on time and resource constraints on model development and operation as compared to improvement in decision because of the higher level of detail.

The model bank concept presents a partial solution to this problem by making models of varying levels of detail for a particular problem available to the decision maker. For example, SPRINTER, a model for the analysis of frequently purchased consumer goods, exists in three levels. Mod I is a very simple description of the diffusion process. Mod II adds the controllable variables of advertising and price. Mod III uses a very detailed market response model based on the behavioral buying process and adds sampling, coupons, margins, and sales calls [18]. Mod I is simple but runs at 10% of the cost of Mod III, and 50% of the cost of Mod II. With these alternatives the manager can select the model which has the best cost/benefit tradeoff for his particular problem.

The model bank might even contain a number of models at a given level of detail for a given problem with each model particularly meaningful to specific managers and their decision styles. Thus, the model bank may ultimately have several levels of model detail and multiple models at each level to service the decision needs of various marketing managers. Development of the model bank must be an evolutionary, adaptive process which adjusts to the varied and changing needs of the managers.

The models should be compatible with models at other levels of detail. Simpler models could be used to evaluate a large number of alternatives and the more detailed ones to evaluate the specific outcomes of one or a few of the alternatives generated by the less detailed model. For example, an aggregate advertising budget model might be used to specify an annual budget. Then a media allocation model could be used to indicate the best media schedule and finally this schedule could be submitted to a micro-analytic simulation to obtain detailed attitude change and micro-purchase response results by market segment. The results might indicate the need for adjustment of the preceding analysis of budget level and media schedule and provide a benchmark for control purposes once a policy has been implemented. This compatible use of models allows low cost examination of many alternatives and a high level of model detail. It should strengthen the value of the model bank and improve its ability to serve decision makers.

Trends in Marketing Models

The model bank concept is supported by a number of new developments in modeling.[1] The first is the emergence of a problem-centered orientation. Much of the early work in marketing models could be characterized as techniques looking for problems, which often sacrificed marketing relevance to satisfy a given solution technique. The rush to formulate the media selection problem as a linear program is a case in point. There are now hopeful signs that marketing problems will begin to dominate techniques in the formulation of marketing models. This trend has been spurred by maturing experience in structuring marketing models, the realization that successful implementation and use depend on this approach, and steady progress in management science and operations research in approaching more realistic and complex problems. Although optimization techniques are improving, the trend in marketing is to non-algorithmic techniques such as heuristic programming and simulation. These are more capable of rich representation of the interdependent and dynamic nature of marketing problems.

Another development is the growing availability of data for estimating and testing models, which should bring more realistic, detailed, and valid model structures. The trend toward realistic market response representation is aided by inclusion of more behavioral phenomena, more variables, non-linear response functions, and stochastic elements in marketing models. Dynamic aspects of markets are also increasingly being incorporated. A significant model trend emerging from development of time shared computers is that toward interactive models. An interactive model operating on a time shared computer system enables a decision maker to quickly and efficiently explore implications of his judgments on given problems. The MEDIAC [9] and ADFORS [5] models provide marketing examples here.

A major development trend is towards inclusion of dynamic effects; Little [8] has proposed a model for adjusting an advertising budget in the face of a changing environment via a series of continuing market experiments, the results of which are used to update the budget decision.

Another model trend is emerging towards building models considering competitive effects. These will have a significant interaction with the data bank. The de-

[1] This section is designed to emphasize the directions of expansion of the state of the art, rather than the basic methodology of existing models. A detailed discussion of models is in [14].

velopment of competitive models must be supported by data bank capabilities in systematic monitoring and storing of competitive market data for developing, validating, and using these competitive models. It would seem important for firms to consider initiating a program of competitive data generation to match their future model intentions.

In addition to competitive and dynamic phenomena, there has been a trend towards including more behavioral content in mathematical models. For example, NOMAD has modeled the new product acceptance process basically as an updating of a brand preference vector on receipt of new advertising awareness, word-of-mouth communication, and product use experience [6]. This behavioral process approach has been utilized in SPRINTER: Mod III at a more aggregated level [18]. A general development of methods for use in behaviorally-based simulation models will play an important role in future models. While better solution methods will be evolved, principal developments will also occur in validity and sensitivity testing of complex behaviorally-based models.

The trend toward model banks with models which include competitive, dynamic, and behavioral phenomena will increase models' importance in the total information system.

THE MEASUREMENT-STATISTICS BANK

The measurement-statistics bank will provide a basis for measurement and estimation and methods for testing response functions and models. It should incorporate methods for both data-based and judgment-based estimation, such as procedures for estimating demand elasticities of marketing variables based on data in the data bank. It should also provide methods for judgmental assessments, such as the reference life cycle for a potential new product in an application of a new product model. In testing response functions and models it should provide techniques for assessing the adequacy of a postulated model or function in the light of available data.

Data-Based Measurement

The recent marketing literature makes the case for data-based measurement methods in marketing clear. The measurement-statistics bank should incorporate a wide variety of multivariate procedures, non-parametric methods, scaling techniques, and numerical estimation procedures [14].

Judgment-Based Methods

Marketing models, particularly normative models for planning marketing strategy, often require a certain amount of judgmental input. While much remains to be learned about effectively obtaining judgmental information, these methods should be incorporated into the system as they evolve.

One obvious example of a judgment-based method applicable in marketing is statistical decision theory. A barrier to its use, however, is the computational burden involved in problems large enough to be meaningful. A program which will perform the numerical analysis, preferably in real time from a remote console, should increase the use of this procedure. If a convenient mode is made available to marketing managers, there should be an increasingly widespread use of decision theory in marketing. Some simple steps have been made in this direction [17].

The importance and utility of judgmental inputs and systems for their evaluation can be illustrated by examples. The first of these, which must remain anonymous for competitive reasons, relates to an application in a company whose problem was to determine which items to feature at what prices in weekly ads to increase store traffic, sales, and profits, as well as how much ad space to allocate to each featured item. Store managers and a consultant developed a simple model describing how the market would respond to this form of promotion. It was made operative on a time shared computer and made available to managers for planning their weekly promotional strategy. It required judgmental inputs from managers, and has produced excellent results in use. The consultant attributes this success to the managers' ability to provide meaningful judgmental inputs to this simple marketing model. This case reinforces the notion that useful judgmental inputs to formal analysis can be obtained from marketing managers.

Another example of the use of judgmental inputs is represented by an application of the SPRINTER: Mod O model to a new chemical product. In this case managers gave good subjective estimates of market response components, but without a model they could not combine them effectively to make the GO, ON, or NO decision and specify a best pricing strategy. Their overall subjective decision was GO for the product, but by combining their component inputs in the model and using their criteria and structure, a NO decision was indicated. Their overall subjective decision was not consistent with the logical combination of their market response judgments. A model can help produce more consistent decision procedures. In this particular case the subjective market response input and the model were also used to identify a pricing strategy predicted to generate 50% more profit.

In view of subjective inputs' importance, the system should include procedures for monitoring their performance from individuals in the firm to help identify individuals who are particularly knowledgeable and help adjust for bias in individual estimates.[2] For example, one company in a rapidly growing area combined judgmental inputs and market data in selecting sites for new outlets. In

[2] This is similar in concept to the monitoring and adjustment of judgment in applications of PERT.

this case, monitoring of the performance of individuals supplying judgmental inputs indicated that the operations vice president tended to supply better judgmental inputs than any of the personnel on the real estate staff. When he subsequently resigned, the company not only lost a competent executive but also a valuable source of judgmental marketing information. The system should also correct any systematic bias in the estimates given by each individual. Claycamp has developed such a procedure for a manufacturer of electronic components, who asks salesmen to report an a product-by-product and customer-by-customer basis their subjective probability of realizing a sale in 30, 60, and 90 days. Each salesman's subjective probabilities are then adjusted on the basis of his past prediction performance. When aggregated across salesmen, subjective probability estimates are the basis of a short run sales forecast used by the production department.

Judgmental inputs are being used in systematic analysis of marketing problems. Interesting work has been done by Winkler on the use of experts and group judgments [19, 20]. He has also proposed some incentives for managers to supply their best judgments, but more research is needed to develop procedures generating good subjective estimates.

Some Design Aspects of the Measurement-Statistics Bank

Computerized statistical analysis has greatly lowered the computational burden in perfoming such analyses. The proliferation of readily available programs for statisical analysis makes it important that a proposed measurement-statistics bank be designed to minimize danger of misuse [10].

As an example, consider regression analysis. The measurement-statistics bank should incorporate complete econometric capability in all the available tests of assumptions which underlie the model. The measurement-statistics bank itself should warn the user of potential pitfalls and recommend appropriate tests and courses of action. Such system warnings and recommendations should help prevent naive use of this method. Sometimes the system can automatically get the user out of trouble. For example, the on-line statistical package DATANAL automatically performs a Fisher exact test when the user has specified a chi-square contingency analysis with insufficient data [13].

The design of the measurement-statistical bank is especially important since model outputs are only as good as their input. A good measurement capability is necessary for effective operation of a decision-information operation.

THE USER-SYSTEM INTERFACE

The last major component is the subsystem which provides the user-system interface, or system input/output capability. As the only direct contact between the user and the system, it is crucial that this interface be designed to provide for convenient, efficient user-system interaction if the marketing information system is to have impact on management.

While the more traditional batch processing operations will continue to play a useful and important role in marketing information systems of the future, our attention will focus on the newer capacity for a closely coupled relationship between manager or user and the system, made feasible by the advent of time shared computers. Time shared systems allow many users to access and use a computer simultaneously. At present the most common form of interactive communication is the remote typewriter. While this form of input/output has been enormously useful and will continue to be so, computer graphics will come to play a much larger role in the future, because graphical display is often a more convenient medium in which to communicate with management.

Morton has described the use of such a graphical "management terminal system" in coordinating marketing and production planning in the consumer appliance division of Westinghouse [15]. This process originally absorbed three weeks of calendar time and six days of executive time. The new graphical system used the same data, models, and analytic approaches, adding nothing more than the capacity for interactive graphical display of such items as forecasted and observed sales, production, and inventory over several time periods by product. The graphical system changed the decision making style drastically: the three top managers coordinating marketing and production would now do so by having a session at the interactive video console. Calendar time required was reduced from three weeks to one half day, executive time from six man-days to one. Thus valuable executive time was released and the organization became more responsive to planning errors since the correction time was dramatically reduced. In addition to these objective results, it was also felt that decision making had improved as a result of the use of this system.

Consider also the problem of sales territory definition for a large sales force. A map of the area to be partitioned could be projected on a graphical display device connected to a computer containing relevant information about the area and the salesman (e.g., distribution of present and potential customers in the area). With a light pen, the sales manager could partition the graphic display area into sales territories. Once at a territory definition which he would like to consider, the computer could take the graphic input and evalute sales and marketing implications of the proposed territorial definitions with a sales model or models using area information stored in the data bank. If the manager approved of his current territorial definition, he might decide to adopt it. Probably he would like to explore several alternatives to achieve a satisfactory (even if not globally optimal) definition. This method of user-machine interaction should enable the manager to effectively use his business judgment in creating alternatives. The computer, as an enthusiastic clerk, would then assist him in evaluating each alternative. Prototypes of this type of graphical territory definition have been developed at MIT's Project MAC for the political redistricting of Massachusetts.

Interactive systems offer several significant advantages in marketing information systems. While they have not yet been fully demonstrated in formal, scientific studies, experience with such systems to date would tend to reinforce these notions. Interactive systems offer the advantages of better data retrieval and interpretation, more timely answers to questions, and, hopefully, better solutions to problems.

Interactive systems allow effective data retrieval since data requests can be answered almost immediately and a conversational mode can lead to a succession of questions and answers meaningful to managers. For example, DATANAL allows a user to access a data base, abstract portions of it, manipulate this working data base to answer questions, and carry out statistical analyses [13]. A brand manager could access test market data to find out how many people are aware of his product, then table awareness against preference, and finally use a chi-square for significance testing. The ability to browse in the data base, ask questions, and receive answers, greatly enhances the manager's ability to interpret data and find problems. A specific marketing example is MARKINF, a language designed to retrieve, manipulate and statistically analyze sales area data [12].

Interactive systems provide more or less instant access to data, models, and measurement capabilities and thereby provide an important calendar time advantage over batch processing systems. This has two major payoffs: (1) it may make analysis feasible or enable it to be more thorough, and (2) considerable executive time may be saved. An interactive system may make analysis feasible in certain situations subject to severe time constraints and may permit more thorough analysis. Consider the corporate acquisition process. Standard practice is for the potential acquiring company to have its acquisition officer study the candidate and develop a set of alternative analyses indicating the likely future of the parent company, the candidate, and the combined companies. Inevitably, during the negotiating sessions, an officer of one of the companies involved will object to some assumption and will want to substitute an alternative. This can easily result in costly delays as well as future meetings before an agreement can be reached. Such a system, as developed by Seaman, should reduce these problems. His is in the process of further development and implementation at Raytheon [16].

In addition to a real time advantage, interactive systems, particularly interactive models, have some differential advantage in solving problems. When a manager can access a model in an interactive mode and try varying input or environmental conditions on the model to see how it reacts, he quickly gains some feeling for how the model responds and whether or not he feels that its behavior is reasonable. Once he has assured himself that it behaves reasonably, the path to management utilization of the model is much smoother. A case in point here would be Little and Lodish's MEDIAC media selection system [9]. This model operates in an interactive mode via a remote teletype. When a media planner is first exposed to this model, he generally tries a variety of alternatives to see if the recommended media schedule makes sense. If it does, his willingness to utilize the model is considerably increased.

It can be concluded that the manager-system interface is critical in the decision-information system since its effectiveness in large measure will determine the usage level of the system. While computer software will improve, a human buffer in the form of a trained specialist probably will still be needed. He would assure that the manager is accessing appropriate models and answer the input and model questions the manager will generate.

CONCLUSION

The interdependency between information system components should be re-emphasized. These have a significant bearing upon the evolutionary development of a marketing information system and upon the personnel required to achieve a balanced development in system components. Most existing information systems have been used for the storage, retrieval, and display of data. This emphasis is not surprising since the team which generally develops such systems is largely composed of computer systems personnel and rarely includes a member of the staff responsible for model-based market analysis. As a consequence, most marketing information systems have not achieved a balanced growth or tapped their full potential.

A balanced growth of the system components is necessary if full advantage is to be taken of the new information technology and advances in marketing models and measurements. For example, the data bank design decisions related to the level of data detail and the length of time historical data will be retained place constraints upon the type of marketing models which may be developed at any point in time.

There is also a need for a planned, balanced growth between the model bank and the data support system. For example, one of the features of future marketing model development will be richer representations of competitive interdependencies. Requisite to the development and implementation of such models will be the collection and storage of competitive data, which may involve many months or years for sufficient data to develop. The initial breakthrough will probably be made in data rich industries such as the pharmaceutical industry. It is no accident that the richest market simulation has been developed in the ethical drug market.

In planning the growth and development of a decision-information system, the manager is a key element. He sets the system goals, defines problems, and is the raison d'etre of the information system. Often, however, his lack of knowledge about models and their potential has led to an over reliance on the existing data needs and decision structures. This results in systems that function only to retrieve and display data (the data bank functions). In order to assure that the contribution of models, measurement, and statistics are fully realized, management scientists must take an active role in system development. They must make their potential contribution known and become deeply involved in the human problems of system development.

If models are to be widely used in the future, they will have to be integrated within the information system context. If the management scientist is involved in the system, his models will probably improve since he will be in a position to help assure that the system will maintain information which will be important in future formulation, estimation, and testing of marketing models. Without the participation of the management scientists, such information might not be maintained in appropriate form within the system.

Three other trends should aid in the design and utilization of decision-information systems. The first is an increasing concern with the human dimensions of system implementation. The second is towards time shared computer utilities. A computer utility offers access to powerful computers and software packages on a usage basis. Thus, what was once an enormous investment in men, machines, and systems has been reduced to much smaller and more convenient units. This lowering of the entry barriers means that the most powerful computers are available to even modest sized firms.

The third and concomitant development has just begun. It is what might be called the "models utility." A model utility is one which makes a model or models available on a syndicated basis via a time shared computer utility. Such a model utility could (and does) offer models for media planning, advertising budgeting, brand management planning, and new product analysis on a time shared basis. Again, this development has lowered the barriers to smaller organizations. Modest sized firms and agencies may now feasibly have access to the new model technology. It seems safe to predict further developments on this front in the next few years. For example, model utilities and computer utilities may be combined in a multi-firm marketing information system. In such a system, an independent entity is established for the purchase of computers or computer time, collection of data, and development of data, models, and measurement banks which will be used by all the sponsors. Support of such independent efforts serves to reduce the risks and financial burdens in system development. Such a system is currently being developed in the ethical drug market.

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