IMPROVING THE EFFICIENCY OF EDUCATIONAL SYSTEMS

1984 - 1994 TEN YEARS OF HELPING DEVELOPING NATIONS STRENGTHEN THEIR EDUCATIONAL SYSTEMS

INDICATORS OF EDUCATIONAL EFFECTIVENESS AND EFFICIENCY

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Douglas Windham

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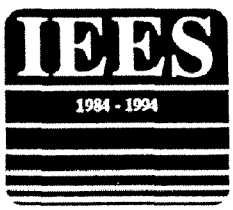

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CHAPTER SIX

EFFICIENCY ANALYSIS AND EDUCATIONAL MANAGEMENT INFORMATION SYSTEMS*

The relationship of efficiency analysis to the creation and use of an educational management information system (EMIS) often has been misunderstood. Efficiency analysis is not a means of **using** the EMIS, it should be the means of **designing** the EMIS. Efficiency analysis does not say just what can be done with data but, more importantly, establishes criteria for determining what data should be collected. This latter contribution is especially important in that the present EMIS operations in most developing nations suggest that tradition and ease of collection often are primary criteria used in the identification of data for collection.

Why should efficiency, rather than quality or equity, be the organizing principle for an EMIS system? Quite simply the efficiency concept incorporates the most inclusive set of criteria one could have for assessment or evaluation of an educational system or of its components. The efficiency concept is inclusive of concerns for quality or equity, whether these latter concepts are defined in terms of inputs, processes, outputs, or outcomes. In addition, by giving equal place in the analysis to both costs and effects, the efficiency concept is more responsive to economic realities and more responsible in terms of recognizing the legitimacy of other social and individual uses of resources. Finally, as was suggested in the efficiency chapter, there is a direct link between understanding how to use efficiency data and conceptualizing the design of an EMIS in terms of multiple indicators and multiple stakeholders.

Because management information systems (MIS) have been developed primarily by non-economists, there has not been the emphasis on a central organizing principle for the systems that one might have expected given that MIS originated in the systems analysis work of Simon (1977). Simon's basic structure of systems analysis parallels that of efficiency analysis in that one begins with problem definition and proceeds through establishment of criteria to the proposal and evaluation of alternative solutions to the selection of an "optimal" choice. This is exactly the economic model of choice and was adapted by— rather than originating with—Simon from classical as well as neo-classical economic literature. Efficiency analysis is, in fact, an application of systems analysis where one seeks to optimize the interaction of costs and effects within constraints on available resources **including information.**

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* The discussion presented in this section has benefited from the review of the EMIS-related literature in the IEES Project's *Issues and Opportunities for Energizing Educational Systems* (1987). Some of the current presentation is directly traceable to that excellent summary prepared primarily by Jerry Messec of The Florida State University.

Information as a scarce resource and as a resource subject to cost-effectiveness considerations has been a major contribution of the work of Simon and of his followers in the MIS and EMIS fields. Paralleling the developments in information system concepts in the last thirty years has been an even more dramatic development in the equipment (hardware) by which information can be processed. Kroeber and Watson (1984) note the dangers inherent in the fascination of planners with the high-technology hardware of MIS (as opposed to the poor quality of data sources and decision-criteria which have not kept pace with the developments in MIS equipment). In stressing **what** a management information system does rather than **how** it does it, MIS reformers are attempting to rebalance the information field in line with concerns expressed here about efficiency data and their use.

The simultaneous development of computers (and their heightened sophistication) has led to a common confusion that MIS is a computer system. In fact, MIS have existed ever since the first systematic collection of data and such systematic collection can be traced to the earliest records of civilization. The improvement of MIS requires two major changes: (1) the ability to identify data needs of users and cost-effective means for the collection of this data at a level of acceptable quality, and (2) more timely and detailed presentation of data in a form readily interpretable by the users. Computers have helped in the first instance by facilitating certain forms of collection and, more importantly, by reducing some forms of transcription and aggregation errors common to pre-computer systems. In the second instance, computers have certainly reduced processing time for large data sets and have allowed much greater detail in the presentation of results.

Given the significant contribution of computers, there are still two important steps left if a sophisticated and responsive MIS or EMIS operation is to be established: (1) the formulation of better criteria for data collection and articulation and (2) better training for data users so they can make use of the data that will become available in greater quantity and detail. These steps cannot be achieved through a further emphasis on hardware development. Both require a new emphasis in terms of the methodological approach taken to the role of information in decisionmaking. Again, the conclusion of this report is that efficiency analysis and its subsumed body of concepts provide the best organizing principles both for the establishment of data criteria and the training of data users.

I. DATA CRITERIA

The critical task in designing an EMIS is the definition of information needs. This can be done in one of three main ways. First, information can be collected because it has "always" been collected and/or because it is relatively easy to collect (the emphasis on enrollment data versus achievement data is explainable in this way). Second, one can conduct a "felt-need" analysis of major decisionmakers in which one asks them to articulate the types of information they require and to assign priorities among the information types. Third, one can impose on the system a set of criteria based on theory and experience but related more to what the MIS professional feels is needed rather than what the end-user or decisionmaker feels is needed. The proposed use of efficiency analysis as an organizing

principle for an EMIS will involve the integration of both the second and third ways of identifying data needs.

The use of a felt-needs approach alone can encounter a variety of problems. One example is that the decisionmakers may not be able to explain in adequate detail the type of information they require. Many organizations fail to express clear decisionmaking criteria or, even if they express them, do not apply them in a significant proportion of their operations.

Matthies and Matthies (1977) describe the possible frustration that may be encountered by information specialists who interview managers in an attempt to elicit decisionmaking details: "Frustrated MIS designers may accuse managers of not adequately understanding their work, while frustrated managers may argue that the designer is not able to comprehend their organization." The tension between information designers and users lies in the fact that the designers seek to simplify the decision process into its objective and measurable components while users operate in a more complex environment where information use is influenced both by organizational structures and bureaucratic practices and by cloudy criteria for success and a partial and uncertain linkage between decisions and decision effects.

This situation parallels that discussed earlier between the use of objective data to establish a framework for the subjective cost-utility judgments of decisionmakers. The problem for many information users is their fear that more and better objective data will make it increasingly difficult to rationalize (in the non-perjorative sense) their inevitably subjective decisions. The problem is aggravated by those information designers whose hubris extends to the point that they resent—and attempt to prevent—any intervention of subjectivity in their information system. Such individuals seek to establish mechanistic processes based on quantitative data and fixed, objective criteria; while some technical and engineering applications of MIS may justify such an approach, it is totally inappropriate for a social activity such as education. In fact, the intrusion of mechanistic processes may be counterproductive in that it can elicit hostility to the EMIS itself by the affected users.

One must accept the fact that within a complex organization such as an educational institution or system one will find decisionmakers who lack the training necessary to do their job. One of the most consistent findings of the IEES series of sector assessments was that the educational bureaucracies were characterized by large numbers of middle-level managers who did not have either formal or on-the-job training concomitant with their responsibilities. In such a situation it is necessary to develop other means for identifying the data needs of the system. Hurtubise (1984) suggests an analysis of the organization with the information designers responsible for identifying structure, environment, and the planning and control processes (the techniques used would include documentation review, observations, and interviews).

Because of the earlier-stated bias of designers toward simplification of processes and quantification of data, there is a danger that the designers will develop an inappropriately

abstract model of the enterprise. This problem was anticipated by Lucas (1973) who proposed the participation of two committees in the design process:

- A priorities committee would assist the designer in making resource allocation decisions and thus avoid conflict between the design of the system and its users. The committee would also bring a better comprehension to the design process of why some projects are undertaken, why others are denied, and how decisions are made for new activities or expansion of existing commitments.

- A user committee would include a large representative group of users and would involve them in the design process. This would result in better informed design and avoidance of possible future conflicts.

Only through the synergistic efforts of the two committees could it be assured that the data criteria of the information system would be both responsive to decisionmakers' perceived needs and to the externally determined requirements (based on needs the decisionmakers may not be competent in ability or training to perceive or articulate).

The assertion here is that there may be a third level of needed competence in addition to that of organizational decisionmakers and information system specialists. There is a need for a conceptual framework for decisionmaking that is generic to scarcity and choice, not just generic to a single information system or organizational structure. That generic conceptual framework is efficiency analysis. Thus, it is asserted here that the principles of efficiency analysis are not just **an** approach to structuring an EMIS but can be viewed appropriately as **the** approach. The efficiency approach defines the alternative types of data that can be collected, offers criteria for choosing among them, provides alternative decision criteria for using the data with the criteria adaptable to different forms of quantification and levels of objective versus subjective valuation, and even suggests the types of training needed by data users. No other conceptual approach is so comprehensive in the applicability of its parts to educational information and its management as is the efficiency concept. And because it may be divided into cost and effects and these two concepts are further divisible into subjective and objective values, and the objective values can be monetary or nonmonetary, one is presented with a wide range of data specifications that may be selected depending on the needs of the users.

II. TRAINING CRITERIA

The training of data and information users has been a challenge faced by all those who desire to improve organizational or system effectiveness but it has posed special problems in the education and human resource sectors because of the quantity of managerial or administrative personnel, the complexity of the choices they face, and the frequent inappropriateness of the educationalists' past training. The last is a problem whether administrators are former teachers without training or professional managers without

classroom or school administrative experience. The need for management training is the most commonly cited administrative problem in education; in part this is because most educational systems promote managers from within the teaching cadre.

The question with which efficiency analysis can help is: What form of management training is likely to be the most useful in preparing educational planners and administrators in the use of cost and effectiveness information? From the earlier discussions presented here, four general categories of training appear necessary for the effective educational manager:

1. specific skill training;
2. training in the conceptual framework of efficiency analysis;
3. training in logic and data-based argument; and
4. training in the application of skills, concepts, and logic to the requirements of their jobs.

Specific skill training for managers has been dominated in recent years by the attention paid to computer training. Too often, the focus has been on training the manager to operate a computer rather than on how to use it as part of the information/decision system. It may soon be common in the developing world—as it is increasingly in developed nations—for managers to operate their own computer terminals. However, for the present, the priority need is to develop high-level computer skills among data technicians who can provide better data processing for managers. Obviously, basic computer knowledge is valuable for managers. First, they need to know what data is available and what the data technicians, by use of the computer, can do with the data. Second, some of the managerial lack of enthusiasm for computers is based upon their concern about subordinate personnel who have skills they, the bureaucratic superiors, do not possess. Basic computer training can both allay these concerns and assure more effective coordination between management and technical personnel.

A possibly more mundane but potentially more important set of skills that should be improved by management training are the skills of assimilating the information in data summaries and reports. All educational managers have experience in this area but they often have not had the proper training in how to study a data summary as a means of generating further data questions and alternative policy recommendations. Similarly, technical reports may be impossible for the manager to evaluate with the result that either the technicians' conclusions and recommendations may be accepted without proper questioning of the assumptions or statistical and personal biases or the report's potentially useful views will be ignored because of the manager's inability to comprehend them.

To permit managers to process the information in data summaries and reports requires the three further forms of training listed above. First, the managers must be trained in the **conceptual framework of the efficiency analysis.** This includes understanding the general framework and definitions and also the ability to comprehend why the efficiency analysis is comprehensive and central to management decisionmaking. Managers also

need to become familiar with why and how efficiency analysis was developed and the specific value and limitations of its application to education. This training in the conceptual framework of efficiency analysis should consist of four parts: (1) establishment of basic terminology with clear definitions; (2) relating efficiency concepts to the basic terminology; (3) indication of the specific application of educational measures as efficiency indicators; and (4) discussion of the statistical, conceptual, and financial limitations of efficiency analysis in the practice of actual educational management activities.

Once familiarity with the conceptual framework has been achieved, educational managers need to receive **training in logic and data-based** argument. To some this may seem an unrealistic and unworkable requirement; others may feel it is unnecessary or inappropriate because it involves imposition of an arbitrarily selected form of intellectual approach on the behavior of the trainees. Training in logic and data-based argument is difficult but not impossible. Many programs of study—mathematics, statistics, physical science, economics—impose a preferred form of logic on students. Whether described as the scientific method, formal logic, or rational behavior, these approaches to reasoning all place a premium on questioning of data, testing of alternatives, the relationship of premises to conclusions, and the consistency of findings.

Recently, a joint program of the USAID-financed IEES Project, the World Bank's Education and Training Division, and the University of Lome was begun with the explicit purpose of improving the skills of educational planners in the analyses of data summaries and reports and the generation of tentative policy recommendations. The experience of this activity to date suggests that the goal of developing improved reasoning skills is attainable but that intensive initial training needs to be supplemented by continuing on-the-job reinforcement.

What this project activity has shown, and what experienced educational advisors can attest, is that the present skills of educational managers and analysts are underutilized not just because of specific skill shortages in technical areas but because of a lack of training and experience in data-based argument. The high intellectual skills possessed by many of these managers adds to their frustration as they recognize that more can be done to convert data into information and to transform educational information into a basis for the reform of educational policies and practices. Objective and data-based argument is not arbitrarily judged to be a superior means of analysis to anecdotal, personal, and subjective argument. It is deemed, however, to be a prerequisite to the application of the manager's or other decisionmaker's personal and subjective views. Without objectivity, data, and logic, no complete and open discussion of present conditions and future alternatives can occur.

No system of applying logic or intuition can guarantee that "truth" will be discovered; however, the approach posed here maximizes the probability of a "correct" decision by increasing the basis for discussion and democratizing the access of participants to the discussion. The use of data and logic is not a substitute for the experience of managers but is a necessary complement in the effort to make educational decisionmaking more effective.

Finally, educational managers must receive **training in the application of skills,concepts, and logic to the requirements of their jobs.** This training takes place best on-the-job and can consist of ongoing counterpart relationships or of recurrent reviews of decisionmaking. In either case the objective of the training is to stress alternatives and justification. What are the alternative sources of data used, why were some selected and others not selected, and why was the data interpreted in the way it was? The discussion of these points increases the managers' sensitivity to the existence of alternative sources, procedures, and conclusions through demanding that the managers be able to justify their decisions.

Managers who realize that their decisions must be justified will be more careful and deliberate in making decisions. The training process must guard against excessive delays caused by concern that decisions will be criticized during review. Two points must be established within the organization in this regard. First, a decision must be judged in terms of the time frame allowed for the decision. A quick imperfect decision often will be preferable to one which is the "right" decision but is derived too late to be implemented. Second, the organization needs to limit personal accountability for the effects of decisions. Except in cases of direct culpability because of individual carelessness or lack of effort, the decisions made should be seen as a product of the decision system and therefore a responsibility of the organization and not just of the individual.

Given the current nature of decision practices in most countries, the latter requirement will not be fully realized. The use of individual scapegoats to deflect criticism from the organizational unit (or from the government) remains a bureaucratically and politically popular technique in both developing and developed nations.

However, to the extent that data and logic allow past decisions to be justified and the decision process to be democratized, it will be more difficult to assign fault for bad results to a single individual or unit. This process of facilitating decisionmaking is itself facilitated if senior administrators and, in the case of government, politicians also have been exposed to the benefits of using data and logic in the ways proposed here.

Finally, as with all education, training of managers is not a finite but a recurrent (if not constant) activity. The information system must be designed so that increased training allows the managers to alter their information demands and so that changes in data availability or information technology can encourage new forms of training. Information quality and decision-making quality should be allowed to improve concomitantly; an imbalance between the two will result in a negation of the quality of either kind.

III. CONSTRAINTS ON AND FACILITATORS OF EFFICIENCY ANALYSIS USE IN EMIS DEVELOPMENT

To understand the policy relevance of efficiency analysis it is necessary first to understand the role that efficiency analysis can play in the EMIS operations of an

educational institution or system. Four alternative situations may occur from the collection and assimilation of educational data within an efficiency framework. First, the analysis may be used to evaluate existing policies and practices and to develop new ones. Second, it may be used to support policies and practices that already have been determined bureaucratically or politically. In this second instance, efficiency analysis use would not affect educational activities immediately or directly. When results reinforced what the senior decisionmakers wished to do anyway, the results would be used. In such cases, all data and analyses are valued not in terms of their ability to inform new decisions but in terms of their ability to justify existing ones.

Third, efficiency analysis and data may have no effect at the level of policy or practice other than to be added to the educational data base. In this situation, senior decisionmakers are unconcerned with the data results, whether the results are favorable or not. However, the data and analyses still have the potential to affect individuals' perceptions at the technical and lower administrative levels of the institution or system. Fourth, the data and analyses may be ignored at both the decisionmaker and technician levels. This situation often will lead to the discontinuance of efficiency analysis and of the supportive data collection and assimilation functions. However, the inertia of some EMIS structures is such that it is not impossible that efficiency data, like much current education data, will continue to be collected (and even reported) without any evidence of its being applied to any purposeful outcome.

The question of which of these four situations will occur in a given country or educational institution is a function of the relative strength of the constraints on, versus the facilitators of, efficiency analysis within the EMIS. Ultimately, all data and information use will be determined by the characteristics of suitability (relevance to perceived issues), understandability (the capacity of decisionmakers to comprehend the data and information), accuracy (the degree to which the data and information correspond to other indicators of reality, internal consistency, and past predictive value), and timeliness (the temporal correspondence of availability with need). For efficiency analysis results, four main constraints and four main facilitators have been identified that will affect the perceptions of these characteristics by decisionmakers.

A. Constraints

The first and most serious constraint on the use of efficiency analysis within an EMIS is the **lack of understanding by decisionmakers of the terms, concepts, and decision criteria used in such analysis.** Although based on logical decisionmaking models, efficiency analysis appears intimidating to those unfamiliar with its specialized terminology. Only through decisionmaker training, of the types described above, can this constraint be overcome. Obviously, to achieve the desired participation in training one will have to overcome reluctance on the part of decisionmakers to engage in such training. The high opportunity costs of their time and their own initial inability to value the possible benefits will discourage the willingness of some individuals to participate in such training.

To overcome this second-order constraint will involve a marketing effort on the part of the agencies or organizations that desire such training. This marketing effort will be supported by some of the facilitators to be discussed later. However, in developing nations, national planning units and donor agencies can combine efforts to encourage greater receptiveness to the training opportunity; the first to produce the demand on EMIS operations to use efficiency analysis and the second to provide scarce resources and training opportunities. Increasing the ability of decisionmakers to understand efficiency analysis will enhance greatly the probability of its incorporation within the EMIS and its use in determining future policies and practices.

The second major constraint on efficiency analysis within an EMIS is the **cost of data collection and assimilation**. Those efficiency measures that depend upon qualitative or observational techniques will be especially hard to justify for systems with a shortage of data system resources. The solution is that each EMIS must begin with a core set of measures emphasizing those cost and effectiveness indicators that are affordable within its budget. The initial emphasis should be on the easily quantifiable and immediate versus the qualitative and distant. But it should be recognized that this system is a foundation for the EMIS, not the capstone. As soon as possible, a set of recurrent, observational studies of specific problem areas should be initiated as a parallel activity to the basic educational census.

The core EMIS information can be supplemented further by special studies of cost and effects of programs that require immediate attention but do not require or justify recurrent study. Project analyses would be an exemplary case of such studies.

In **every** case, a cost-utility analysis must underlie each decision to add, maintain, or delete a form of data or analysis within the EMIS. The administrative head of the EMIS, supported by an advisory committee consisting of information technicians and educational decisionmakers, ultimately must be the locus of responsibility for this cost-utility analysis. Such analyses also can be the basis for requests for additional funding of the EMIS.

The third constraint on the use of efficiency analysis within an EMIS is **the concern over suitability, accuracy, and timeliness of efficiency information**. As the discussion on cost and effectiveness measures illustrated in detail, the more suitable the efficiency measure, the more problems it may pose in terms of accuracy or timeliness. The closer a cost or effectiveness measure approaches a conceptual ideal the more difficult it may be to operationalize and to measure accurately and the more time its collection and assimilation are likely to require. The result of this condition is to reduce the ability of efficiency analysts to justify their results to other educationalists.

Once again there is no facile solution. The analyst must balance the utility of a more sophisticated and precise measure of cost or effectiveness against the disadvantages in terms of (1) financial expenditures on collection, validation, processing, and interpretation and (2) time delay from the request for information until it is available. Efficiency analysis is unique in this regard. It not only provides a basis for organizing an EMIS by specifying

types of data that ideally should be selected, it also provides criteria for devolving from the ideal to what is practical given an EMIS organization's human, physical (equipment and facilities), and financial resources.

The final major constraint on efficiency analysis is **the concern over redistribution of organizational power.** This is a special case of the general data phenomenon that as data increase, those who control and/or understand the data gain influence. This can be manifested in terms of both a horizontal and vertical restructuring of power. Horizontally, a director of educational statistics may increase his or her influence at the expense of directors of other "line" divisions within an organization (the latter would be the heads of such units as primary education, teacher training, and vocational/technical programs). If the other directors do not have the skill to assess data and to summarize and interpret data reports, these officials will have a less effective impact on the decision process within their organization.

The result may be that the interest of the units headed by these directors will be less well represented. In the short run this could lead to greater dependence on those quantitative measures that are the common products of statistical units; in the long run the effects will be to undervalue all experiential and qualitative insight and to elevate the head of the data unit to a position of "first among equals" if not to a *de facto* superiority over the other directors.

Vertical realignments of power can be caused to the extent that data—and especially data generated by efficiency analysis—is understood by junior administrators but less well understood by their superiors. The senior officials, if they are not able to ignore such data, may become increasingly deferential if not overtly dependent on their subordinates to explain the data and analyses and for guidance in extracting recommendations. This process of dependence may be gradual but will culminate in the creation of a technocratic level within the organization that has an influence on the final decisions that far exceeds that indicated by the placement of the technocrats within the organizational chart.

B. Facilitators

To offset the influences of these constraints, four specific facilitators of increased use of efficiency analysis have been identified. The first, and least subtle, **is the self-interest of the units who collect and assimilate data.** The vested interest of such units is to increase the demand for and use of their production. These units, and their personnel, normally will be a constant source of lobbying efforts to promote a greater role for all data in the educational unit's or system's decisionmaking processes. There is no stronger indicator of bad management than a statistics unit that passively awaits requests for data or suggestions of new types of data that may be generated. While one appropriately may be suspicious of excessive self-promotional zeal on the part of data units, excessive passivity is an issue of even greater concern. The ideal situation is a data unit that hopes to expand its influence by improving the characteristics (applicability, understandability, accuracy, and timeli-

ness) of the educational information it produces while showing appropriate responsibility in terms of data costs.

A more generic facilitator within educational organizations of the use of efficiency analysis is **the desire for managers to have a means to depersonalize the decisionmaking process.** As was explained earlier, bureaucratic systems have evolved patterns of individual responsibility for bad decisions as a means of protecting the credibility of the overall bureaucracy. However, the individual decisionmakers can attempt to protect themselves only by presenting evidence that they based their decisions on accepted data and decision criteria. Thus, the increased availability of data facilitates this depersonalization of culpability.

The third facilitator is related to the above in that it is characterized by **the tendency of decisionmakers to promote creation of a common data base for decisions.** The advantage for such a common data base is that it facilitates more general participation in decisions while focusing the discussion on data interpretation. Rather than having five different opinions on the probable number of students or of the ratio of boys to girls, the debate can concentrate on the meaning for policy and practice of the accepted figures on enrollments and gender proportions.

Finally, an important impetus toward efficiency analysis specifically and better data generally is **the need for the EMIS to attain or maintain parity with other information systems.** This need can be formalized by government as in the case where the agency responsible for national planning sets data requirements for all administrative units in government. Alternatively, the pressure may be less formal but equally powerful if the education unit or ministry finds itself at a disadvantage in policy or finance debates because of the lack of persuasive efficiency data comparable to that possessed by competing units or ministries. The international agencies, especially UNESCO, have had a role in the past in promoting standardized data collection. If such agencies increased the relevance of these standard systems by reorganizing them around the efficiency principles, the systems could be disseminated widely with a significant positive effect on individual national data operations.*

The net effect of the aforementioned constraints and facilitators of efficiency analysis within EMIS structures will vary from nation to nation and even among educational units within a single nation. However, the overall trend is clearly discernible: the educational data base is increasing in quantity and quality and so are the information processing systems. The ultimate constraint and facilitator is the nature of human capacities: the

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* The potential for such reorganization was reflected by the degree of interest in the recent OECD conference on educational indicators (Washington, D.C., November 3-6, 1987). The range of views presented are suggested by the papers presented by the U.S. Department of Education, C.E. Finn, Jr., T.N. Postlethwaite, A. Purvis, and K. Eide.

capacity of the information technicians to improve the four characteristics of their data and its affordability and the capacity of decisionmakers to use the data effectively. Ultimately, these capacities will determine the structure of the overall EMIS and the role of efficiency measures and indicators within it.

In the next section a brief summary of the earlier discussions will be presented. This will be followed by a list of general recommendations that deal with how national governments and donor agencies can increase the role of efficiency analysis in the review and formulation of educational practices and policies so as to promote greater individual benefits and enhanced systemic efficiency.