Analysis for a Comprehensive Computerized Information System for Schools in Saudi Arabia

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ABSTRACT. Management Information Systems (MIS) are vital tools to the efficient management of organizations, and hence of schools as well. This paper presents the results of system analysis of schools in Saudi Arabia as a necessary first step towards the development of a comprehensive computerized management information system.

The paper follows an input-output systems analysis approach. It starts with a description of major school activities, identifies the reports/documents currently generated by the schools. The information flow for different activities is analyzed by using Data Flow Diagrams. The processing requirements of all the reports and documents have been analyzed in terms of volume, complexity, computational needs. The frequency and time constraints for generating the reports/documents have been analyzed. The paper is concluded with a discussion on the drawbacks of the current practice of manual information management and qualitatively recommending the design and development of a comprehensive computerized information system.

1. Introduction

Management information system is a universal tool that helps management run an organization efficiently. A school which is a very important organization for national development is no exception to this.

All schools, like other organizations, do have some kind of information system or subsystems which may or may not be well designed and integrated. Thus, the need to examine the information requirement of schools through formal analysis as a prerequisite to the development of a well designed information system becomes obvious. With
the availability of computer technology at affordable price, the trend decidedly favours development and implementation of comprehensive computerised information system.

Education in Saudi Arabia has been expanding rapidly both in number of schools and enrollment. For example, in the period between 1976/77 and 1985/86, the number of secondary schools increased from 257 to 928, intermediate schools from 824 to 2387 and primary schools from 3878 to 7812[1]. During the same period, the number of students in these levels increased from 59,933 to 180,140 (high school); 177,921 to 402,118 (intermediate); and 726,063 to 1,347,431 (primary). The number of teachers also kept pace with this growth and stood at 12,124; 29,948 and 87,600 for the three levels respectively. These numbers at '93-'94 remain at similar levels as the system approaches steady state[2].

Although schools everywhere have similar functions, there can be great variation in terms of information requirement from one country to another due to local practices and regulations. Saudi Arabian schools have their unique requirements, which stem primarily from the following reasons:

1. Language: Since input/output of school MIS need to be in Arabic, off-the-shelf English software cannot be used directly. An Arabic interface is needed.

2. Specific Reporting Requirement: Schools in Saudi Arabia are bound by a large number of preformatted periodic, mostly annual, reports which form the basis of statistical reports and planning by the ministry. Furthermore, specific grading policies as well as pass/fail policies require unique system specifications. For example, final exam contributes 35% while class work contributes 65% of the marks obtained by a student in a course. However, when a failed student is given a retake exam, the contribution of class work is changed to 70%.

The schools, have the responsibility of efficiently delivering quality education. This can be ensured only through better school management. One of the important tools to manage a school more efficiently is a well designed information system. Thus, it is obvious that an analysis of the school operations here is necessary to evaluate the need for a comprehensive information system.

The paper starts with the organization of a typical Saudi school followed by the description of the major activities needed for school management. These activities are depicted through data flow diagrams showing the flow of data between various files and entities comprising the school. Next, the paper describes the reports and documents generated in the process of various school activities and subsequently the data processing requirements to generate these reports. The paper concludes by highlighting the need for a computerised information system for efficient management of school activities.

2. Organization of a Typical School

From an information point of view, the school can be viewed as comprising several broad functional units, as illustrated in the schematic diagram in Fig. 1, exchanging information with one another and also with the outside world.
In most schools, the administration is run by the headmaster aided by a few clerical staff. However, teachers are assigned different administrative tasks by the headmaster as and when needed. In terms of facilities, schools are designed to have labs, libraries, playground, cafeteria, mosques and other similar amenities.

The functional units in a school serve both as sources as well as destinations of information generated by other units in an integrated manner. The school which is the integration of all these units serves in turn as a source of information for outside users such as parents, ministry or public in general.

All the schools under the Ministry of Education follow uniform educational and administrative guidelines set by the Ministry. The educational program at each level is well defined and well structured. For each level, there is a fixed set of subjects to be taught. The contents of each subject are also fixed by the Ministry in the form of specially printed textbooks. The weekly contact hours for each subject, examinations, evaluation procedure and marks distribution for different exams are also fixed by the ministry. However, individual schools are free to schedule courses and exams to suit their individual circumstances. There are two terms in a year with half yearly and yearly exams. There is provison for make up/reake exams for students failing in the first attempt.

While the state schools are administratively directly under the ministry, the private schools also have to follow certain guidelines and are academically under the jurisdiction of the ministry.

3. Major Activities in the School

There are several major activities performed in the normal course of school operation. These activities are well structured and fairly unified throughout the Kingdom. Within these activities, data, information and reports are generated at various times by
different functional units and subsequently passed on to other relevant units or external users such as the administration, the parents, the ministry, ... etc. A brief description of these activities is given below.

3.1 Student Admission
- Provide blank application forms to prospective students.
- Receive filled-up forms along with past academic records, if any.
- Check applications to accept/reject students.
- If accepted, open a file for student. Add his name to the class list.
- Inform the student.

3.2 Student Assignment to Different Sections of a Class
- Obtain list of promoted students, failed students, new students and class capacities.
- Assign students to different sections and prepare class lists.
- Send the lists to relevant teachers, files and notice board.

3.3 Course Scheduling (Time Tabling)
- Obtain list of teachers, classes, courses, time periods and classrooms.
- Assign classroom and teachers and prepare master schedule.
- From master schedule, obtain individual class schedule and teacher schedules.
- Distribute the teacher schedules to teachers and class schedules to students.
- Keep records of the schedules in relevant files.

3.4 Preparation of Exam Schedules
- Obtain course list and exam dates from academic calendar.
- Prepare the exam schedule.
- Distribute exam schedules to teachers and students.
- Key the exam schedule in relevant file.

3.5 Grade Processing and Reporting
- Collect course-wise grades of exams for all the classes.
- Enter the grades in grade master sheet for each class.
- Compile the marks, i.e., add marks rank students, ... etc.
- Prepare list of promoted students, failed students and students to sit in repeat exam.
- Prepare progress reports/promotion cards.
- Distribute progress reports/promotion cards to students.
- Generate aggregate statistical reports about student performance.
- Distribute aggregate reports to relevant parties.
- Keep records of list of promoted, failed and repeat students in relevant files.
- Keep records of grades in class files.
- Keep records of progress reports in students files.

3.6 Acquisition of Equipment
- Prepare requisition list of equipments.
- Send the list to the Ministry.
- Receive material according to list approved by Ministry.
- Update the equipment records in master equipment file.
- Send receipt to the ministry. Save a copy of receipt in the transaction file.
3.7 Transaction of Equipment
- Receive request of transaction, i.e., issue or return of equipments.
- Check equipment records if necessary
- Effect the transaction.
- Update equipment record in Master equipment file.
- Save the transaction record.

3.8 Preparation of Annual Reports
- Obtain data from all relevant files.
- Prepare the reports in formats predefined by ministry.
- Send the reports to ministry.
- Keep copies of reports in Annual report file.

In addition to the activities detailed above, there are other numerous activities carried out by the school as outlined below:
- Issuing of transfer certificates to students.
- Absence reporting on students.
- Personnel management which includes keeping records of staff, leave, absence, overtime, preparing salary bills, etc.
- Library management: This includes acquisition of books, keeping records of transaction and stock of books and other library materials.
- Management of physical facilities: This includes keeping record of physical facilities like buildings, furniture, cars, air conditioners, office equipments, etc., and preparing requisition for maintaining these facilities.

4. Data Flow Analysis for Major Activities

One of the widely used tools for structured system analysis and design is the data flow diagrams (DFD), that trace the data flow throughout the system showing the storage of data and data transformation processes.

For various conventions in DFD, one may refer to standard texts on Systems Analysis and Design (for example, Sendall, Gore and Stubbe, or Davis and Olson). Figures 2-11 show the DFD's related to some of the activities described in the preceding section.

5. Reports and Documents Used in School

The analysis presented in the preceding sections does indicate the existence of different types of reports and forms used by internal and external users. These reports and forms were mainly collected from different schools at primary, intermediate and secondary levels. Personal interviews with the headmasters and teaching staff were conducted to gain further understanding about how the data are gathered and processed into information. These interviews also elicited information about frequency of report generation, difficulty of gathering data and complexity and processing them manually. The Department of education in the Western region also provided valuable information about different forms and reports received periodically from individual schools. The investigators also benefited from the views and suggestions obtained through the interviews.
Fig. 2. Dataflow diagram for admission process.

Fig. 3. Dataflow diagram for student assignment to different sections.
Fig. 4. Dataflow diagram for course scheduling processes.

Fig. 5. Dataflow diagram for preparation of exam schedule.
Fig. 6. Dataflow diagram for grade processing and reporting.

Fig. 7. Dataflow diagram for acquisition of equipment.
Fig. 8. Data flow diagram for preparation of annual report.

Fig. 9. Data flow diagram for preparing transfer certificate.
Fig. 10: Dataflow diagram for absence reporting.

Fig. 11: Dataflow diagram for maintenance activity.

The scope of this paper preclude individual discussion of these documents. However, a detailed study and analysis of these documents is reported elsewhere[9], the result of which is presented as a detailed list in Table 1.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Type of Action</th>
<th>Start</th>
<th>Duration</th>
<th>Notes</th>
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<td>0100</td>
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<td>Action</td>
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<td>30 min</td>
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<td>30 min</td>
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Note: The table continues with similar entries for other types of actions and their corresponding details.
<table>
<thead>
<tr>
<th>FORM CODE</th>
<th>REPORT ITEMS</th>
<th>FREQUENCY</th>
<th>TYPE OF REPORT</th>
<th>DATA ORIGIN</th>
<th>VOL. DATA</th>
<th>PROCESSED</th>
<th>FUNCTION</th>
<th>DIFFICULTIES ENCOUNTERED</th>
<th>COMPLIANCE NEEDS</th>
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<tr>
<td>C1</td>
<td>PREMATURE CARD</td>
<td>1 YEAR END</td>
<td>GRADE AND CLASS RECORDS</td>
<td>VERY LOW</td>
<td>2-3 WEEKS</td>
<td>VOLUNTARY AND RECORDS</td>
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<tr>
<td>C2</td>
<td>PROGRESS REPORT</td>
<td>2 TERM END</td>
<td>GRADE AND CLASS RECORDS</td>
<td>VERY LOW</td>
<td>2-3 WEEKS</td>
<td>VOLUNTARY AND RECORDS</td>
<td>HIGH</td>
<td></td>
<td></td>
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<tr>
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<td>1 YEAR END</td>
<td>GRADE RECORDS</td>
<td>LOW</td>
<td>2-3 WEEKS</td>
<td>MANUAL COMPILATION IS POSSIBLE</td>
<td>HIGH</td>
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</tr>
<tr>
<td>D2</td>
<td>SUMMARY STATISTICS ON EXAM PRACTICE</td>
<td>1 YEAR END</td>
<td>GRADE RECORDS</td>
<td>LOW</td>
<td>2-3 WEEKS</td>
<td>MANUAL COMPILATION IS POSSIBLE</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>DETAILED COURSE-WISE STUDENT GRADES</td>
<td>1 YEAR END</td>
<td>GRADE RECORDS</td>
<td>LOW</td>
<td>2-3 WEEKS</td>
<td>SEARCH, SELECTION OF DATA &amp; COPYING</td>
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<tr>
<td>D4</td>
<td>SUMMARY REPORT ON 1ST ROUND EXAM RESULTS</td>
<td>1 YEAR END</td>
<td>GRADE RECORDS</td>
<td>LOW</td>
<td>2-3 WEEKS</td>
<td>SEARCH &amp; SELECT DATA FROM REPORT D2</td>
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<td>D5</td>
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<td>1 YEAR END</td>
<td>GRADE RECORDS</td>
<td>LOW</td>
<td>2-3 WEEKS</td>
<td>SEARCH, SELECTION OF DATA &amp; COPY</td>
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<td></td>
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<tr>
<td>D6</td>
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<td>1 YEAR END</td>
<td>GRADE RECORDS</td>
<td>LOW</td>
<td>2-3 WEEKS</td>
<td>SEARCH, SELECTION OF DATA &amp; COPY</td>
<td>HIGH</td>
<td></td>
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</tr>
</tbody>
</table>

REPORTS ON STUDENTS:

| STUDENT PROGRESS REPORTS, MONTHLY | MONTH END | STUDENT RECORDS & CLASS MARKS | MEDIUM | 1 WEEK | INFO, COLLECTION, ANNUAL COMPILATION | HIGH |
| STUDENT PERFORMANCE IN CLASS | TERM END | CLASS MARKS | HIGH | 1-2 WEEKS | INFO, COLLECTION, ANNUAL COMPILATION | HIGH |
| DAILY LOG OF STUDENT'S ACTIVITIES | DAILY | CLASS RECORD (FROM TEACHERS) | LOW | 1 DAY | MONITORING DAILY ROUTINE | LOW |
| LIST OF ABSENT STUDENTS | MONTH END | DAILY ATTENDANCE RECORD | MEDIUM | 1 WEEK | LARGE DATA VOLUME, MANUAL COMPILATION | HIGH |
| STUDENT ADDRESSES | TERM END | STUDY RECORDS | HIGH | 1 MONTH | LARGE DATA VOLUME, MANUAL COMPILATION | VERY HIGH |
| UNDERSTANDING CONFLIGUATION | - | STUDENT RECORDS | LOW | - | DETAILS FROM DIFFICULT TO FILL |

* ONLY TO COMPARE OS FILED THAT HAS ALL DETAILED AND ARE FILLED UP MANDATORY ENOUGH TIMES THE STUDENT REMARKS THROUGH THE BULLET. IT SEEMS THAT THESE ARE MANY PIECES OF INFORMATION ON THEM THAT HAVE MAXIMAL UTILITY.
It has been found that most of the internal forms are not standard or well structured. The format of these forms/documents vary from one school to another and sometimes within the same school. It is also possible that some of these forms are not actively used in some schools. However, certain documents such as yearly reports, grade reports, ... etc., sent to the ministry are very well defined and highly structured, although occasionally do contain information of doubtful relevance.

It should be noted that a large number of the reports23 such as yearly reports, grade reports, promotion cards, ... etc., are event oriented, voluminous and need to be produced in a limited time frame. This results in great strain on the resources, especially teachers who have to work extra hours to meet the deadlines.

6. Data Processing Requirements

Analysis of processing requirements gives an idea about the nature and quantity of work required to generate all the needed information. The analysis is based mainly on the volume of data, the frequency of generation, the complexity of calculation involved, and computational requirement. Other attributes of information such as timeliness, accuracy, ... etc., also influence the total work load. Table 1 shows a global analysis of data processing requirements of a typical school.

6.1 Volume of Data

The exact volume of data involved is difficult to estimate since it may vary from school to school depending on the number of students, teachers, classes, ... etc. Also, it depends on the amount of data handled to produce individual reports. From Table 1, it can be seen that the volume of data involved in most of the reports is quite high, particularly those related to individual students, student grades, books and equipment.

6.2 Frequency/Time Constraint of Report Generation

Generally, most of the reports are generated on a periodic basis, mostly every term or every year. Even though this is not a high frequency, a number of these reports have stringent time constraints. For example, promotion cards, progress reports, annual reports, ... etc., need to be generated within a short time following the examinations. Additionally, some reports (for example, transcript of a student) may be required on a random basis when requested by a user. In such cases, speedy preparation of the report is desirable although the frequency is not high. A summary of the frequency of the report generation is also presented in Table 1.

6.3 Complexity of Calculation and Computational Needs

Generally, the calculation involved in preparing these reports are rather simple. Basic arithmetic is enough for the purpose. However, a good number of these reports involve simple but lengthy computations. For example summary statistical reports of different kinds, the annual reports, ... etc., require multiple scanning of entire files to produce the necessary statistics. Manually, this is a tedious and time consuming task.

7. Conclusion

The analysis of the school information system brings out certain important features which may be summarized as follows:
a) The volume of data handled in the course of report generation is quite large for most of the reports. For some reports, it can be extremely large. The number of reports and documents is also quite large. Although, the computational complexity for preparing these is generally low, the computational requirements for some of them (for example, yearly reports) is very high. The manual preparation of most of these reports is thus tedious, time consuming and error prone.

b) It is difficult to produce some of the reports on a timely basis because of short time available to the school. For example; the manual preparation of yearly report is difficult and teachers have to work overtime to prepare them. This increases the temptation to compromise on the quality of reports.

c) Not all the documents, particularly the ones used internally, are standardized or well structured. This discourages (or sometimes inhibits) storing of many information in an organized and accessible manner.

d) Evaluation of student performance and its trend is important in judging the standard of a school. Although the grade report prepared by schools for the ministry shows the students' performance, it mainly contains the pass/fail statistics or the raw grade obtained by students. It does not contain meaningful performance analysis. Also, trend analysis of different performance parameters (such as average standing of the graduates) over the years are not done at the school level. On the other hand, some of the reports contain unfiltered raw data of doubtful use to the Ministry.

e) The schools, as a part of normal operation, keep a large number of records on students, grades, teachers, ... etc. Manual record keeping and retrieval of such a large amount of data can be at best cumbersome and at worst incomplete and inaccurate.

Looking at the deficiencies in the system, tremendous scope for improvement exists. The following possible improvements can be visualized:

a) Adoption of standardized and well structured reports and forms for internal and external users.

b) Introduction of new reports for performance evaluation and trend analysis of important parameters.

c) Removal of redundant reports.

d) Removal of redundant and duplicate data from selected reports sent to the Ministry.

In conclusion, it can be said that the introduction of a comprehensive computerized information system will enable generation of accurate reports on a timely basis. In addition, it will do not relieve the school administration from the tedious task of manually preparing the reports and allow generation of more meaningful reports. Such a system can be introduced in all schools in the Kingdom and can form the basis of higher information system at national level. The design and development of such a computer-based information system will be presented by the authors in a subsequent paper.

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References

تحليل نظام معلومات متكامل للمدارس في المملكة العربية السعودية

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المستخلص: تؤدي نظم المعلومات الإدارية دورًا هامًا في عملية إدارة المؤسسات، وكلاً من المدارس جزءًا منها. تعرض هذه الورقة تحليل نظام معلومات مدارس المحافظة في المملكة، وتقنية وتحليل تصميم نظام معلومات متكامل على الجانب الألي. تمّ استخدام الرسوم التصويرية لتحديد الخط العام للفائدة، واحتياجاته، وتصميمه، وبيانات التحليل وفقًا للشريعة الرئيسية، التي تتضمن إصدار أو رصد أو قراءة المعلومات. ثم يتم تحليل خط النقل هذه المعلومات باستخدام الرسوم البيانية لتمكين المحاولات من خلال تقسيم واستخدام المعلومات، وتحديدها وتفاصيلها الأصلية. كما أن التحليل يعرض توزيع إصدار التفاصيل والبناء النافذة لتقسيم حقوق المهمة الرئيسة لإصدار إذا كانت منها. 

وتستخدم تقنية بعمر حيوي للمعلومات الاجتماعية في المدارس المحلي لصالح التحليل، واستودا إنها كما تضمن تثبيت كفاءة نحو تصميم نظام معلومات متكامل على الجانب الألي.