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ABSTRACT

PMIS (Planning and Management Information System) is an information system that supports the decisionmaking process of executive management in local school districts. The system is designed around a comprehensive, longitudinal, and interrelated data base. It utilizes a powerful real-time, interactive data management system for strategic planning; evaluation studies; and local, State, and Federal reporting. (Author)

# PMIS Project

## Planning & Management Information System

**A Project to Develop a Data Processing System for Support of the Planning and Management Needs of Local School Districts**

PMIS: SYSTEM DESCRIPTION

Work performed in compliance with
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The Council of the Great City Schools is a coalition of 22 of the largest urban school districts in the United States, organized to study, develop, implement and evaluate programs designed to promote educational reforms that will insure quality and equality of educational opportunities.

The Council Board of Directors consists of the Superintendent of Schools and one Board of Education member from each of the member cities. Representing a combined total school population of almost five million children from the 22 member cities, the 44 voting members of the Board of Directors can move decisively on problems which directly affect the achievement of educational excellence in urban areas.

The Council provides an effective mechanism for the dissemination of information and the exchange of ideas and insights among the large urban centers and is able to coordinate research and demonstration activities. The member city school districts provide a laboratory for experimental and developmental work in undertaking innovative and imaginative approaches in the search for ways and means to improve the education of inner city children.

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PMIS PROJECT

PMIS Project Staff members directly responsible for this effort are:

| | |
|---|---|
| Richard H. Fiddleman | PMIS Project Manager |
| Michael M. Gorman | PMIS System Designer |
| Barry Barnes | Dallas Site Manager |
| Mary Selles | Materials Coordinator |
| Jennifer K. Pegues | Project Secretary |

Council subcontractor responsible for Data Management System implementation is MRI Systems Corporation, of Austin, Texas.

This document is one in a series of publications detailing development work on the PMIS project. The others are:

| | | |
|---|---|---|
| Conceptual Design Report | 1500-1-1 | April, 1971 |
| Detailed Design Report | 1500-2-2 | November, 1971 |
| Final Report, Year 1 | 1500-3-1 | October, 1971 |
| Data Management System | 1500-4-1 | December, 1971 |
| System Description | 1500-5-1 | April, 1972 |
| PMIS Data Bases | 1500-6-1 | April, 1972 |

# Chapter 1

## INTRODUCTION

In every school system the major decisions that shape and direct the system as a whole are made by the few who comprise executive management, and they are held responsible when wrong decisions seem to have been made. Replacement of these individuals seldom helps, because even new school officials, i.e., the Board of Education, the Superintendent and his executive team, often continue to have limited and outmoded management support systems to help them make major decisions.

While most school officials are familiar with the role of computers in accounting, payroll, personnel, facilities and other basic functions, few realize that these same computers can also be used to help solve many complex and hard-to-define management problems. Due to recent advances in computer software (programming) executives can now use computers easily, quickly and with great effect. Now, managers can directly interface with computers to acquire the background knowledge needed to deal with management oriented problems.

A system designed to help management has recently been developed by the Council of the Great City Schools. Called PMIS, this system is presently being implemented in Dallas, Texas. PMIS is a computer based system which helps top management make more effective decisions by providing accurate and timely information. Thus, it supports the decision making process in specific functional areas by assembling, storing and retrieving information.

To design a management support system several distinct and unique characteristics of management had to be considered. First, managers do not deal with specific, well-defined problems like payroll,

report cards or attendance records. They deal with more complex issues. Second, a system for executives must be able to answer many kinds of questions, simple as well as complex, with speed and efficiency. Finally, the system must contain reliable data, for any decision reached by executive management has a high error impact.

These considerations led to three design requirements. First, an effective executive management support system must contain broad and comprehensive data about the district. Second, it must be able to answer questions easily. And third, the answers must be accurate and timely. Because these requirements are met by the PMIS design, it can help executive management in strategic planning, comparability studies, equal education planning, fiscal resource studies, and in preparing state, local and federal reports.

PMIS is a management information system because it supplies specific information to top management; it is not, however, a "cure-all" for school district ills, a universal data bank for all questions, or a replacement for day-to-day operational systems such as payroll, report cards, etc. Rather, it is a tool designed to increase the effectiveness of top school system management.

Background

The PMIS project was conceived in early 1970 in response to needs expressed by the Joint State/Federal Task Force on Evaluation and by the Council's twenty-two member school districts. There were then no comprehensive data processing systems to aid school managers as they planned and evaluated educational programs, nor was there effective automated support to generate reports on the results of Federally funded programs to state and Federal agencies. After a series of discussions

with the U. S. Office of Education, the Council conceived a project to develop a pilot PMIS type system in one Council district, and after on-site testing, to make this pilot system available to other Council cities. The Dallas Independent School District (DISD) was chosen as the pilot site and, in October 1970, the Bureau of Elementary and Secondary Education of U. S. O. E. funded the project. At present the design work has been completed, a prototype system has been developed for demonstration purposes, and three meetings have been held with member city personnel to keep them abreast of the project. PMIS is scheduled to be operational in Dallas by late 1972.

## Chapter 2

## PMIS APPLICATION AREAS

PMIS is designed to support management in four areas: strategic planning, other top management functions, research & evaluation, and general reporting. A resume of each area examined during the design process is presented here.

### Strategic Planning

The eight steps of the PMIS strategic planning process are:

Program Evaluation

Goal & Objective Setting

Program Analysis

Program Development

Program Budgeting

Budgeting - Administration Review

Budgeting - Board Review

PMIS Follow-Up

Each step, composed of a mixture of manual and automated activities, receives support from PMIS in the form of status reports and projections. A status report may be as general an an overall ethnic description for the district, or as detailed as a longitudinal comparative study of peer environments and achievement levels for a particular program. The PMIS projection capability is based on two computerized models. The first, a linear program, optimizes the recommended mix of services for various programs, based on stated district-wide objectives. Information and insight gained from this model are then input to the second model which generates 5-year budget projections for enrollment, program costs, staff requirements, and revenues. The strategic planning process is designed

to occur over a 15 month cycle so that final and first steps overlap to allow adjustments based upon current evaluations.

Top Management

While other management functions are too numerous to be listed exhaustively, they generally fall into two categories--tactical planning and informal accountability. These activities include district-wide achievement level analyses, descriptions of student population characteristics, program effectiveness reports, staff utilization reports, and facility-need projections.

Research & Evaluation

PMIS provides researchers-evaluators with the capacity to perform longitudinal studies, either descriptive or inferential, of student achievements, adjustments, or deviations for many different student categories. These might include studies on school profiles, student profiles, profile trends, drop-outs, student follow-up, and grading and reporting.

General Reporting

This support area helps provide responsiveness to the accountability requirements imposed by Federal, state, or local agencies. Federal reports are mainly concerned with Federally funded programs and ethnic distributions of students and staff within programs and facilities. State reports cover a broad range of information needs in these same areas. Local reports might be typified by a press-release, a written response to a specific request, or an annual report required by the Superintendent.

These four areas, then, constitute the range of PMIS applications. Since each area imposes unique requirements, the next chapter discusses how they have affected the PMIS design.

## Chapter 3

## DESIGN BACKGROUND

The four factors that influenced the PMIS design were: the application area data needs; the size and complexity of the user school district; the volume of intended system use and the type of users; and the hardware and software in Council member districts.

### Application Area Data Needs

It was determined that data on students, staff members, programs and facilities was needed for all four application areas. Since the output requirements of these areas are dynamic -- that is, not predictable -- the use of summary data as a primary source for PMIS was ruled out because summaries imply predetermined outputs. It also became apparent that historical data would be needed for strategic planning and for longitudinal evaluation studies. In addition, the data base content had to allow for change as the school district evolved. Since the PMIS application areas often require many different yet related categories of data in one report the data bases had to be completely interrelated. This necessitated links between students, staff, programs, facilities, and the like.

PMIS also posed a problem of data secuirty. Because of the comprehensive data bases and their interrelatability, safeguards were needed to prevent unauthorized data access and dissemination.

### School District Size & Complexity

The fact that the PMIS data bases contain individual rather than summary data created a considerable problem in terms of data storage and processing efficiency. To indicate dimensions, the Dallas Independent School District, a medium size member district, has over 150,000 students,

over 10,000 employees, and between 200 to 300 facilities. The design of the PMIS data bases had not only to store this data but to do so in a way that would allow easy, quick, and efficient data retrieval for the many PMIS reports. The processing time problem for these reports or queries is discussed below.

System Use and Users

There were additional factors that posed potential threats to PMIS system performance or through-put: the time and effort required to construct a query, and the amount of computer time for query processing. Because PMIS was designed to be an operational tool of management, it was anticipated that there would be a large number of PMIS users. This ruled out the use of traditional programming languages as vehicles for queries and dictated that PMIS have English-like, easy-to-learn-and-use query languages that would permit direct interface with the PMIS data bases.

The second factor, processing time, has three parts. First, since PMIS is an information system it is input-output bound rather than process bound. Second, most PMIS queries were expected to be logically complex. Third, the user-oriented query languages suggested a large volume of queries. These three factors together presented PMIS with a significant through-put problem. Traditional data storage structures (sequential and index-sequential) were determined to be unacceptable because they were not designed for real-time data management. Therefore, new storage structures had to be used which would make the processing time for a query so fast that it would in essence be independent of query complexity. In this way the projected large volume of complex queries could then be efficiently handled.

## Member City Hardware & Software

Since almost 75% of Council member cities and the pilot site had a computer at least the size of an IBM 360/40 with 256K bytes of memory and a three pod IBM 2314 disk drive, it was mandatory that Council require PMIS software to operate in that environment. To further ease member city problems in developing their versions of PMIS, Council decided that all software be as machine-independent as possible.

## Requirements Summary and Software Acquisition

After careful review of the design considerations and the proposed application areas, three overall requirements were established.

First, PMIS needed a comprehensive set of data bases that reflected the application area needs, and these data bases had to contain data on students, schools, programs, staff and facilities.

Second, PMIS needed a broad base of computer software that would allow:

- Sophisticated data base structures for complex querying
- Efficient storage of vast amounts of data
- Cost-effective querying
- Easy to learn and use query languages
- Comprehensive controls for data base security

Third, PMIS had to include and be able to support computerized models for strategic planning.

Council staff recognized that the second requirement would be practically impossible to fulfill during the lifespan of the contract; therefore, a request for proposals (RFP) was constructed that reflected the software needs. Twelve companies responded to Council's RFP, and after

a two month evaluation MRI Systems Corporation of Austin, Texas, was determined to have a data management system conforming to the PMIS design requirements. In summary, this data management system (SYSTEM 2000) meets the PMIS software requirements in three ways:

- First, SYSTEM 2000 has hierarchically organized, multi-level, nested repeating group structures that are invertible to give both complete data relatability as well as almost instantaneous response time to queries.

- Second, SYSTEM 2000 can operate with simultaneous multiple users and simultaneous user modes (TP, RJE, and Batch).

- Third, SYSTEM 2000's five languages give a complete range of data management powers for interactive query, queue access for query and data maintenance, formal report generation, and detailed procedure-oriented processing. Three of these languages are English-like in form.

Council, equipped with an in-depth knowledge of the application areas, the various requirements for system use and users, the intended operational environment, and the capabilities of the data management system was then in a position to design a system that could become an operational tool of management.

## Chapter 4

## PMIS SYSTEM DESIGN

PMIS is composed of four interrelated subsystems. The data bases, the focal point of the PMIS design, are contained in the Data Base Subsystem. They are created and maintained through procedures in the Data Acquisition Subsystem, and are utilized in the Reports Subsystem which is the retrieval mechanism for PMIS. The final subsystem, Internal Control, provides an overall monitoring function to PMIS with a complete log of PMIS activities as its output.

### The Data Base Subsystem

This subsystem contains the PMIS data bases and the software necessary for their support. These data bases are: STUDENT I, STUDENT II, STUDENT SUPPORT, and SCHOOL SUPPORT. The STUDENT I data base contains facts about each student currently enrolled in the district. STUDENT II contains data about each student who has left the district in the previous five years. The STUDENT SUPPORT data base holds current and historical data about: individual schools and their students, educational programs in the district and students in the programs, facility descriptions and uses, and staff members in the district. The fourth data base, SCHOOL SUPPORT, contains data on district revenues and population characteristics. Figure 1 lists the data bases and generally describes the data present in each.

The significance of the data base design is the efficiency with which it meets the challenging demands of the user and the manner in which it is interrelated, as shown in Figure 2. Its design anticipates that STUDENT SUPPORT and SCHOOL SUPPORT can satisfy most queries and are frequently on-

| STUDENT I DATA BASE |
| --- |
| Current Students<br><br>Biographic Data<br>Context Data<br>Educational Assessment Data<br>Student Achievement Data |

| SCHOOL SUPPORT DATA BASE |
| --- |
| Annual Entries for<br>District Population Characteristics<br>by Ethnic Group<br><br>Revenue Sources, Amounts, and Use<br>Restrictions by Program of Use. |

| STUDENT II DATA BASE |
| --- |
| Past Students<br><br>STUDENT I Data<br>Termination Codes &<br>Follow-up Surveys |

Figure 1 (Continued on next page)

PMIS DATA BASES

STUDENT SUPPORT DATA BASE

School Characteristics Data
- (Annual Entries for)
- School Identification Data
- Follow-up Assessments of Students
- Active Community Programs
- Disruption Types and Comments
- Grades in School and for Each Grade Educational Achievement Data within Target Group within Ethnic Groups with Student Counts

Programs Data
- (Annual Entries for)
- Program Identification
- School Site Identification
- School-level Program Information
- Instructional Methods
- Grades and Grade Achievement Levels of Student Populations and Ethnic, Sex, Age, Target, and Student Count Characteristics for Each Student Population
- Student Grouping Methods
- Indicator of Program Effectiveness Relationship
- Agency Sponsorship

Facilities Data
- Descriptive and Locational Data
- Additions
- Functional Areas
- Classroom Data

Staff Data
- Biographic Data
- Higher Education Data
- Certification Data
- Employee History and Annual Entries for Assignment Data
- Inservice Education

Figure 1 (Continued)

PMIS DATA BASES

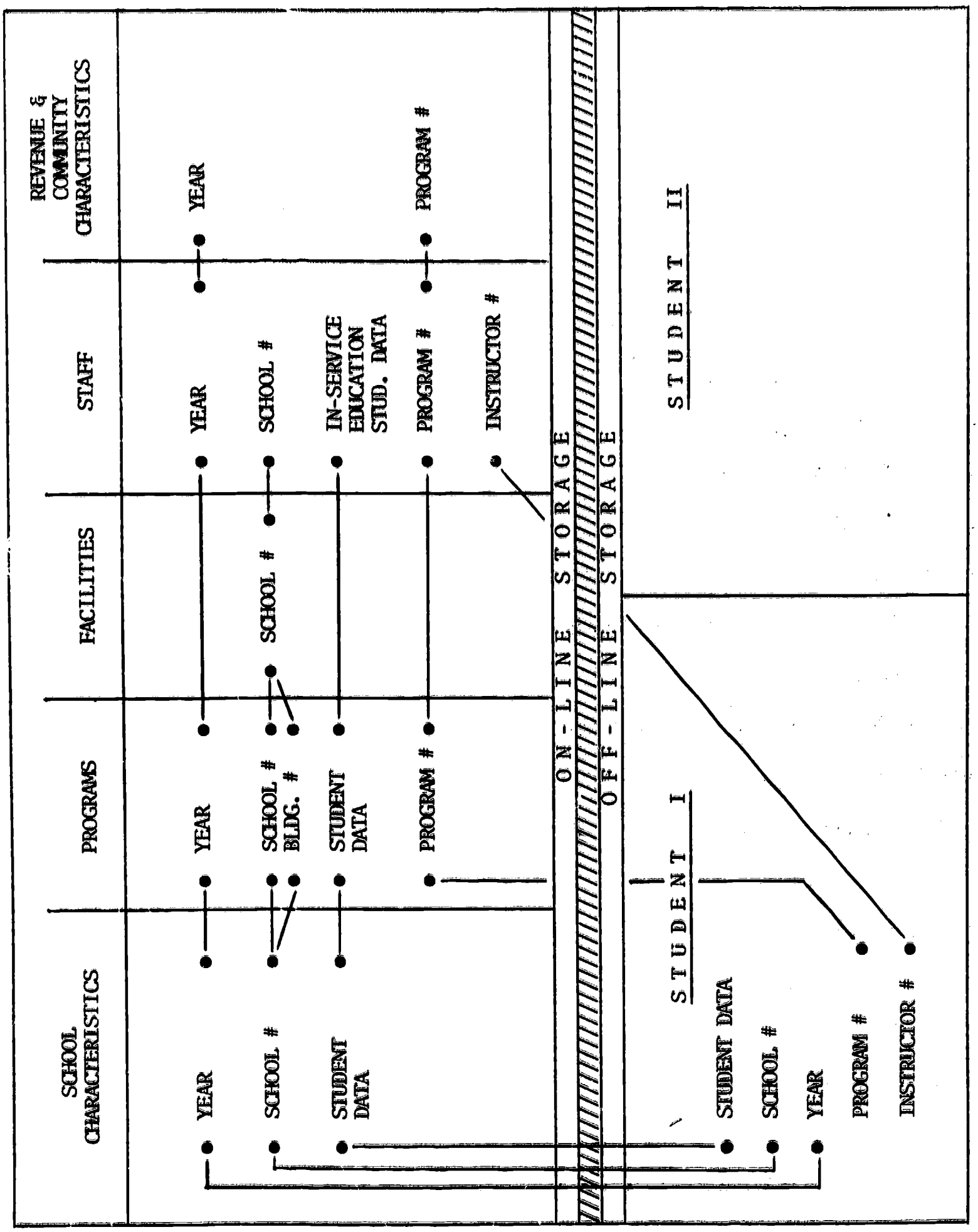


Figure 2

DATA BASE INTERRELATIONSHIPS

line while STUDENT I, and STUDENT II are processed less frequently. The required on-line storage reserved for PMIS comprise about one million characters for the data management system and any other administrative or special purpose data bases. STUDENT I, STUDENT II, STUDENT SUPPORT, and SCHOOL SUPPORT are referred to collectively as the PMIS data bases.

The Data Acquisition Subsystem

In general, a PMIS data base receives data from two sources, the school system, and other PMIS data bases. The former data source includes data from the student, staff, and program accounting systems in the district. The latter incorporates data from STUDENT I for use in STUDENT II and computed summary data from STUDENT I for use in the School Characteristics and Programs sections of the STUDENT SUPPORT data base.

This subsystem contains the software necessary to capture PMIS data from operational systems and feed it into the appropriate data bases, commands for transferring data from one base to another, and programs specifically designed to construct the computer summary data described above.

The Reports Subsystem

This subsystem, the retrieval mechanism for PMIS, utilizes the PMIS data bases and two types of software. The first type, the five languages of SYSTEM 2000, enables users to construct their own queries and process them against the PMIS data bases. The second type of software is a library of pre-programmed routines contained within the reports subsystem which generate pre-defined reports. Information about each report is contained in a data base (REPORTS) specially created for the reports subsystem.

The REPORTS data base serves as a library for report descriptions and is used for report selection either by means of titles, key words and phrases, formats, or abstracts. The actual commands for report

production are also contained in this data base.

The Internal Control Subsystem

This subsystem is comprised of the procedures and commands used by the other subsystems, the record-keeping aspects of PMIS data bases, and the systematic documentation of system events, i.e., a run log. This subsystem embodies its own data base, CONTROL, which in turn includes information, commands, and procedures to carry on the subsystem's activities.

System Security

Because PMIS contains vast amounts of data which could be used incorrectly or out of context, there are three layers of system security. First, a potential user must explicitly know how to operate a terminal or other input device, and understand the exact procedures for bringing PMIS into an active or ready state. Second, the system requires that a user specify a valid password to gain entrance to a data base. Third, once a user has an active data base, the password used automatically imposes restrictions on data retrieval, modification or qualification operations at the data element level. In addition to this security, passwords can be changed quickly and easily by the system administrator.

PMIS Computer Languages

PMIS provides its users with five computer languages. While all can be used for both data retrieval and modification, they differ in form and intended use from each other. The five languages are: Immediate, Queue, Report Writer, COBOL, and FORTRAN. The following language descriptions include only the highlights of each.

Immediate Language

The Immediate language of SYSTEM 2000 provides a versatile set of data manipulation and analytic capabilities for standard information

production, single-element updates, and non-related queries. The language commands are designed for interactive use from remote keyboard terminals and are processed individually. Each command is in two parts, the action clause and the qualification clause, the former specifying the action to be taken, and the latter enumerating the criteria to be satisfied before the action is performed.

The action clause includes the capability of printing the answers in a vertical and sequential format, or in a matrix or columnar format with titles and spacing. Answers can include the data, counts, sums, averages, maximums, minimums, and standard deviations. Answers can also be sorted high or low, based on their own value or on the value of other elements. Update commands include adding, removing or changing data values.

The qualification clause sets conditions under which data must qualify for the action clause, and conditions may be connected by a Boolean AND or OR. Each condition may include qualification regarding the existence or failure of data, and existing data may be further qualified for a specific value, range of values, or a greater-than, less than, value, and so forth.

In summary, the Immediate language provides for very sophisticated queries in an easy-to-use language. The following problem and its solution illustrate this point.

Problem:

> Print all names of students who took English or Math and failed.

Immediate Command:

```
PRINT STUDENT NAME WHERE
     ENTRY HAS COURSE EQ ENGLISH AND GRADE EQ F  OR
     ENTRY HAS COURSE EQ MATH AND GRADE EQ  F:
```

## The Queue Language

The Queue language of SYSTEM 2000 is similar to the Immediate language in form but is different in that Queue language commands are processed in groups, not individually. As an illustration of Queue language processing, if a user has 10 Queue language commands, all are first checked for syntax. The syntactically correct commands then have their qualification clauses processed together, and all the action clauses are processed against the qualified data. This type of processing is especially suited for efficient high-volume updates.

## Report Writer Language

The Report Writer enables a user to prepare complex reports easily, following a set of quickly learned report formatting conventions. The user specifies column, row, page headings, dates, footnote captions, and explanatory notes; defines the procedures for report generation; specifies the footnote references for functions, values, and picture restrictions; determines the sequence and ordering of report output; controls the accumulation of subtotals and grand totals; defines the synonym tables for expansion of coded data; and specifies the portion of the data base from which the report is to be drawn.

## COBOL & FORTRAN Languages

Since SYSTEM 2000 has a unique data structure designed especially for large scale data base management, its data bases are incompatible with FORTRAN and COBOL. The SYSTEM 2000 designers, however, recognized that the COBOL and FORTRAN languages offered significant processing capabilities not included in the Immediate, Queue, or Report Writer languages and that there were many existing applications written in COBOL or FORTRAN that could use advanced data management capabilities

of SYSTEM 2000. Therefore, a Procedure Language Interface complete with SYSTEM 2000 qualification logic was developed to make these languages fully compatible with the SYSTEM 2000 data bases.

Design Summary

PMIS is a complete self-contained system. It has its own data structures, data loading, editing, and modification software, its own query languages, and detailed specifications for use and application. One unique feature of the PMIS design is that it can be utilized by persons not trained in data processing.

# Chapter 5

## PMIS BENEFITS

The benefits to be derived from PMIS are both general and specific. In general, PMIS provides an advanced tool based on technology to assist local school districts improve their efforts in long-range planning, comprehensive evaluations, management oriented functions, and general reporting. Specifically, the PMIS benefits fall into three categories: data, application areas, and system design.

### Data Benefits

PMIS, designed on the basis of an in-depth needs analysis, uses comprehensive integrated data bases to provide both longitudinal and descriptive studies. The data bases are flexible so their structures can be modified. Data can also be changed, added, or purged without affecting the overall structure.

### Application Area Benefits

In general, the performance of each application area will be enhanced by PMIS data bases, languages, and models. Specifically, PMIS applies a systematic and formal process to the evaluation, goal setting, forecasting, and alternatives selection process within strategic planning. The evaluation process will be improved because PMIS permits extractions of data not now possible concerning student, staff, programs, and facilities. Goal setting will be furthered by the PMIS ability to assess goal impact and variables which affect goal achievement. The PMIS projection model will aid forecasting. Program alternatives selection will improve because a PMIS linear programming model will be used to determine program mixes based on fiscal and non-fiscal constraints.

In other areas of top management, PMIS provides almost unlimited types of support for day-to-day problems. For example, community relations can be improved when the information on student or school characteristics is immediately available for discussion. Similarly, teacher negotiations can be supported because staff backgrounds, staff salaries, etc., can be rapidly summarized. The key to effective support, of course, is the comprehensive, integrated data base which allows a manager to access a wide range of information about each student, staff, program, and facility in the district.

In the area of Research and Evaluation, PMIS can dramatically assist researchers by providing on-line interactive hypothesis testing, advanced statistical packages, the PMIS data bases, and the five computer languages.

The fourth area, state, local, and Federal reports will receive a great boost from PMIS by making available a source of data and a production mechanism. It is estimated that PMIS may reduce report definition, creation, and production time by 50 to 75 percent.

System Design Benefits

The PMIS system design has been developed in light of the unique demands of managers. The use of English-like languages for query purposes has been stressed to make the system a daily operational tool. The data base has been designed to incorporate changes because of new situations with a minimum of impact on other parts of the system. Security features are an integral part of the system design due to the centralization of large amounts of sensitive data. Much of the design benefits accrue from the Council's choice of data management system; the remainder stem from a variety of Council imposed design requirements.

## Chapter 6

## SUMMARY AND CONCLUSION

PMIS was designed to fit into the existing management structure of school districts to enable decision makers to better use data already collected. It is actually a new approach to MIS system development because its design places emphasis on flexible data structures, user languages, general system use, intense user training, and documentation. PMIS itself is highly transferable because it relies on a commercially available data management system for most data handling. Thus, the efforts expended in PMIS development (or transfer) are highly productive because they center on the three most important items in any MIS development: data base design, data collection, and user training.

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