

September 1981

Evaluation of Computer-Based Management Information Systems Effectiveness

Shaker A. Zahra*

The University of Mississippi

Follow this and additional works at: <https://digitalcommons.georgiasouthern.edu/sbr>



Part of the [Business Commons](#), and the [Education Commons](#)

Recommended Citation

Zahra*, Shaker A. (1981) "Evaluation of Computer-Based Management Information Systems Effectiveness," *Southern Business Review*. Vol. 7: Iss. 2, Article 6.

Available at: <https://digitalcommons.georgiasouthern.edu/sbr/vol7/iss2/6>

This article is brought to you for free and open access by the Journals at Digital Commons@Georgia Southern. It has been accepted for inclusion in Southern Business Review by an authorized administrator of Digital Commons@Georgia Southern. For more information, please contact digitalcommons@georgiasouthern.edu.

EVALUATION OF COMPUTER-BASED MANAGEMENT INFORMATION SYSTEMS EFFECTIVENESS

Shaker A. Zahra*

In a rapidly changing environment like today's, Computer-Based Management Information Systems (CBMIS) have become vital for the success and even the very survival of many contemporary organizations. Thus it becomes imperative that management attempts to ascertain the effectiveness of such systems.

The purpose of this article is twofold. First, it explores the various problems management encounters when trying to assess the performance of these systems, and presents four approaches of evaluation. Second, it provides specific recommendations to reorient research related to this important area. More importantly, it offers some guidelines to aid managers to better utilize CBMIS.

Why Evaluation?

Many factors force management to pay special attention to the evaluation phase of CBMIS. Most important of these factors are:

- (1) Corporate investment in computers and information systems has been rising sharply since the late 1960's.¹ However, current economic conditions necessitate that management be assured that these systems are paying off in the form of improved decisions and appropriate responses to environmental changes.
- (2) Evaluation, as Seward rightly noticed, provides direction for allocating effort for redesigning the weaker elements of the system to improve its overall performance.²
- (3) Evaluation plays a very critical role in examining proposed system configurations. It provides a sound basis for selecting the system that best fits the organization's need of information. Although this article focuses on existing CBMIS, rather than proposed ones, it is obvious that careful evaluation at the development stage makes it easier to perform subsequent evaluations.
- (4) The process of evaluating CBMIS has, in some cases, led to recognition of certain problems which exist within the organization and not necessarily within the domain of the MIS function. For instance, it revealed management inability to set goals or design policies or develop clearly stated criteria.

*The author wishes to thank Dr. David E. Blevins, Acting Chairman, Department of Management and Marketing, University of Mississippi, for his comments on an earlier draft of this article.

What to Evaluate?

While some writers continue to emphasize evaluation of CBMIS performance or efficiency, the recent trend in literature focuses on the effectiveness of these systems. The difference between the two orientations is a major and qualitative one.

Evaluation of CBMIS efficiency, while important, is insufficient to ensure the usefulness of the system. As Axelrod explained, while efficiency relates to the methods of production, effectiveness is much broader.³ It is applications-oriented and measures the system's orientation to managerial decision-making. Consequently, management should be more interested in evaluating CBMIS effectiveness.

Problems of Evaluating CBMIS Effectiveness.

To many managers and organizations, the evaluation of CBMIS is a formidable undertaking and a very demanding challenge. Among the major problems management faces in this respect are the following:

(1) CBMIS are new to management and many managers feel unqualified to perform a thorough evaluation process of these systems.⁴

(2) The concept of a Management Information System (MIS), as Keim and Janaro observed, "has never been adequately defined to the agreement of researchers and practitioners in this field."⁵ This complicates the analysis and evaluation of CBMIS.

(3) Multiplicity and complexity of the variables are usually considered in the evaluation and their interrelatedness. A recent study by Mansour and Watson illustrates this point. Defining computerized MIS performance as a function of computer hardware, software, behavioral, structural, and environmental variables, they identified twenty four factors to be considered if sound conclusions are to be drawn.⁶

This complexity stems from two different sources. The first is emphasis on effectiveness which is hard to define and measure with precision. The second is the nature of the CBMIS itself. As one writer explained, CBMIS is a "system of people, equipment, procedures, documents, and communication that collects, validates, operates on, transforms, shares, retrieves, and presents data for use in (managerial decision-making)."⁷ This multidimensionality demands consideration of several variables in analysis. Analysis is further complicated by the need for mastery of quantitative analysis methods which many managers still find difficult to understand, let alone use. Furthermore, use of such tools demands judgement on the part of the manager who, as stated earlier, feels unqualified to make a decision in this respect.

(4) Evaluation criteria are hard to define and leave the door wide open for subjectivity. While they are usually selected based on user needs, demands of comprehensiveness, reliability and validity, and demands of statistical analysis, the human side of CBMIS, to a great extent, defies quantification.

Hamilton proposed a classification of evaluation criteria according to the purpose of evaluation and the means to measure accomplishment of objectives.⁸ As Table 1 shows, evaluation can be either summative or formative. Summative evaluation determines whether the CBMIS has achieved end-result objectives. Formative evaluation assesses the quality of the system, and emphasizes prior conditions which must be satisfied if end-result objectives are to be realized. The means of measuring objectives' accomplishment are classified as direct measures of observable outcomes, intermediate measures, and surrogate "attitudinal" measures.

(5) Numerous managerial decisions have to be made prior to evaluation. The scope, timing, criteria, and the responsibility for evaluating have to be decided upon.

(6) Lack of reliable approaches of evaluation is another problem. Although one is overwhelmed with interest in MIS in general and the number of articles and books which deal with the topic, one is struck by an apparent lack of interest when it comes to the issue of evaluation. Available literature is unusually impoverished.

Approaches of Evaluation

With above problems in mind, the following is a brief discussion of four approaches of evaluation which can help managers better appreciate the effectiveness of their CBMIS. The limitations of each are also explored.

1. Economic Evaluation of CBMIS. More than a decade ago, Chervany and Dickson noted that although the economic effectiveness of an MIS is of paramount importance, the current state of understanding of its cost and benefit functions is limited at best.⁹ Such is the case today. A major reason behind this is that the work of many statisticians who attempted to measure the value of information within the framework of the information theory has not been incorporated into the broader issue of evaluating CBMIS.¹⁰

The economic approach itself is simple. It consists of three consecutive phases.¹¹ In the first, the expected value of information is determined by using available models proposed by the information theorists. Both tangible and intangible benefits should be estimated. In the second phase, all relevant costs of the CBMIS are measured. This demands careful analysis of technology-volume, cost-quality, response time-technology-cost relationships, and the desired level of accuracy of the system's output. This is a most demanding phase indeed since both tangible and intangible costs are to be identified.

In the third, and final phase, costs and benefits of the CBMIS are broken down by period; thus providing a basis for constant monitoring of the system. In addition, some managers find it necessary to use available financial tools such as ROI analysis, break-even analysis, or incremental analysis in comparing the expected values of information to that of its costs in the objectives of the organization relevant to the system.

The results of the three phases are usually summarized in a

TABLE 1

Hamilton's Classification of CBMIS Evaluation Criteria

PURPOSE OF EVALUATION

		SUMMATIVE	FORMATIVE
MEANS TO MEASURE ACCOMPLISHMENT OF OBJECTIVES	DIRECT	A. System cost-effectiveness Organizational performance	D. System specification Systems quality Service levels Operations process problems
	INTERMEDIATE	B. Budget compliance for operation/maintenance costs Changes in information handling procedures Changes in decision maker Changes in decision process	E. Budget compliance for development costs Technical quality System controls Development process problems
	SURROGATE	C. Perception of system value Utilization	F. Perception of system adequacy User participation

Source: J. Scott Hamilton. "An Investigation into the Post Implementation Evaluation of Computer-Based Information System Effectiveness," AIDS Proceedings (1979), p. 152.

table, similar to Table 2, which makes it easier to make comparisons and, hence, decisions.

It is obvious that while this approach provides needed insights regarding the CBMIS, it is insufficient to precisely determine its effectiveness. It demands subjective estimates of costs and benefits which often necessitate guessing.¹² Furthermore it neglects the technical and operational aspects of the system. All that it does, then, is to provide an indication of the system's ability to cover its costs.

2. The System's Performance Approach. Unlike the previous method, this approach employs three types of evaluations: technical, operational, and economic. Thus it provides a more comprehensive and reliable picture of the system's effectiveness. As suggested in Figure 1, the three phases should be performed in sequence.

The purpose of the technical evaluation phase is to examine the system's ability to perform information processing using a variety of tests. Three tests are commonly used.¹³ The first is the Bit Error Rate (BER) which is defined as the quantity of bits received in error divided by the total quantity of the bits received. The objective is to ensure the accuracy of generated information. The second test is the Block Error Rate (BKER). This is defined as the number of blocks received containing one bit error divided by the total quantity of blocks received. The third is Error-Free Seconds (EFS) which is used to measure the success in sending required information. Most often EFS is used in conjunction with BKER.

This phase is incomplete without careful examination of the capabilities of the central processing unit (CPU), data entry capabilities, storage media and devices, output capabilities, and comparing current system with other available technology.¹⁴ A common mistake here is leaving this step of evaluation to systems analysts and engineers because managers find it difficult to understand show it is done. This is not only dangerous but also fatal to the quality of evaluation. Top managers should show, at least, some interest in this area and inquire as to what is taking place.

The second phase of this technique relates to the operational aspect of the CBMIS. Its purpose is to determine how well the system works particularly in terms of output, error rates, and timeliness. This is often done by determining the degree of irrelevance and/or noise in the messages received by the different managerial levels. The best way to accomplish this objective is to establish a task force to review reports generated by the system with special attention to unused ones.

The third, and final, phase is that of economic evaluation. Its purpose is to determine the extent to which the system is considered economically self reliant, i.e. its benefits are at least equivalent to its costs. The procedure usually followed here is very similar to that previously described under economic evaluation.

It should be pointed out that although this approach gives more

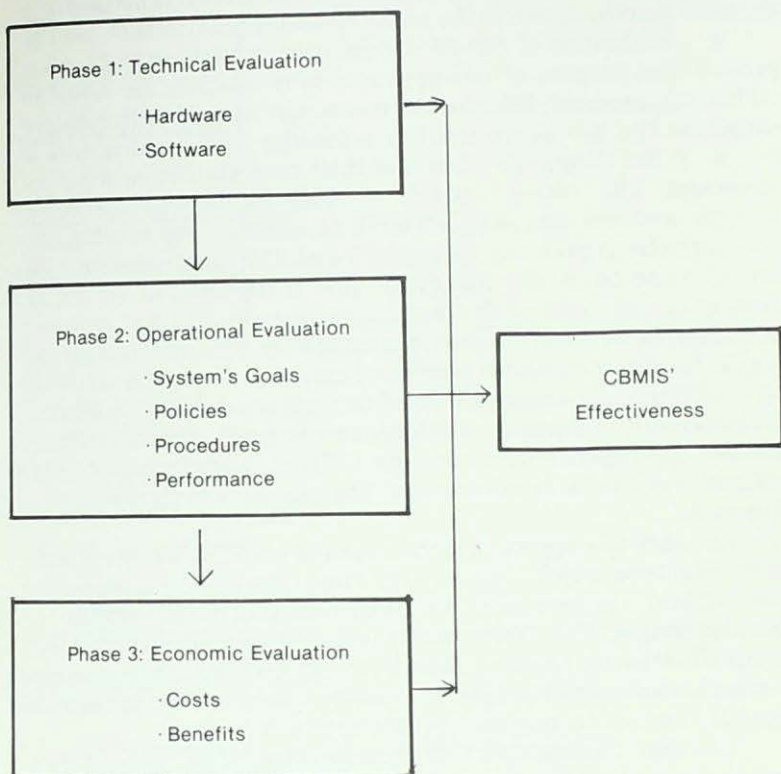


Figure 1
Stages of CBMIS' Performance Approach

reliable evaluation results, it does not assure managers that the particular CBMIS contributes positively to the decision-making process which is the *raison d'être* of the system. Therefore it is necessary to examine its orientation to the needs of managerial decision-making.

3. Evaluation of CBMIS' Orientation to Decision-Making Approach. The purpose of this approach is to measure the extent to which management information needs for various activities are satisfied. The procedure itself is a lengthy one. It starts with a review of the company's goals and their compatibility with its environment. The second step is to examine current strategies, policies, and procedures which were designed to help reach goals. The third step is probably the most critical. Critical decision-making areas should be clearly identified. This is followed, in the fourth step, by an analysis of the decision-making process, i.e. how are decisions made? The fifth step is to determine different information needs. Finally, information needs and current information produced by the CBMIS are compared based on their availability, timeliness, and reliability. Relevance of information to managerial-decisions is further investigated by examining different decisions and their utilization of available information. The technique is summarized in Figure 2.

Although this approach is theoretically sound, it is plagued with many problems which limit its usefulness. For instance, managers have difficulty in describing the decision-making process and its sequential stages. Thus they find it more difficult to identify their needs of different types of information. In addition, the technique demands managerial judgment. Finally, analysts find it hard to quantify the results obtained by this approach.

4. User Satisfaction Measurement Approach. Seward proposed an evaluation approach which focuses on assessing the "satisfaction" of the users of the CBMIS with its outputs. This is done in eight stages.¹⁵ The first deals with the specification of the information system itself. That is, what is it supposed to do? This demands careful determination of the system's outputs. The second stage deals with identification of user groups. Both primary and secondary users should be specified by reviewing mailing lists. In the third stage the users' functions are defined. The objective here is to precisely describe the actual tasks and activities they perform. The fourth stage involves determination of most important information dimensions. These usually include content, degree of frequency of reports, level of reports detail, and the format of reports.

The fifth stage is probably the most important and most problematic. A questionnaire should be developed to be used in gathering data from users as to their satisfaction with the CBMIS. Here strict adherence to the scientific principles is a must. Meanwhile, demands of practicality should not be overlooked. Furthermore, it is of crucial importance to develop a reliable and valid questionnaire, otherwise results will be rendered meaningless. Pretesting the questionnaire can aid in assuring that it meets these requirements.

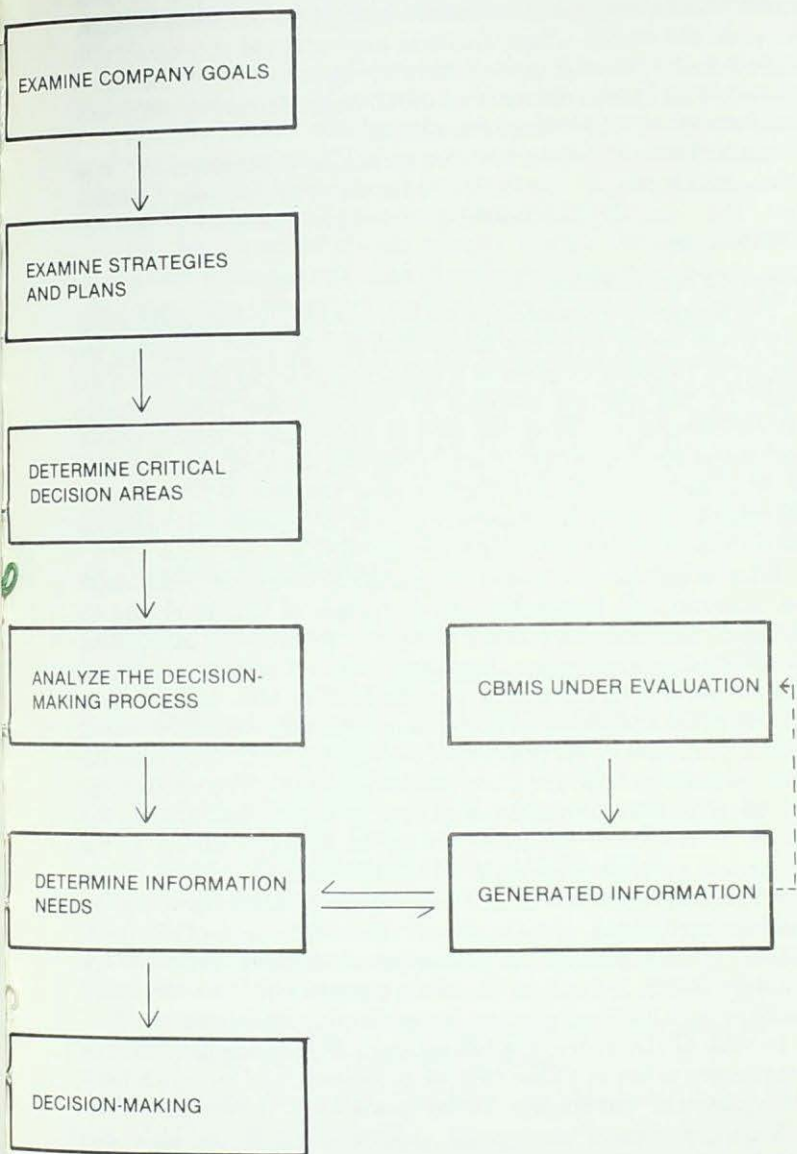


Figure 2

Examination of CBMIS' Orientation to Management Decision-Making

The sixth stage deals with the administration of the questionnaire. Here special attention should be given to the means by which the questionnaire is distributed. This is usually followed by data tabulation and performing statistical analysis in the seventh stage. Finally, in the eighth stage, findings are reported to appropriate staff and line personnel, particularly the system's users, personnel responsible for system design, and the management group which has the authority to make changes in CBMIS.

While Seward claims that this technique is inexpensive¹⁶, it is obvious that it is time consuming. Also there is a serious question about the validity of results reached based on use of questionnaire(s).

Discussion and Conclusions

The foregoing discussion leads to a most disturbing conclusion. There exists today no single model that can be used to assure the manager of the effectiveness of a CBMIS with accuracy. This is explained by the relative newness of such systems, their complex technical nature, apathy on the part of management, overemphasis on proposed systems rather than evaluating existing ones, and the lack of sound conceptualizations and/or interest on the part of researchers. As recently observed by Specht, "empirical research in computer-based information systems (MIS) is in its infancy."¹⁷

What is needed to improve the quality of research in this area? First, a sound and comprehensive paradigm of CBMIS should be developed. This will help orient research projects by pinpointing areas of possible exploration. Furthermore it will provide a means of communication between scholars in the field of MIS. Second, more review articles are needed. Poor as it is, available literature should be made available to the practicing manager. Third, there is an immense and urgent need for more empirical research particularly in the area of post-implementation review or evaluation. Fourth, the findings of empirical research should be made available to the managers in an understandable form and language.

An article of this nature is incomplete without exploring the possible contributions of managers. To an extent, lack of empirical research in CBMIS is a result of manager's lack of interest in the evaluation phase. Indeed, as Hamilton pointed out, "few organizations have an organized process for evaluating effectiveness."¹⁸

In view of the above, the following guidelines are presented to aid managers to better utilize CBMIS, in general, and ascertain their effectiveness in particular. These guidelines, however, are no substitute for sound managerial practices based on logic and careful analysis. These guidelines are:

Top management involvement in and support of the planning, designing, and implementing the CBMIS is insufficient to assure its effectiveness. This interest and support should extend to the evaluation phase, too.

(2) Top management should clearly specify the goals and

responsibilities of the CBMIS. This will facilitate goal accomplishment and ease the system's effectiveness evaluation.

(3) Continuous evaluation is a must. Periodic evaluation should be planned ahead of time to avoid waste of time, money, and effort.

(4) The objective of evaluation should be clearly stated. This will help in selection of criteria and/or approaches of evaluation.

(5) Evaluation should rely on multiple criteria and utilize multiple approaches. This point can never be overemphasized. Multiple criteria/approaches will ensure consideration of the various socio-technical aspects of the CBMIS.

(6) Management should clearly assign the responsibility of evaluation. Although selection of evaluation agent is made in view of the scope, time framework, and the approach used, it should not be left entirely to systems analysts and/or engineers. They tend to be overly specialized and often do not appreciate managerial information needs. This, however, does not mean that they do not contribute positively to the successful evaluation of the CBMIS. Rather, it emphasizes the need for management involvement in the process.

(7) Managers need to remember that CBMIS is a valuable resource whose existence is justified by its contribution to better decision-making. Thus failure to provide needed information should be thoroughly investigated.

Reference Notes

1. Cashman, Michael, "1978 DP Budgets," *Datamation*, 24 (January 1978), 92-95. Also, Nolan, Richard L. "Controlling the Costs of Data Services," *Harvard Business Review*, 55 (July-August 1977), 114-24. Also, Strassman, Paula A. "Managing the Costs of Information", *Harvard Business Review*, 55 (September-October 1977), 133-36.
2. Seward, Henry H. "Evaluating Information Systems", in *The Information Systems Handbook*, eds. F. Warren McFaralan and Richard Nolan (Homewood, Illinois; Dow Jones-Irwin, Inc., 1975), 132-53.
3. Axelrod, Warren C. "How Effective is Your Computer", *Info-systems*, 26 (February 1979), 50-54.
4. Murray, Thomas J. "The New Top Manager," *Dun's Review*, 115 (June 1979), p. 94.
5. Keim, Robert t. and Janaro, Ralph E. "Cost-Benefit Analysis of Information Systems: Is a Format Approach Possible?," *American Institute For Decision Sciences Proceedings of Twelfth Annual Meeting* (Las Vegas, Nevada: November 5-7, 1980), p. 177.

6. Mansour, Ali H. and Watson, Hugh J. "The Determinants of Computer Based Information System Performance," *Academy of Management Journal*, 23 (1980), 521-33.
7. Eldin, Hamed K. and Croft, May. *Management Information Systems: Management Science Approach* (New York: Petrocelli, 1974), p. 19.
8. Hamilton, J. Scott. "An Investigation into the Post Implementation Evaluation of Computer-Based Information System Effectiveness," *American Institute For Decision Sciences Proceedings of Eleventh Annual Meeting* (New Orleans, Louisiana: November 19-21, 1979), 152-54.
9. Chervany, Norman L. and Dickson, Gary W. "Economic Evaluation of Management Information Systems: An Analytical Framework," *Decision Sciences*, 1 (July-October 1970), 296-308.
10. *Ibid*, p. 296
11. For a different approach, Boyd, D.F., and Krasnow, H.S. "Economic Evaluation of Management Information Systems," *IBM Systems Journals*, 2 (March 1963), 2-23. Also, Emery, James C. *Cost/Benefit Analysis of Information Systems*. The Society for Management Information Systems (SMIS) Workshop Report No. 1 (Chicago, Illinois: SIMS, 1971).
12. Keim and Janaro, p. 179. Also, a complete discussion of problems of this approach is found in Zahra, Shaker A.: *Evaluation of Computer-Based Management Information Systems Effectiveness* (Unpublished MBA Thesis: National University, San Diego, California, April 1978.), pp. 112-131.
13. Dick, George M. "The Communication Channel: It's Broken-Now What?" *Datamation*, 23 (October, 1977), 113-22.
14. Mansour and Watson, p. 522. Also, Walker, Michael G. "A Theory for Software Reliability," *Datamation*, 24 (September, 1978), 212-14.
15. Seward, p. 138-47.
16. Seward, p. 147.
17. Specht, Pamelas. "Development of a Comprehensive Management Information System Empirical Research," *American Institute for Decision Sciences Proceedings of Twelfth Annual Meeting* (Las Vegas, Nevada: November 5-7, 1980), p. 165.
18. Hamilton, p. 152.

Shaker A. Zahra is a Graduate Instructor and Research Assistant and Ph. D. candidate in Management, Department of Management and Marketing, The University of Mississippi.