Strategic Planning for Management Information Systems

By: William R. King

Abstract

Planning for the information systems in an organization generally has not been closely related to the overall strategic planning processes through which the organization prepares for its future. An MIS strategic planning process is conceptualized and illustrated as one which links the organization's "strategy set" to an MIS "strategy set."

The literature of management information systems (MIS) concentrates largely on the nature and structure of MIS's and on processes for designing and developing such systems. The idea of "planning for the MIS" is usually treated as either one of developing the need and the general design concept for such a system, or in the context of project planning for the MIS development effort.

However, strategic planning for the informational needs of the organization is both feasible and necessary if the MIS is to support the basic purposes and goals of the organization. Indeed, one of the possible explanations [6] for the failure of many MIS's is that they have been designed from the same "bottom up" point of view that characterized the development of the data processing systems of an earlier era. Such design approaches primarily reflect the pursuit of efficiency, such as through cost savings, rather than the pursuit of greater organizational effectiveness.¹

The modern view of an MIS as an organizational decision support system is inconsistent with the design/development approaches which are appropriate for data processing. The organization's operating efficiency is but one aspect for consideration in management decision making. The achievement of greater organizational effectiveness is the paramount consideration in most of the management decisions which the MIS is to support; it also must be of paramount importance in the design of the MIS.

There is an intrinsic linkage of the decision-supporting MIS to the organization's purpose, objectives, and strategy. While this conclusion may appear to be straightforward, it has not been operationalized as a part of MIS design methodology. There are those who argue that the MIS designer cannot hope to get involved in such things as organizational missions, objectives, and strategies, since they are clearly beyond his domain of authority.

This article describes an operationally feasible approach for identifying and utilizing the elements of the organization's "strategy set" to plan for the MIS. Whether or not written state-

¹"Efficiency" may be thought of in terms of a ratio of output to input. "Effectiveness" relates output to the goals which are being sought.
ments of these strategic elements — e.g., missions, objectives, etc. — exist, it still often will be necessary to perform the identification phase of the analysis, since such written statements are frequently outdated, or may be of the variety that are commonly produced for public relations purposes rather than for strategic management purposes. If credible statements of organizational purpose and strategy do exist, only that portion of the process which deals with transforming organizational strategy into MIS strategic parameters need be implemented.

MIS Strategic Planning — An Overview

Figure 1 abstractly shows the overall process for performing MIS strategic planning. This figure shows an "MIS Strategic Planning" process which transforms an "Organizational Strategy Set," made up of organizational mission, objectives, strategy, and other strategic organizational attributes, into an "MIS Strategy Set," made up of system objectives, constraints, and design principles.

Figure 1 describes an information-based approach to strategic planning for the MIS in that it identifies an information set — the "MIS Strategy Set" — which will guide the design and development of the MIS. While the elements of this MIS Strategy Set — system objectives, constraints, and design principles — are not usually thought of in this context, they are generally recognized to be the guiding considerations in developing the MIS design (e.g., [10]).

However well recognized the elements of the MIS Strategy Set are, Figure 1 shows the MIS Strategy Set as emanating directly from another information set, the "Organizational Strategy Set." This direct relationship between the two information sets is neither well recognized nor operationalized. It is this linkage which is the province of MIS Strategic Planning and it is on the operationalizing of the transformation process between these two information sets that this article focuses.

It will prove useful to describe both the "Organizational Strategy Set" and the "MIS Strategy Set" in some detail, before describing an operational process for accomplishing the MIS Strategic Planning function which is described conceptually in Figure 1.

The Organizational Strategy Set

The "Organizational Strategy Set" is composed of those elements of organizational purpose and direction which are developed as a result of the organization's strategic planning process — the organization's mission, objectives and strategy — as well as certain other strategic organizational attributes which are of particular relevance to the MIS.

Since the terminology which is applied to these strategic planning outputs generally varies from

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**FIGURE 1. Overall MIS Strategic Planning Process**
company to company and between business firms and public agencies, it is useful to define and illustrate the elements of the organizational strategy set used in this article. No inference should be drawn that these are proposed as the "correct" descriptions, or that the definitions used here are universally appropriate; rather, the delineations are useful for fully developing the MIS Strategic Planning process.

**The organization's mission**

The broadest strategic planning which must be done by an organization is that of its mission. An organization's mission statement tells what it is, why it exists, and the unique contribution it can make. The mission answers the organization's basic question, "What business are we in?" Some people consider such questions idle academic nonsense; to them, their mission — the business that they are in — is clear: "We make widgets," or "We run railroads."

It became increasingly apparent during the 1960's that such thinking was too limited. Organizations which felt that they knew their business disappeared in vast numbers from the scene. Today's business, however bright its growth prospects may appear, may not exist in its current form in only a few years.

Conversely, during the 1970's, it also became apparent that firms which slavishly followed expansive views of their mission could encounter serious problems. Broad mission statements were open invitations to get into new businesses solely on the criterion of "potential profitability." Such a criterion does not take into account vital factors such as expertise — technological, market, and otherwise; neither does it take into account the uncertainty which is inherent in potential profit. Many of the companies which got into new "growth" businesses on this basis in the 1960's found themselves in the position of selling off unprofitable ventures in the 1970's [12]. These problems have led to the conclusion that the mission statement for an organization must carefully define what it does not do, as well as what it does.

The values of such a clearly defined mission statement can be illustrated with the "business statement" of one medium-sized firm:

We are in the business of supplying system components and services to a worldwide, non-residential air conditioning market. Air conditioning is defined as heating, cooling, cleaning, humidity control, and air movement.

While such a statement may at first seem to be the same as "We make widgets," it clearly specifies by exclusion many things that the firm does not do: it does not supply air conditioning systems — rather it focuses on system components; it does not address itself to the residential market for air conditioners; etc.

**The organization's objectives**

Once the organization's mission has been determined, its objectives — desired future positions or "destinations" that it wishes to reach — should be selected. These destinations may be stated in either quantitative or qualitative terms, but they should be broad and timeless statements, as opposed to specific, quantitative goals, or targets.

For instance, among the stated objectives of PPG Industries are:

"1) ... to increase earnings per share to attain a continuing return of 14.5% or more on stockholder's equity and to provide consistently increasing dividends [the prime objective]."

"2) ... to employ the least number and highest quality of people necessary to accomplish the prime objective and to provide them with the opportunities to develop and apply their fullest abilities."

"3) ... to have the company accepted as a dynamic, responsible, professionally managed, profit oriented corporation engaged in exciting and important fields of business, with the ability to meet successfully the economic and social challenges of the future." [5]

While such statements may at first appear to be "motherhood and sin," they say very important things about the company. For instance, the "image" objective, #3, says that PPG cares greatly how it is thought of in society. This serves to clearly constrain other choices which must be made in the planning process, e.g., strategies which may be followed to attain the prime objective.
**The organization's strategy**

The organization's strategy is the *general direction* in which it chooses to move in order to achieve its goals and objectives. For instance, one company has stated that it:

"... has heavy investment, a good reputation, great skills and experience, a viable organization, and, in some instances, a special situation in the ... industries."

and that it will:

"... exploit these strengths and, ... not diversify at the present time, into unrelated industries."

A more detailed strategy for another firm includes the following:

"... increase U.S. market penetration through the development of a regional manufacturing capability and the development of secondary distribution channels."

Another company's strategy calls for a:

"... low-price, low-cost product achieved through product standardization ..." together with:

"... the development of new products on a similar basis in a posture of defensive innovation against the technological progress of competitors."

Again, as with a mission statement, the strategy is as important for what it does not say, as what it does say. By excluding numerous, possibly valid ways of achieving a stated objective, it ensures a focusing of organizational resources and precludes a "scatter-gun" approach which is likely to be ineffective and which is likely to result if numerous managers are permitted to make decisions without strategy guidance.

**The MIS Strategy Set**

The MIS strategy elements, which are the substance of strategic planning for the MIS, are system objectives, system constraints, and system design strategies.

**System objectives**

System objectives define the *purpose* which the MIS is to serve. For instance, system objectives may be stated in terms that are similar to, but much more specific than, organizational objectives — e.g., "to permit the payment of 98% of invoices by the due date" is a system objective stated in *activity terms*. Also, system objectives may be stated in direct *information and communication terms* — e.g., "to collect, and process all routing and cost information and provide it in a timely fashion to the dispatcher." The most sophisticated variety of system objectives are stated in decision-oriented terms — e.g., "to permit the determination of the best routing no more than one hour after the tentative routing choice has been implemented."

**System constraints**

Both internal and external constraints must be identified if MIS planning is to be effective. These constraints will emanate both from outside and within the organization.
The MIS Strategic Planning Process

The process for MIS strategic planning is one of transforming the Organizational Strategy Set into an appropriate, relevant, and consistent MIS Strategy Set.

Explicating the organization's strategy set

The first step in MIS strategic planning is the identification and explicating of the organizational strategy set. Some elements of the organizational strategy set may exist in written form. The organization's strategic, or long-range, plan is the most obvious source of such material. So too are various pronouncements made by chief executive officers in reporting to their various constituencies: stockholders, unions, government, etc.

However, existing plans may be deficient if the planning process is not a sophisticated one which explicitly gives consideration to such broad choices as that of the organization's objectives. Other documentary evidence may be deficient in that it is prepared for a "public relations" purpose rather than for the purpose of guiding managerial choice. If so, an explicit process of identifying strategy set elements will be required of the MIS designer.

Such a process may be thought of in terms of a number of steps:
1. delineating the claimant structure of the organization,
2. identifying goals for each claimant group, and
3. identifying the organization's purposes and strategy relative to each claimant group.

Delineating the organization's claimant structure

The organization's purpose, objectives, and strategy must necessarily relate to its various clientele, or claimants — those who have a claim on it. These claimants, sometimes referred to as "stakeholders" to distinguish them from the legal owners of corporations, have a stake in the activities and future of the organization. Thus, most business firms will delineate its owners,
managers, employees, suppliers, customers, and creditors as claimant groups. Other claimants whose views and desires will form a basis for the organization's purpose and strategy may be local governments, local communities, competitors, other firms in the same industry, and the general public.

Identifying the goals for claimants
The goals of each claimant group must be accounted for in the organization's mission, objectives, and strategy. King and Cleland have shown an approach for doing this which involves the qualitative description of the nature of each claimant's claim and the specification of measures, direct or proxy, of the degree to which the claim is being satisfied.

Identifying the organization's goals and strategies for each claimant group
Once the nature of each claimant group's claim has been identified, the organization's goals and strategies relative to each group must be identified. Sometimes these linkages will be quite simple, as in linking a desire for a 15% ROI to the stockholders' desire for investment return. "Per share earnings" objectives relate to the goals of stockholders as well as to those of creditors, who wish the firm to remain financially stable. "Social responsibility" objectives can be traced directly to the goals of the general public and local communities, as can strategies involving the construction of pollution-free production facilities and the employment of minority group members. "Product quality" objectives and strategies are traceable directly to the interests of customers, government regulatory agencies, and the industry.

Methodologies for further explication and validation of the organization's strategy set
Once tentative statements of organizational mission, objectives, and strategy have been developed either from written documents, an analytic process such as that just described, or more commonly some combination of the two, the organization's top managers may be asked to critique the statement. This feedback step essentially says, "Here is what MIS analysts can infer about the organization's MIS-relevant missions, objectives, and strategies. Please give us your opinion as to the validity of these inferences."

These queries may be presented to top management either as overall statements on which to comment or in the form of Likert scale statements with which top managers may agree or disagree to various degrees. The overall statement format allows for more substantive feedback, but the use of the Likert scale permits easier aggregation of judgments into an overall priority evaluation of the strategy elements. This latter approach also is conducive to assessing the "other" organizational strategy attributes. For instance, Likert scale items related to the "willingness of top management to accept change," and the "familiarity of management with the use of decision models" permit the assessment of these factors as they are perceived to be important by the managers who will ultimately be the users of the MIS.

Transforming the organizational strategy set into the MIS strategy set
The heart of MIS strategic planning is the process through which the organizational strategy set is transformed into a set of system objectives, system constraints, and system design principles which comprise the MIS strategy set.

Figure 2 shows the overall process. The top of the figure shows various claimant groups which may have been identified. The upper wide rectangle is the "Organizational Strategy Set" which delineates organizational objectives, strategies, and other strategic attributes. The lower wide rectangle is the "MIS Strategy Set" entailing system objectives, constraints, and design strategies.

An illustration of the process
Figures 3 and 4 illustrate in specific terms how the overall process of Figure 2 operates. Figure 3 is an illustrative explosion of the Organizational Strategy Set. The organizational objectives, strategies, and other attributes which are shown there are each related to those elements of the claimant structure from which it is primarily
FIGURE 1. Overall MIS Strategic Planning Process
### ORGANIZATIONAL OBJECTIVES

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>to increase earnings by 10% per year (S, Cr, M)</td>
</tr>
<tr>
<td>O₂</td>
<td>to improve cash flow (G, S, Cr)</td>
</tr>
<tr>
<td>O₃</td>
<td>to maintain a high level of customer good will (Cu)</td>
</tr>
<tr>
<td>O₄</td>
<td>to be perceived as socially responsible (G, P)</td>
</tr>
<tr>
<td>O₅</td>
<td>to produce high quality, safe products (Cu, G)</td>
</tr>
<tr>
<td>O₆</td>
<td>to eliminate vulnerability to the business cycle (S, Cr)</td>
</tr>
</tbody>
</table>

### ORGANIZATIONAL STRATEGIES

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₁</td>
<td>Diversification into new businesses (O₁, O₆)</td>
</tr>
<tr>
<td>S₂</td>
<td>Improvements in credit practices (P₁, O₂, O₃)</td>
</tr>
<tr>
<td>S₃</td>
<td>Product redesign (O₃, O₄, O₅)</td>
</tr>
</tbody>
</table>

### STRATEGIC ORGANIZATIONAL ATTRIBUTES

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>highly sophisticated management (M)</td>
</tr>
<tr>
<td>A₂</td>
<td>poor recent performance has fostered a recognition of the need for change (S, M)</td>
</tr>
<tr>
<td>A₃</td>
<td>most managers are experienced users of computer services (M)</td>
</tr>
<tr>
<td>A₄</td>
<td>high degree of decentralization of management authority</td>
</tr>
<tr>
<td>A₅</td>
<td>organization must be responsive to regulatory agencies</td>
</tr>
</tbody>
</table>

### FIGURE 3. Organizational Strategy Set

The organization's strategies are related to its objectives. This is also shown in Figure 3. For instance, the diversification strategy (S₁) is derived from two objectives (O₁ and O₆) — a desire for earnings and a need to eliminate vulnerability to the business cycle.

Figure 4 shows the MIS Strategy Set and how it is derived from the Organizational Strategy Set. It shows how system objectives, constraints, and design strategies are delineated and related to various elements of the Organizational Strategy Set as well as to other elements of the MIS Strategy Set. For instance, the MIS objective of improving the speed of billing (MO₁) is directly related to the organization's credit strategy (S₂).

The constraints and environmental information (C₂ and C₃) are related respectively to various organizational attributes (A₁ and A₃) and specific MIS objectives (MO₂, MO₃, MO₄). The design strategy involving the systems inquiry capability (D₅) is derived from the MIS objective of providing quick response to customer inquiries (MO₇) which is, in turn, derived from the organizational objective of maintaining a high level of customer good will (O₃).

Figures 2, 3 and 4 also show how the "poor recent performance" strategic organizational attribute (A₂) leads to a system constraint that recognizes the possible future unavailability of necessary development funds (C₁), which in turn dictates both a modular design strategy (D₁) and a design strategy which recognizes that the system may never be finished and may therefore be required to operate effectively at each stage of partial completion (D₂).

It is impractical to demonstrate all of the relationships which exist among the elements of the
### MIS Objectives

<table>
<thead>
<tr>
<th>MO1</th>
<th>to improve speed of billing (S&lt;sub&gt;2&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO2</td>
<td>to provide information on product failures (S&lt;sub&gt;3&lt;/sub&gt;)</td>
</tr>
<tr>
<td>MO3</td>
<td>to provide information on new business opportunities (S&lt;sub&gt;1&lt;/sub&gt;)</td>
</tr>
<tr>
<td>MO4</td>
<td>to provide information which will permit the assessment of the level of organizational objectives (O)</td>
</tr>
<tr>
<td>MO5</td>
<td>to provide timely and accurate information on recent performance (A&lt;sub&gt;2&lt;/sub&gt;)</td>
</tr>
<tr>
<td>MO6</td>
<td>to produce reports desired by regulatory agencies (A&lt;sub&gt;5&lt;/sub&gt;)</td>
</tr>
<tr>
<td>MO7</td>
<td>to produce information which will permit quick response to customer inquiries (O&lt;sub&gt;3&lt;/sub&gt;)</td>
</tr>
</tbody>
</table>

### MIS Constraints

<table>
<thead>
<tr>
<th>C1</th>
<th>Availability of funds for MIS development may be reduced (A&lt;sub&gt;2&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>System must incorporate best available decision models and management techniques (A&lt;sub&gt;1&lt;/sub&gt;, A&lt;sub&gt;3&lt;/sub&gt;)</td>
</tr>
<tr>
<td>C3</td>
<td>System must incorporate environmental information as well as internal information (MO&lt;sub&gt;2&lt;/sub&gt;, MO&lt;sub&gt;3&lt;/sub&gt;, MO&lt;sub&gt;4&lt;/sub&gt;)</td>
</tr>
<tr>
<td>C4</td>
<td>System must provide for different reports involving various levels of aggregation (A&lt;sub&gt;4&lt;/sub&gt;)</td>
</tr>
<tr>
<td>C5</td>
<td>System must be capable of producing information other than management information (MO&lt;sub&gt;6&lt;/sub&gt;)</td>
</tr>
</tbody>
</table>

### MIS Design Strategies

<table>
<thead>
<tr>
<th>D1</th>
<th>Design on modular basis (C&lt;sub&gt;1&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2</td>
<td>Modular design must produce viable system at each stage of completion (C&lt;sub&gt;1&lt;/sub&gt;)</td>
</tr>
<tr>
<td>D3</td>
<td>System must be oriented to differential usage by various classes of managers (A&lt;sub&gt;4&lt;/sub&gt;, C&lt;sub&gt;4&lt;/sub&gt;)</td>
</tr>
<tr>
<td>D4</td>
<td>System should be responsive to the perceived needs of its users' managers (A&lt;sub&gt;1&lt;/sub&gt;, A&lt;sub&gt;3&lt;/sub&gt;, A&lt;sub&gt;4&lt;/sub&gt;)</td>
</tr>
<tr>
<td>D5</td>
<td>System should have real-time inquiry capability (MO&lt;sub&gt;7&lt;/sub&gt;, O&lt;sub&gt;3&lt;/sub&gt;) — use COBOL (A&lt;sub&gt;1&lt;/sub&gt;, A&lt;sub&gt;3&lt;/sub&gt;)</td>
</tr>
</tbody>
</table>

### FIGURE 4. MIS Strategy Set

two strategy sets — one for the overall organization and one for the MIS. However, the figures show sufficient detail to illustrate the myriad of relationships as well as how they can be operationally developed from a claimant analysis.

**The methodology of the process**
The methodology which may be used for developing the MIS Strategy Set as shown in Figure 2 is one in which analysts make inferences, based on their experience and knowledge of information systems: the range of system objectives, characteristics, and design principles are shown to be consistent with the elements of the Organizational Strategy Set. For instance, a stated objective of one bank was "... to provide knowledgeable counselling on all of the customers' financial matters." This combined with a precise statement of the "businesses" that the bank is in allows the MIS analyst to define a range by interpreting "all" the work literally as well as in a more limited, but still reasonable, fashion. A range of system objectives is created in this way extending from:

"Provide basic data and reference information on stocks, bonds, options, real estate, etc. — a predefined range of financial alternatives that extends beyond those that form the 'business' of the bank."

to:

"Provide data on all of those financial alternatives which are the 'business' of the bank — e.g., savings accounts, treasury bills, trusts, certificates of deposit, etc."

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Ranges such as this can be derived from many different elements of the Organizational Strategy Set and used to construct alternative general designs for the MIS. In principle, this is a combinatorial problem. For instance, one MIS general design is represented by the combination of the most ambitious extremes in the range for each objective, constraint, and design principle; another one is made up of the least ambitious extreme for each element, etc. The analyst, in practice, will wish to construct only a reasonable number of alternative reasonable designs for presentation to management.

This process gives management the opportunity to select an MIS general design as well as provides the basis for understanding the alternative designs. This is because the designs have been generated from "business raw materials" — the elements of the Organizational Strategy Set — rather than on more typical, but less understandable, technical bases.

This process therefore provides both an intrinsic link between the organization's guiding influences and those which will guide the detailed design and implementation of the MIS. It also provides a basis for effective manager/analyst communication about the MIS — one of the most important, but least developed, aspects of MIS design.

Conclusions

The MIS Strategic Planning process involves the identification and assessment of an "Organizational Strategy Set" — an informational set which delineates the organization's mission, objectives, strategies, and other strategic attributes. This set can be transformed into another information set, an "MIS Strategy Set," which delineates system objectives, constraints, and design strategies.

The outputs of MIS strategic planning become the inputs to the subsequent systems development process. In many organizations these planning outputs have been arbitrary starting points for system development. The process described here derives these inputs to system development from the organization's most basic tenets. Such a process is much more likely to produce a system which is closely related to the organization, its strategy, and its capabilities.

The MIS strategic planning process described here cannot be delineated in algorithmic form because the relevant aspects of the Organizational Strategy Set will be vastly different in various organizations. However, the process of identifying and assessing the Organizational Strategy Set has been systematically outlined using the concepts of claimants and measurable claimant goals. Once organizational strategic elements have been identified, they can be validated through the structured queries of the organization's top management.

Once the Organizational Strategy Set has been delineated, its various elements can be transformed into MIS Strategy Set elements by analysts who are familiar with the available system alternatives, configurations, and attributes. This is a process which analysts perform in any case, but it is usually done with only the most vague reference to the elements of organizational purpose and strategy. The process described here necessitates an explicit and rational consideration of these relationships.

An important aspect of the MIS strategic planning process is that it ensures that the MIS is developed as an integral part of the organization and not merely appended to it. The process inherently requires manager/analyst interaction of the variety as specified by King and Cleland [7] and others [2, 4]; it would be foolhardy for the MIS analyst to attempt this process in isolation from management. This approach also provides for specific feedback from management, even in those cases where the Organization's Strategy Set is already well explicated. Such interaction has been identified as one of the primary requirements for successful MIS implementation.

This process further presents an operational framework within which the "information analyst" — a job title which resulted from an ACM educational study [3] — can operate in a system planning role. Previously, the role of the information analyst has been prescribed, but has been given no operational guidance that relates directly to the MIS field. The MIS strategic planning framework presented in this article provides such guidance.
The process does not explicitly deal with the assessment of priorities for a number of systems which might be a part of an overall MIS master plan. It does, however, provide a basis for explicating individual systems in a fashion which facilitates choice and priority setting. For instance, a system which is not closely related to many elements of the Organizational Strategy Set may inevitably be assigned a low priority since limited funds are best spent on those systems which most directly address those objectives that the organization as a whole is trying to achieve.

One objection to the described process can be raised in terms of its superficial circularity. The MIS design is to be based on organizational mission, objectives, and strategy which are themselves the product of management choice. Thus, a system which is meant to support management decision making is, in fact, designed on the basis of choices which have already been made. This difficulty is inherent in any systems design effort. Unfortunately many such systems are designed without knowledge of previous strategic organizational choices and are therefore obsolete before they are developed.

The relatively great longevity and enduring nature of organizational strategy, objective, and mission choices suggest that this planning approach is surely valid for the support of middle-level organizational decisions, a management level which Anthony has classified as the management control level [1]. Moreover, the approach is even valid for an MIS which is designed to support strategic choice, since there must be some starting point at which a system is developed to feed back information on the validity and degree of attainment of strategies already chosen. Such a system can directly support the selection of new future strategies, and it can be adapted to permit their assessment as well.

References


About the Author

William R. King is Professor of Business Administration in the Graduate School of Business at the University of Pittsburgh. He is the author of eight books and more than 60 technical papers in the fields of MIS, Planning, and Systems Analysis. His most recent book, Marketing Management Information Systems was published in 1977.

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