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ABSTRACT

The design of an information system for the Los Angeles Unified School District (LAUSD) is described in this the first in a series of six reports. The system is designed to support educational accountability--the concept that schools and educators should be held responsible (accountable) for educational results. The information system represents an attempt to introduce accountability by implementing and supporting program budgeting, a management philosophy and methodology that aids decisionmaking under resource constraints. The report identifies and discusses general information system goals; it describes the guidelines for information system design and implementation; it specifies the information requirements of District decisionmakers operating in an accountability/program budgeting environment; and it concludes by enumerating and discussing guidelines concerning methods of information collection, storage, and dissemination. (Other reports in this series are: LI003909 through 003912). (Author/NH)

VOLUME 1

AN INFORMATION SYSTEM FOR EDUCATIONAL MANAGEMENT: Design Considerations

John Farquhar
Barry Boehm

Prepared for the Los Angeles Unified School District

R-930/LACS
DECEMBER 1971

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This report was prepared for the Los Angeles Unified School District under Contract 2410. Views or conclusions contained in this study should not be interpreted as representing the official opinion of LAUSD.

1

VOLUME I
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Design Considerations

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PREFACE

In response to community, legislative, and student pressures, school administrators have recently begun to examine the potential of modern management tools and practices. This search for techniques that might function effectively in an educational context led to the adaptation of such methods as program budgeting and accountability. Another tool frequently chosen for educational assistance is the modern management information system, a computer-based aid to planning and decisionmaking.

In late 1970, the Los Angeles Unified School District (LAUSD) contracted with The Rand Corporation to design such an information system in support of educational management. This system is specifically intended to aid planning and decisionmaking (through implementation of accountability and program budgeting) in schools partially supported by Title I provisions of the Elementary and Secondary Education Act. This report is the first in a series describing the results of that effort. It defines near-term information system requirements, design guidelines, major design constraints, and information needs of educational decisionmakers. The report is intended as the conceptual and technical keystone for subsequent system design. The series also includes:

- M. L. Rapp, *An Information System for Educational Management, Vol. II: Data Requirements for Accountability*, R-931-LACS. Defines the future shape of the accountability system, and feasible long-term trends and requirements in the areas of research and evaluation.
- T. S. Donaldson, *An Information System for Educational Management, Vol. III: Data Requirements for Evaluation; A Review of Educational Research*, R-932-LACS. Reviews and discusses the literature concerning student evaluation, providing direction for eventual information system growth.

- J. A. Farquhar, D. H. Stewart, and J. Lombaerde, *An Information System for Educational Management, Vol. IV: Functional Design*, R-933-LACS. A functional description of the proposed information system, specifying input and output data, file formats, and necessary processing.

- J. A. Farquhar, I. M. Iwashita, and S. H. Landa, *An Information System for Educational Management, Vol. V: A Design for Implementation*, R-934-LACS. Describes and discusses alternative hardware, software, and support configurations that might provide the desired services, and the costs and benefits of each.

- L. A. Dougharty and S. A. Haggart, *An Information System for Educational Management, Vol. VI: An In-Service Training Program*, R-935-LACS. Describes the education and training for educational administrators charged with effective use of program budgeting, accountability, and the designed information system.

SUMMARY

This report is the first in a series of six describing the design of an information system for the Los Angeles Unified School District (LAUSD). The system is designed to support educational accountability--the concept that schools and educators should be held responsible (accountable) for educational results. The information system represents an attempt to introduce accountability by implementing and supporting program budgeting, a management philosophy and methodology that aids decisionmaking under resource constraints.

The report identifies and discusses general information system goals, which include:

- o Support accountability at the classroom level;
- o Support program budgeting;
- o Support educational research and evaluation;
- o Support short- and long-range decisionmaking.

In addition, the report describes the following guidelines for information system design and implementation:

- o Avoid decisionmaking by computer;
- o Provide easy information access;
- o Provide flexibility and expandability;
- o Provide high reliability and easy "maintainability."

The information system is designed to reposit and disseminate information at the classroom level; no information is stored on individual students. The smallest unit of budget and expenditure information stored is the *subject area*, which corresponds to Level 5 of the California program budgeting structure. These design choices represent a compromise between system effectiveness and increased costs.

The report also specifies the information requirements of District decisionmakers operating in an accountability/program budgeting environment. Information needs in six areas are discussed:

- *Community profile data*, including information on the socio-economic characteristics of the community, and on perceived community desires concerning education;
- *Personnel data*, concerning assignments, attributes, and qualifications of educational personnel;
- *Facilities data*, describing characteristics and utilization of physical facilities;
- *Inventory data*, monitoring the status and location of equipment and supplies;
- *Program/budget data*, describing projected budgets and expenditures, and ongoing programs;
- *Educational outcomes data*, indicating results of educational programs.

The report concludes by enumerating and discussing guidelines concerning methods of information collection, storage, and dissemination:

1. Minimize collection load on instructors and administrators.
2. Utilize existing collection systems wherever possible.
3. Maintain extensive common data elements among special-purpose files.
4. Present information related to specific decisions.
5. Maintain mix of recurring and inquiry reporting.
6. Report information by exception whenever possible.

If established along these lines, the information system can significantly aid the administrator's planning and decisionmaking. In addition, should the LAUSD opt for an organizational restructuring, the implemented system can materially assist the transition.

CONTENTS

FIGURES

I. INTRODUCTION

Educational managers face complex, diverse, and constantly changing problems. A few years ago, the major difficulties in public education involved the search for innovation--new educational programs to meet the needs of a dynamic society--with little thought given the costs of such programs. Recently, however, the educational environment has become resource-constrained. The major problem has become to provide a base level of quality education to all, in an environment at once expanded by new community and student demands and yet contracted by legislative and public refusal to pay more for inconclusive educational results.

These difficulties--increasing public pressure and decreasing resources--can be accommodated or remedied in several ways. Some of the more attractive possibilities include:

- o Allocating and managing scarce resources more efficiently, achieving increased results per dollar;
- o Measuring and evaluating educational strategies more effectively in order to determine where expenditures have the highest payoff;
- o Understanding, monitoring, and explaining the benefits of educational programs more thoroughly, assuaging public doubts (and thus loosening pursestrings).

Implementation of the above tasks requires information on where and why money is being spent, on the effects these expenditures produce, and on the individuals responsible for these effects. In most school districts, this information is informally gathered and disseminated. Often, an administrator has insufficient information (because of either noncollection or slow dissemination) to make the decisions vital to effective continuation of the educational process.

This report is the first of six volumes describing a computer-based information system and the philosophy and methodology it will support. The system is intended as a formal means of rapidly providing meaningful information to educational decisionmakers, allowing them to identify effective management and educational outcomes within

any institution, and to match these with particular educational strategies, tactics, and practitioners. Toward this end, the information system supports and provides a means of implementing two promising concepts currently proposed to aid education: program budgeting and accountability.

II. INFORMATION SYSTEM GOALS, REQUIREMENTS, AND CONSTRAINTS

This section discusses the context and environment of the proposed information system. Originally, the system will be implemented as a prototype at three Title I schools within the Los Angeles Unified School District (LAUSD): the Ninety-sixth Street Elementary School, Markham Junior High School, and Jordan High School. These three were chosen for initial experimentation primarily because students normally progress through all three. Alternative implementations, such as three elementary schools or unrelated primary and secondary institutions, were rejected because of the limited breadth of educational and logistic problems encountered in these restricted environments.

SYSTEM GOALS

The prototype information system is intended as an aid to district, area, and school administrators. This general idea is disaggregated into four specific management goals: support accountability at the classroom level, support program budgeting, support educational research and evaluation, and support short- and long-range decisionmaking.

Support Accountability at the Classroom Level

The concept of accountability holds that school systems, schools, and educators should be held responsible for educational outcomes. Accountability is frequently mentioned as the key concept in assessment of educational performance at any level. A useful information system must provide the kinds of data necessary to understand better the relationship of input (financial, material, and intellectual resources) to output (qualitative and quantitative) within any educational subset. It must also provide the data necessary for day-to-day decisions. In practical terms, support of accountability at the classroom level means that detailed data on many aspects of the school--magnitude of resources, teacher skills, pupil backgrounds, measures of achievement--must be stored, processed, and disseminated to the proper individuals. It also requires a dynamic information system, i.e., one capable of retaining and processing information to allow perception of changes over time.

Possible implementations of accountability range from decentralization of large districts to use of the "voucher system," which allows students to attend the school of their choice. A full treatment of alternative implementations is found in Ref. 1.

All accountability systems have certain common areas; the information system described here uses these as major design criteria. Accountability in any form requires:

- o Comprehensive, multidimensional data on student, school, and District achievement;
- o An effective method of relating educational inputs (human and financial) to outputs (student achievement);
- o More reliable methods of planning, monitoring, and administering educational programs.

Although these common points can be used as information system criteria, a more specific model of accountability is needed.

The concept of accountability chosen involves de-facto decentralization, so called because it represents decentralizing authority without redrawing school or other boundaries. In this model, each school principal is responsible for setting objectives and planning and administering programs, taking into account the particular problems of his school service area and the special talents and preferences of his staff. He may allocate his resources as he wishes, acting as an educational entrepreneur.† Accompanying this authority is a responsibility: the principal is held accountable for educational outcomes. A full discussion of this concept, and the reasons for its choice, is found in Ref. 2.

Support Program Budgeting

There are two reasons for including program budgeting as an information system objective. The first reflects the State of California's

†Within, of course, the rather stringent limitations imposed by the Education Code. Although discussion of these limitations is beyond the scope of this report, it should be pointed out that a comprehensive granting of authority to principals must come through revision of the Education Code.

effort to make educational program budgeting a reality by 1974; although not mandated for district use, a state changeover to program budgeting will bring numerous difficulties to the district using traditional budgeting methods.

The second reason is that program budgeting (often referred to as the Planning-Programming-Budgeting System (PPBS)) is a powerful aid to the educator in planning and administering his educational programs. Program budgeting is a management philosophy and methodology that aids rational decisionmaking under resource constraints.

The educational administrator using program budgeting first establishes specific educational goals and objectives. Working directly from these, he then proposes alternative educational programs that might meet these goals, and evaluates each in terms of costs and benefits. The programs are generally costed over a multiyear period, allowing the planner to judge the *long-range* costs and benefits of a particular set of educational programs. The program "mix" is subject to constant scrutiny and frequent alteration, particularly as the results of various programs are obtained. Figure 1 illustrates a simple version of educational planning in a program budgeting context.†

Program budgeting is an ideal support for accountability, both for those being held accountable and for those concerned with overall evaluation. It allows specific community and institutional objectives to be translated into programs, and helps the administrator plan rationally for long-term objectives. Moreover, program budgeting is an ideal vehicle for rational and straightforward display of educational decisions to the community and to higher decisionmakers. Any system of educational management, including accountability, is possible without program budgeting; however, because program budgeting can bring to any scheme the clarity and rationality that should accompany so critical and important a process as educational management, it is a primary objective of the proposed information system.

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†The reader interested in a complete treatment is referred to Haggart, *et al.* [3], for an excellent discussion of program budgeting as implemented for public education.

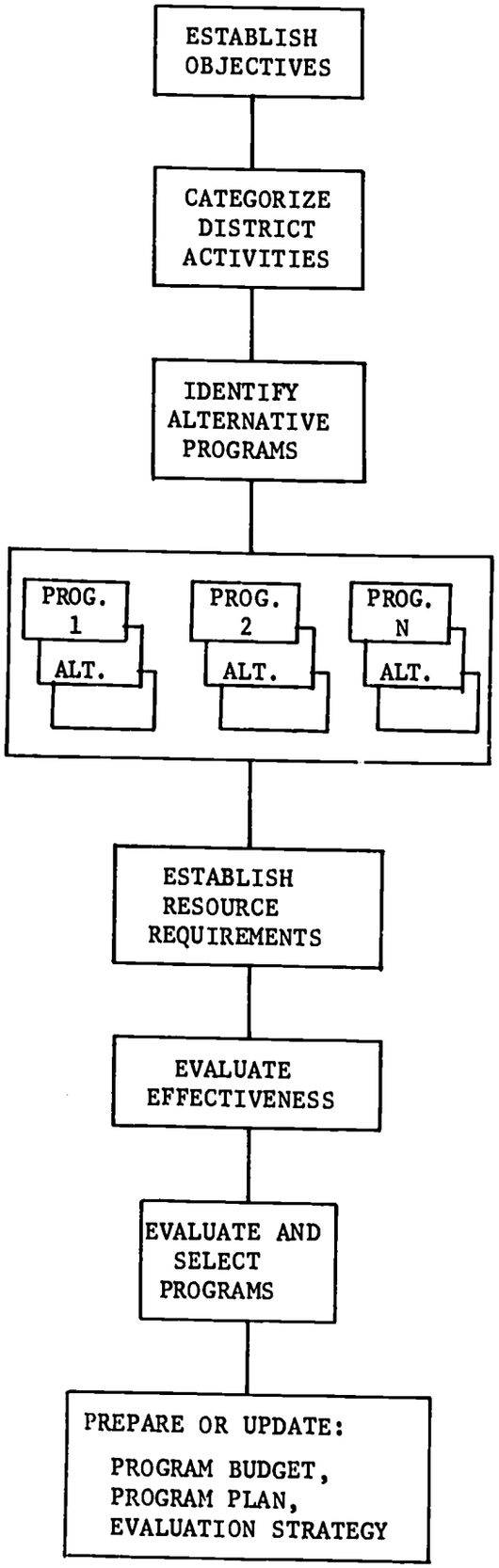

Fig. 1--Program Budgeting in an Educational Context

Support Educational Research and Evaluation

Another major information system goal is to support efforts to evaluate educational programs. This goal brings new requirements to the information system design. Primarily, these requirements are for longitudinal data, following the progress of teachers or students over a long period of time. Another capability supporting evaluation involves "spinning off" subfiles of a large file, and integrating these with other data pertinent to a research project. An information system used for evaluation also requires the capability for integrating school data with external socioeconomic data. This usually implies compatibility among school-based, census tract, and health data.

The data collected and analyzed in research and evaluation are used in a variety of ways. With proper interpretation, they are the key to both accountability and program budgeting, and are used to measure the success of a particular school or classroom.†

Evaluation data are also crucial to program budgeting. Program results form the basis for continuing or altering a particular menu of educational programs. Proper evaluation, however, can affect the educational structure even more broadly. For example, programs may be achieving the desired results, but longitudinal studies may reveal that students are not "succeeding" in later life. Such information might well occasion a total rethinking of the goals, objectives, and criteria of the educational program structure. This is particularly true in areas where test scores are chosen as criteria, and yet insufficiently correlate with subsequent achievement.

Finally, evaluation supports research into other methods of assisting students. A comprehensive data base on student characteristics and learning styles, as well as on instructor and environmental descriptors, may be correlated with achievement data for a variety of purposes. Primary among these is evolution toward "diagnostic-prescriptive" aids, models allowing the educator to prescribe--with some *a priori* certainty--specific pedagogy to best utilize a student's learning style.

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†The usual extensive *caveats* about evaluation data and their interpretation (or misinterpretation) apply here, particularly when discussing who is to be held accountable.

Support Short- and Long-Range Decisionmaking

The major goal of the contemplated information system is to enhance both long-term and day-to-day planning and decisionmaking. This goal is equally relevant at the district, school, and classroom levels. Long- and short-range decisionmaking imply somewhat contradictory information system requirements. Long-range activities require reports that are as comprehensive as possible and that relate information concerning district activities to information concerning community needs and desires. However, such information is not "time critical," i.e., the information system need not be designed for rapid perception and response. Information accurate within a year is often acceptable when attempting to perceive long-term trends. Day-to-day decisionmaking, on the other hand, requires very timely information.

In general, it is difficult to conceive of single reports satisfying both of these needs. For example, the day-to-day decisionmaker needs a rapid compilation of the number of students within the system after school opens in September. If he must wait until this information is integrated into a comprehensive planning document, considerable time may elapse before the data are reported. No single solution satisfies both needs. The most attractive course requires meeting reporting requirements for each type of decisionmaking separately, rather than attempting both through the same information system outputs.

Decision-orientation serves as a valuable criterion for information system design. It can be used to judge whether or not a particular report should be produced or a given data item regularly retrieved. In many cases, reports that appear necessary or reasonable may be discarded because no decisions are directly or indirectly (e.g., background information) based upon the reflected data items. This design goal also leads to rules for clustering information. For example, personnel data are most decision-oriented when accompanied by information on an individual's skills, education, and experience. However, most personnel-information systems produce, as a key report, a simple roster of personnel names, addresses, and position data. Such a listing has little continuing value as a decisionmaking aid.

SYSTEM DESIGN GUIDELINES

Several general rules (a second-level set of objectives) will be followed in information system design. As mentioned earlier, reports and reposited information are to be decision-oriented. This requires minimizing the amount of paper flowing through the system, and insuring that administrators only receive reports pertinent to planning and decisionmaking. Primary attention is also given to providing exception information (notification of irregular activity) and removing computational drudgery. If an area superintendent traditionally looks at two monthly reports and manually subtracts to discover the difference between attendance levels at various schools, he may be performing a function more appropriately performed by the information system. Much of this philosophy is reflected in the program budgeting system itself since this information is (by definition) decision-oriented.

A second design guideline regards avoiding *decisionmaking by computer*, a subtle malady involving too-rigid software that allows the computer to make decisions. Avoidance of this involves exposing decision variables rather than embedding them in the structure of the computer software. Every effort must be made to keep computer programs bias-free, displaying all decision information for scrutiny by administrators.

Another major design guideline involves *making information easily available* to those authorized to receive it. Alternatively, this implies a full effort to educate decisionmakers concerning the information available and its most effective use.

Another guideline concerns system *flexibility*. Since the LAUSD is currently in a state of organizational flux and many administrators (e.g., area superintendents) are fairly new at their jobs, it is difficult to make a definitive statement of information needs. Because design is of a three-school prototype, some efficiency may be sacrificed in order to make file designs and report-generation capabilities more flexible (and expandable) than in a district-wide system.†

†This may be taken to an unhealthy extreme. Rand recently audited the development of an information system intended to cost 1.5 million dollars and to run on a 360/50 computer system. This effort shows no

A final guideline requires *high reliability*. The first requirement of reliability is that the system be operational as frequently as possible, untroubled by downtime or too-frequent preventive maintenance. Decisionmakers must have confidence in the system. Reliability considerations also demand great care in guaranteeing that only accurate and valid data enter the system; periodic checks and file purges must be built in to guarantee file integrity. All entered information must be well-defined and difficult to misinterpret. For example, the concept of administrative overhead must be clearly defined. District personnel are very sensitive to charges that a large overhead exists in the educational system. This, of course, reflects the fact that such items as health services and janitorial services are included in administration; in many districts, these items are part of the city budget.

OTHER PERTINENT DESIGN ISSUES

System Resolution

An important issue of information system design involves the basic (lowest-level) data units to be reposited. Many educational information systems resolve to the student level, i.e., a data record is kept on every student within the system. The proposed Los Angeles Schools information system will resolve to the classroom level, maintaining a separate data record on every classroom or class.

The arguments for and against various levels of resolution are manifold. Both costs and potential benefits of an information system tend to rise spectacularly in translation from the classroom to the student level. In the case of the Los Angeles Schools, a student system must reposit approximately 650,000 records in the initial data base. A classroom system requires approximately an order of magnitude less. Although system costs do not similarly decrease, resource requirements

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signs of completion, with a cost-to-date of 3 million dollars. In addition, the information system will require a much larger (and more expensive) hardware configuration. A major portion of this overrun may be traced to an obsessive concern with flexibility.

(initial hardware in particular, as well as clerical support) are substantially greater for a student-level system. In the current financial environment, the sheer magnitude of these costs excludes a student-level system from realistic consideration.

Benefits as well as costs are curtailed in a classroom-level system. Such a system provides little direct help to students; primary benefits will accrue through more effective educational planning and administration. However, every opportunity must be taken to insure that information system design is open-ended, allowing rational transition to a student-level system at such time as resources allow such upgrading.

A second question concerns the level of the California program budgeting structure reflected in the information system. The current structure reflects six levels:

Level 1: District.

Level 2: Functional Program Grouping (Instructional Programs, Instructional Support).

Level 3: Subfunctional Program Grouping (General Education, Special Education, Vocational Education, etc.).

Level 4: Lifespan and Site Program Grouping (Elementary, Secondary, etc., for each Level-3 classification).

Level 5: Subject Area or Department Programs (English, Mathematics, etc.).

Level 6: Subject-Area Subclassification (e.g., within English: Speech, Listening, Spelling).

The level of resolution chosen is reflected primarily in the distribution and assignment of program costs. Resolution to Level 5 has been chosen for the proposed information system because it is currently impossible to track costs in any finer detail without requiring teachers to break down expended time by specific skills. Although program budgeting is not currently in use, it is accurate to say that current accounting systems resolve to Level 4, and in isolated instances to Levels 5 and 6. Thus, an overall penetration to Level 5 represents a considerable increase in the sophistication and accuracy of cost-accounting procedures.

System Privacy and Security

Another major issue concerns information access and privacy. The proposed system grants information access through *access tables*--data held within the information system describing administrative positions, associated personnel, and the list of data items or files available to the particular requester.

Information privacy is not of truly critical importance in a classroom-level information system. No data are stored on individual students, and the data held on certificated and classified personnel are, for the most part, noncontroversial. Nevertheless, security and privacy of data must be well protected because of the possibility of a student-level system. Complex security and privacy routines, if provided at the inception of a system, usually increase computer software costs approximately 5 to 10 percent. If these routines are added after system completion, they may increase software expenditures by as much as 50 percent. In addition, if remote access to the proposed information system becomes a reality, privacy problems will be compounded. Some base of software protection can serve as a helpful foundation for further and more sophisticated protection routines.

The second issue--physical installation security--is extremely important. When implemented, the information system will represent a considerable capital investment in computer hardware. More important, though more difficult to assess, is the value of the data to be stored in and around the information system. Any number of constant threats to this concentration exists; fire, earthquake, and vandalism are the most dangerous. These factors must be considered in locating the information system, and in determining physical-access and data-storage procedures. All except remote information storage are outside the realm of information system design. Two design guidelines address the storage question: (1) duplicates of the previous month's master files will be stored remotely, as will transactions pertinent to that file; and (2) all history files will be duplicated and retained remotely (indefinitely). Such retention procedures satisfy security and backup requirements, and provide a convenient base for later longitudinal analyses.

Figure 2 summarizes the philosophical and technical environment for information system design.

OBJECTIVES

- Support accountability at the classroom level
- Support program budgeting
- Support educational research and evaluation
- Support short- and long-term decisionmaking

DESIGN GUIDELINES

- Avoid decisionmaking by computer
- Provide easy access to information
- Provide flexibility, expandability
- Provide reliability and easy "maintainability"

SYSTEM RESOLUTION

- Classroom level, expanding to student level
- Level 5 of state program structure

PRIVACY AND SECURITY

- Access-table control
- Recognition of more extensive privacy software requirements
- Physical security aided by extensive data backup

Fig. 2--Summary of System-Design Requirements

III. INFORMATION NEEDS FOR EDUCATIONAL FUNCTIONS

This section discusses current LAUSD operations, information pertinent to successful operation, and expected future needs. These needs have been elicited and refined in a variety of ways. The first and most important is interaction with LAUSD personnel. A variety of District, area, and school personnel were interviewed concerning their current needs, how well these were met, and their future needs (in an accountability/program budgeting context). This effort was very valuable in information system design.

A general discussion of these interviews points up several important criteria for both information system design and the environment that must support the implemented system. In general, the information needs indicated as priority items deal with such basic items as facility occupancy, number of personnel attached to a particular school, personnel qualifications, etc. Considerable concern was evinced about the inability to obtain these basic data---so much so that it was difficult to discuss needs associated with more sophisticated management techniques. It is very difficult to talk about information needs for future educational resource allocation to an administrator who, despite his best efforts, cannot find out how many of his classrooms are in use.

This preoccupation with immediate requirements is caused largely by the tremendous pressures of providing education on a shoestring budget. Few of those encountered had strong conceptions of program budgeting and accountability, nor any ideas about what form these should take. This again is the result of being overburdened with the present--there is no real time to consider the future. Nevertheless, the interaction exercises yielded much in the way of future direction. Most of the information needs were eventually derived from an approximation of responsibilities, inferring information needs from administrative duties.

SUMMARY OF EDUCATIONAL OPERATIONS

Toward determining information needs, functions performed within the school system were divided into four separate areas: planning, administration, counseling, and instruction.

Planning

Because of the critical nature of this activity and the size of the school district, a large percentage of district effort is expended in planning. Once such a large operation goes into motion in September, it is difficult to effectively or economically change its direction. This is reflected in the information system's heavy emphasis on planning activities, particularly activities related to allocation of human and material resources.

Planning activities may be subdivided into several areas. The first steps involve establishing goals and objectives, and designing educational programs. This is carried out in any school district, regardless of size or particular management philosophy used. In a program budgeting system, goals and objectives are of primary importance; they essentially determine the shape of the programs and attendant evaluation strategies. Both definition of goals and program design draw heavily on a variety of data elements. Demographic data are extremely important, describing the socioeconomic background of specific student populations, and defining future school populations. Personnel data are equally important, detailing the particular strengths and talents of administrative and teaching personnel. Resource information is critical to formulating goals and objectives, and designing programs. Formulated without accurate data, educational goals and programs may be either too ambitious or too pessimistic with respect to available resources.

Having designed a variety of alternative programs, the educational planner evaluates them in terms of resources, expected outcomes, and priorities, choosing a complement of programs that best meets established criteria. Following this, a budget and program plan is prepared, as is an evaluation strategy for judging program results. The results of this

evaluation feed back into planning activities, perhaps changing goals and objectives or leading to the redesign of programs.

Figure 3 summarizes planning operations, showing the informational inputs and outputs of each phase in the process.

Administration

The second area of information needs is associated with administration of ongoing programs. This process involves examining, at appropriate intervals, the progress of a particular educational program. It also requires monitoring expenditures as they occur throughout the school year in order to insure that the school system is operating on budget. In addition, the system currently contains many discretionary items--and more may be added in the future. These may include personnel, in the form of "task forces" or specialist teachers, who can be allocated in response to noted educational trends. In other cases, discretionary resources may be funds for audiovisual equipment, special texts, or additional educational aids.

Instruction

These activities are generally practiced within the school, supported by considerable District-level planning of curriculum and methodology. The school principal and the individual teacher decide instructional strategy--how to manage a particular group of students to secure the best educational outcome. These individuals are also responsible for executing the instructional strategy and evaluating performance, both on an ongoing basis and as some final measure of program effectiveness. An information system that penetrates only to the classroom level is of little help to the individual teacher in planning instructional strategy or in performing instructional activities. Primarily, classroom-level information helps principals or District decisionmakers judge what specific types of instruction and personnel best meet community, school, or classroom needs.

INFORMATION INPUTS	FUNCTION	INFORMATION OUTPUTS
Educational and social theory Demographic information Public desires Student performance information Labor market projections	1. Establish goals, objectives a. Program b. School c. Classroom	Goal statements
Goals and objectives Relevant experience Salary schedules (5-yr) Inventory cost schedules and status (5-yr) Facilities cost schedules and status (5-yr) Demographic information Public desires Previous performance Analytical and computational tools	2. Design alternative programs 3. Determine resource implications and benefits; choose programs	Elements of *Program and Financial Plan* Program memoranda Special studies reports Program inventory
Demographic information Previous performance	4. Establish performance criteria a. Program (district) b. School c. Classroom	Performance criteria Testing requirements (if any)
Program design (incorporating information used for functions 2 and 3)	5. Prepare budget	*Program and Financial Plan*
Program design	6. Identify points of accountability	Statements of responsibility
Information used for functions 2 and 3	7. Establish evaluation strategy	Evaluation plan
Demographic data Teacher skill and interest profiles	8. Allocate and assign: (Instructional Strategy) a. School administrators b. Classroom teachers c. Counseling services	Assignment notification

Fig. 3--Information Needs for Planning

Counseling

Another area largely unaffected by a classroom-level system is counseling activities--handling student and behavioral problems that arise on a day-to-day basis, and guiding students concerning particular courses and vocational and educational aspirations. An information system can, however, be of some assistance, even at the classroom level. Demographic information is extremely valuable in sketching a background for appreciating behavioral problems, even if it is not of the "fine-grain" type that describes a particular student. In addition, labor-market data are valuable in directing individual students into particularly important or critical occupational or educational areas. Figure 4 summarizes the information aspects of teaching and counseling.

DATA NEEDS IN THE PROTOTYPE SYSTEM

Six categories of information emerge from examination of the data summarized in Figs. 3 and 4: community profile, personnel, inventory of materials and equipment, program/budget, facilities, and educational outcomes. These categories exist independently of the data structures. For example, financial and evaluation data may be displayed for classrooms, schools, areas, or educational programs. Throughout this discussion, however, two types of aggregations are considered important: (1) by *organization/location* (e.g., schools or areas), to judge results in those areas; and (2) by *program*, to allow management and evaluation of particular educational strategies and tactics.

Community Profile

Demographic data are vital to program planning, administration, teaching, and counseling, particularly in long-term aspects (using population and economic projections to judge the resources needed five or ten years in the future).

The demographic data needed are displayed in Fig. 5. Basically, this involves data on the social, cultural, and economic character of the school population. In addition, information must be provided to

ADMINISTRATION

INFORMATION INPUTS	FUNCTION	INFORMATION OUTPUTS
Grade reporting Test reporting, attendance reporting	1. Monitor educational outcomes	Inveatigation of exceptions; restatement of objectives
Recurring expenditure reports	2. Monitor expenditure	Investigation of exceptions; remaining funds budget
Combination of educational outcomes and estimate of available budget	3. Allocate discretionary items a. Task force peraonnel b. Specialists c. Aides	
All data gathered	4. Report progress to public	Board briefing; "fact aheet"
Attendance data	5. Report average daily attendance (ADA) to State	ADA summary
Facilities data	6. Allocate maintenance	Assignment notification

INSTRUCTION

INFORMATION INPUTS	FUNCTION	INFORMATION OUTPUTS
Resumé of successful methods Demographic Program goals and objectives State syllabus Experience	1. Establish instructional strategy	Instructional plan
Experience Demographic Norm-referenced measures Criterion-referenced measures	2. Evaluate educational progress	Report cards Parent-teacher conferencea

COUNSELING

INFORMATION INPUTS	FUNCTION	INFORMATION OUTPUTS
Cumulative file Health data Teacher contact Behavioral referral form	1. Determine cause of behavioral referrals	Posting to student's cumulative files
Cumulative file Teacher contact College placement guide	2. Guide concerning aspirations and course necessities, vocational opportunities, college placement	n.a.

Fig. 4--Information Needs for Administration, Instruction, and Counseling

DATA SOURCE	DATA ITEM
	POPULATION
Registration	Student population--current year
Census data, live births	Projected student population:
-projection	- 1 year (maximum accuracy)
-projection	- 5 year
-projection	-10 year
	SOCIOECONOMIC
County welfare roles	Number of students from AFDC families
National census	Parent's educational level
Census; Federal impact data	Parent's occupation
	Median family income
Census; recognition survey	Service-area racial composition
-projection	(for all socioeconomic factors)
-projection	1 year (maximum accuracy)
-projection	5 year
	10 year
	FINANCIAL
County Assessor's Office	Single family dwelling count
County Assessor's Office	Multifamily dwelling count
County Assessor's Office	Average residential assessment
County Assessor's Office	Average multiresidential assessment
County Assessor's Office	Total service-area assessment
County Assessor's Office	Assessed value per student.
	COMMUNITY NEEDS AND DESIRES
Recurring sampling through questionnaire	Information on attitudes, desires, and priorities of parents

Fig. 5--Community Profile Data Requirements

financial planners concerning the tax base and character of the neighborhoods to be served by the educational institution in that area. Figure 5 also presents community needs and desires. These displays are the first step in establishing a coherent picture of information needs; they are translated into actual report formats and file structures in Ref. 4.

Personnel Data

Personnel information serves three major functions: payroll, budgeting, and assignment of instructional and administrative duties. Two basic types of personnel data are necessary: on existing human resources (for assignment and payroll); and on positions (authorized manpower within the District, whether or not the position is currently filled), for use in establishing budgets and assessing future personnel needs.

Figure 6 summarizes personnel information needs. This statement of needs presupposes that efficient assignment of personnel requires considerable information on capabilities and special talents. Information should also be included on the interests and preferences of teaching and administrative personnel so that proper assignment procedures can take into account both District and individual needs and desires. Finally, information is necessary to determine an employee's career path. The major purpose of matching educational results to particular subjects or student types is to assist in determining the most beneficial assignments.

Facilities Data

Facilities data are used to determine the resources necessary to maintain facilities at a prescribed level. In addition, they can give the administrator insight into the availability of space when additional demands are made on his area of supervision. Facilities data also allow rough judgment of the quality of this aspect of the educational environment. This judgment may in turn be weighed against educational outcomes to assist in judging the effect of various physical environments upon

DATA SOURCE[a]	DATA ITEM
	PERSONAL
Employment application	Name, address, telephone
	Date of birth
	Race
	QUALIFICATIONS
Transcripts	Educational level and major
Testing program	Characteristics (verbal ability, etc.)
Employment application	Years service outside District
Personnel action notification	Date of hiring
In-service attendance records	In-service attendance
Request for tuition reimbursement	Current degree pursuance
Testing program	Language fluency (non-English)
Certificating agencies	Certificates held; associated service time
Personnel questionnaire	Special qualifiers
	PREFERENCES AND INTERESTS
Personnel questionnaire	Preferred certificate
Transfer requests	Preferred location
	Preferred subject area and grade level
	BUDGET AND STATUS
Assigned by budget authority	Position number
Personnel action notification	Location
Personnel action notification	Funding sources
Personnel action notification	Current salary and schedule
Personnel action notification	Premiums
	LONGITUDINAL
Retention from personnel action notification	Previous assignments (classroom)
Retention from personnel action notification	Mobility history

[a]Only primary sources are listed; most information would be more efficiently gathered from personnel questionnaires.

Fig. 6--Personnel Data Requirements

educational performance. Figure 7 lists data items pertinent to facilities management.

Inventory Data

Inventory data reflect the source, value, status, and location of educational materials within the District. Such items as textbooks, expendables (pencils, paper, etc.), and audiovisual equipment are accounted for through an inventory system. In the case of nonexpendable items, such a system reflects the location and maintenance status of materials, and allows rapid allocation to programs having need for such materials. In the case of expendables, which are not usually circulated, the system is used to maintain a consistent level at the various locations, either through reception of requests for additional supplies or through automatic reordering and dispatching of these supplies. Figure 8 lists the information necessary for inventory control.

Program/Budget Data

Program/budget data fall into two categories: budget data and expenditure data--tracking money as it is expended (or committed, in the case of encumbrances). Inputs and outputs within the budget process are diverse. In most cases, several budget cycles of varying completeness precede final budget figures.

Figure 9 lists budget and expenditure data. Resources are apportioned in three ways: program, fund, and expenditure class code. One of the requirements of a realistic information system is to relate each type of expenditure to the others. This is done through "crosswalk reports," illustrated in Ref. 4. The purpose of the crosswalk is to allow administrators trained in classical accounting to easily adapt to and utilize the program budgeting display. This point is elaborated below (see p. 27).

Educational Outcomes Data

Effective program budgeting and accountability require information on educational results. Although a classroom-level information system

DATA SOURCE	DATA ITEM
	IDENTIFICATION
Base data from school survey	Name Address Location indicators (facility and service area)
	PHYSICAL DESCRIPTORS
School survey	Year of construction
School survey	Number of buildings
School survey	Construction types
School survey	Field Act conformance
School survey and HUD survey	Physical descriptors--paint condition, etc.
School survey and HUD survey	Number of classrooms and condition
School survey and HUD survey	Air conditioning, soundproofing
School survey and HUD survey	Security
School survey and HUD survey	Room descriptors: toilets, gymnasium, utility room, etc.
	USAGE DESCRIPTORS
Registration data	Classroom utilization
Registration	Double sessions
School superintendent	Nonstandard utilization (voc. ed., community activities, etc.)
System-determined	Maintenance schedule
Building superintendent	Vandalism incidence
	FINANCIAL
County Assessor's Office	Assessed valuation
Budget authority	Funding sources

Fig. 7--Facilities Data Requirements

DATA SOURCE	DATA ITEM
Purchase order	Item name, description
Purchase order	Vendor
The remaining data items are generated primarily by the Inventory system, a closed system in the sense of having few external inputs or outputs.	Repair status
	Repair vendor
	Preventive or recurring maintenance schedule
	Current location
	Responsible agent
	Purchase/lease/rental
	Funding source (purchase/lease)
	Funding source (maintenance)
	Reorder level indicators (for recurring purchases)
Request for use	Distination
Return receipt	Location verification

Fig. 8--Inventory Data Requirements

DATA SOURCE	DATA ITEM
	BUDGET
Budget authority	Proposed current year expenditure: -Program -Fund -Expenditure class code
Budget authority	Five-year budget projection -Program
	EXPENDITURE
Total "accounts payable"	Expenditure to date: -Program -Fund -Expenditure class code
Notification of commitment	Encumbrances: -Program -Fund -Expenditure class code

Fig. 9--Program/Budget Data Requirements

does not maintain information on individual students, it must somehow reposit data gathered from particular schools, classrooms, and educational programs. In most cases, this can be done by tapping existing information systems: the attendance reporting system, the test results reporting system, grades, etc. The information is gathered in aggregated form, capturing classroom or program results rather than individual data. This allows maintenance (within the information system) of evaluation and performance data at a cost far less than that of a student-level system.

Figure 10 summarizes the information needs for a classroom-level system. As can be judged from the lefthand column, most of the data are gathered from secondary sources within the school district. Such identifying information as classroom number and student group identification is internally generated to avoid problems of incompatible codes (such as might exist between attendance and test-scoring information).

DATA SOURCE	DATA ITEM
	IDENTIFICATION
Internally generated	Classroom identifier
Internally generated	Student grouping identifier
	CHARACTERISTICS
See Fig. 5, p. 20	Socioeconomic status indicators
Testing program	Aptitude measures
Historical files	Achievement history
Registration data	Mobility
	PERFORMANCE
Attendance register	Attendance
Testing program	Test scores
Grade reporting register	Grades
Instructor	Instructor evaluation (criterion-referenced)

Fig. 10--Educational Outcomes Data Requirements

Control Information

This final category, listed in Fig. 11, comprises information used as a basis for organizing all data held within the system. Consequently, it shapes information system capabilities and products. Financial data will be reported by program, fund, and expenditure class (the financial identifiers); within these categories, they may also be reported by organization or by physical location (location identifiers). This control information mainly defines the sequence and combinations of information to be routinely reported.

FINANCIAL

Program identification (Levels 1 through 5)
Fund identification
Expenditure class code

LOCATION

Organization
Physical location (District-Area-School)
Classroom identification

PUPIL

Classroom identification
Longitudinal grouping identification

Fig. 11--Control Information

INFORMATION COLLECTION, STORAGE, AND DISSEMINATION

Presentation of guidelines in all three of these areas must take into account the current administrative structure (centralized), the expected future structure (decentralized, with principal accountable), and (most important) the fact that there will be an extensive transition period. The information system must at least accommodate this transition; with proper design and planning, it can considerably aid it.

Information Collection

One guideline is primary in this area: minimize data generation and manipulation by both administrative and instructional personnel. Teachers already must perform attendance registration, marking, and behavioral referrals, and enter this information into the system. Although it would be more convenient (and efficient) from the designer's viewpoint to design a new data-collection system (and subsequent set of forms, procedures, etc.), such a system would work unnecessary hardship. This information system will not eliminate--at least initially--the other systems currently extant. Therefore, any loads peculiar to this system will represent additional loads.

Minimizing primary collection loads means that the information system must draw from secondary sources; such secondary sources will be used whenever possible. Incompatibilities that might exist will be accommodated within the confines of the information system, not by preparing new collection systems.

Information Storage

The fundamental guideline in this area concerns integrating the information stored within the system. In this context, integration means the degree to which compatible identifiers that link files exist. For example, to display program expenditures and program results on the same report, the "program identifier" must exist within every record stored in both the financial and the evaluation data files.

Various questions arise in school administration. For example, how much would it cost to place one Spanish-speaking teacher in every school where over 50 percent of the students are Spanish-surnamed? Answering such questions rapidly and with a minimum of programming requires that:

1. The information system have a mechanism capable of rapid response to questions of this sort.
2. A key exist linking demographic data to instructor data (e.g., school location code).

3. A key exist linking instructor data to financial data.

4. A means be available to add up pertinent financial data (in this case, instructor's salaries).

Many such links must exist between files. In most cases, the linking data are the control information summarized in Fig. 11.

Information Dissemination

Methods of dissemination are critical to the success of any information system. Information must be readily available to the decisionmaker, or its cost of access (in his time) will exceed its worth. It must be available in a form easily used for decisionmaking, or the cost of manipulation will exceed its worth. The real value of information is often much higher than that assigned to it by decisionmakers; for this reason, extreme care must be taken to make information readily and easily available.

Information may be provided in three ways: *recurring*, as in the production of monthly or weekly reports on the status of certain variables (such as expenditures); *exception*, notifying the decisionmakers of unusual behavior; or *on-demand*, in which specific information is provided in response to a request. An information system must provide some of all three; providing all information all the time is usually unnecessary, confusing, and wasteful. The design question, involving the mix of the three types of dissemination, is addressed in detail in Ref. 4.

All types of service will be provided by the prototype information system. Recurring information is provided because it is necessary to continued operations. Inquiry information is provided because it meets the rather special and ever-changing needs accompanying the educational process: need for information to cope with special state, Federal, and local requirements; information to answer questions from concerned members of the community; and data items necessary to illuminate trends or inconsistencies perceived in recurring reports.

Many of these inconsistencies may be specially reported as such. Information is usually of considerably greater value if exceptional

figures (such as unusually high or low classroom attendance, or unusually large expenditures) are noted. This can be done by the information system by calculating expected levels and singling out occurrences not within a calculated range. Entire reports may be made up of such information, published periodically, and referred to as *exception reports*. These reports serve as impetus for gaining further information through inquiry techniques.

Summary

The following guidelines apply to the collection, storage, and dissemination of information:

1. Minimize collection load on instructors and administrators.
2. Utilize existing collection systems wherever possible.
3. Maintain extensive common data elements among special-purpose files.
4. Present information related to specific decisions.
5. Maintain mix of recurring and inquiry reporting.
6. Report information by exception whenever possible.

THE INFORMATION SYSTEM AS AN AID TO TRANSITION

The information needs described in this section exist regardless of the type of school system or the particular management philosophy in favor. What will differ as the structure changes is the distribution and aggregation of management information. Changes in these two areas mirror changes in responsibility. The shift of decision-oriented information from district to school level should accompany a shift of responsibility and authority.

Shifting information flows also shifts power and responsibility; this shift is the essence of decentralized accountability. No implication is intended that power will be shifted through depriving district-level administrators of information. Yet decision-oriented information--at the school level--will be provided only those administrators formally

charged with making operational decisions. Other administrators will be provided with other information, often to judge the performance of the school-level decisionmaker. To a great extent, the information system can thus shape the administrative structure, and the structure will mirror the changes in the information system. When carried out carefully and rationally, these changes can do much to insure the desired organizational restructuring.

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