Technical co-operation with and between Member States with a view to the reform and modernization of education systems

Developing a Computer-Assisted Management Information System for Education (CAMISE)

by
L. Tiburcio and E. Malka

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DEVELOPING A COMPUTER-ASSISTED MANAGEMENT INFORMATION SYSTEM FOR EDUCATION (CAMISE)

by L. Tiburcio and E. Malka

Report prepared for the Government of the Republic of Trinidad and Tobago by the United Nations Educational, Scientific and Cultural Organization (Unesco)

UNESCO
The present report refers to the main findings and recommendations of the mission requested by the Ministry of Education of Trinidad and Tobago, with a view to advising on the design and implementation of a computer-assisted management information system for education (CAMISE).

The mission was carried out under Unesco's regular programme for 1986 - 1987. It took place from 17 to 28 January 1987 and was composed of Mr. Luis Tiburcio, Unesco staff member and specialist in educational planning and management and organizational analysis and Mr. Emmanuel Malka, consultant, computer specialist.

Following the general analysis of the existing management and information system and problems of the Ministry of Education, the report presents various suggestions regarding the global architecture and implementation schedule of the CAMISE, as well as the corresponding training requirements and the comparative analysis of the possible hardware configurations.

The United Nations Educational, Scientific and Cultural Organization (Unesco) is thankful for the excellent cooperation and support provided to the mission by the Ministry of Education of Trinidad and Tobago and the United Nations Development Programme's local office.
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I. Summary and major recommendations

1. The analysis of the planning, management and information systems of the Ministry of Education in Trinidad and Tobago has revealed the existence of serious problems, both in terms of efficiency and relevance. The major problems consist of the duplication of certain planning processes (general vs. technical/vocational education), as well as the overlapping and high administrative operational costs of the existing information flows and processing system.

2. Within this context, the design of a computer-assisted management information system for education (CAMISE) would have to attempt to rationalize the information system of the Ministry of Education and to integrate the several types of data and information functions, as required for the effective functioning of the planning and management processes.

3. Reflecting this basic objective, the CAMISE concept, recommended by the mission suggests the creation of a relational data base management system, which would centralize all the information required by the various divisions/units of the MoE.

4. Such a CAMISE model could be implemented according to two possible configurations: (i) a network of micro-computers and (ii) a mini-range computer connected to terminals. Although the report analyses and compares both hypotheses, the mission recommends this last configuration (identified as configuration B).
5. Actually, this latter solution seems to be more adequate regarding the central information needs of the Ministry, and certainly more cost-effective than configuration A. Furthermore, this hypothesis could more likely be expanded without excessive cost, given the material and technical facilities provided by such a system, as compared to the network of micro-computers. In addition, the data base management system's software packages are less performant within networked configurations, especially if the system is supposed to deal with a large volume of information.

6. During the contacts with the national authorities and the UNDP office, the mission was informed that the implementation of the CAMISE should and would be considered as a project to be submitted to external financing agencies, given the severe economic and financial crisis of the country. The mission has also been requested to prepare a draft project description (see annex 4) as well as to refer to Unesco the country's willingness to have this Organization's cooperation regarding contacts with possible donors, following the Government's approval of this report and the attached project description.

II. Introductory remarks on management information systems (MIS)

7. The education system is a massive organization with many levels of decision-making and with multiple action centres disseminated all around the country. With such a system, decisions have to travel quite a long way before reaching the points where they are executed. On the other hand, education faces a situation of great scarcity of resources, which have to be properly used and optimized. Both educational planning and management and decision-making require accurate, timely and relevant information. It is to be noted that information is a basic and fundamental resource, which must be properly managed as any other organization's resources.
8. In Trinidad and Tobago there is a strong concern for improving the quality of the planning and management processes as well as its productivity and effectiveness. The establishment of a computer assisted management information system for education (CAMISE) will strongly contribute to the achievement of such an objective.

9. The development of electronic data processing and the rapid dissemination of micro-computers will facilitate the production of information, which if properly handled, can effectively assist in decision-making. One of the major implications of this situation for an information system is that the emphasis will be, not only on additional processing capacities of the same information, but also on different information, better processed and more relevant.

10. The design of an MIS depends on two major elements:

   (i) the organizational goals and structure;

   (ii) the information required by the decision-making and management processes.

Regarding the organizational structure, it is worth mentioning the eventual difficulties in planning the coordinated development of general and technical education, given the existence of two different units performing planning functions. Educational planning is a comprehensive and integrated process and is the necessary instrument to influence and build for the future, to set medium and long-term objectives. It is also, or should be, a continuous, motivating and learning process, implying a permanent dialogue between the various levels of management, allowing for a real feed-back and adaptive or corrective action. In this connection, the role, organization and methods of planning should be redefined for the purpose of coordinated management of an extended educational field.
11. Basically, there are six types of information which the Ministry of Education (MoE) is processing viz:

- D1 enrolment of pupils
- D2 personal and professional information of teachers and other staff
- D3 school buildings and facilities
- D4 school performance
- D5 finance
- D6 the school list or directory

The analysis of the present situation of the MoE as far as the information system is concerned reveals, in brief, the following:

- the existence of the same data in the same files located in different sections;

- the lack of relevant information regarding certain functions (e.g., educational facilities, micro-planning);

- the collection of the same type of data by different services, implying high administrative costs;

- excess of time and delays in the processing and analysis of existing data.
III. Overview of the existing situation

12. The following chart shows "who does what" in terms of information:

<table>
<thead>
<tr>
<th>Enrollments (D1)</th>
<th>Staff (D2)</th>
<th>School Facilities (D3)</th>
<th>School Performance (D4)</th>
<th>Finance (D5)</th>
<th>School List (D6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.S</td>
<td>U</td>
<td>U,P,S</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>CURR. DIV.</td>
<td>U</td>
<td>P,U</td>
<td>U</td>
<td>U,R</td>
<td>U</td>
</tr>
<tr>
<td>GEN.ADM.</td>
<td>U</td>
<td>-</td>
<td>C,P,U</td>
<td>-</td>
<td>P,U,C</td>
</tr>
</tbody>
</table>

(*) Cf. detailed notes on page 13.

Code:  
- C: Data Collection  
- R: Data Recording  
- P: Data Processing  
- U: Data Utilization

(i) **Data collection**:  
- organized by different agents, even when it refers to the same type of information;
- system based on school supervisors and questionnaires (regular data sheets or occasional enquiries).

(ii) **Data recording**:  
- in most divisions and sections this function is a long and time-consuming manual task;
- new data is not added/integrated with the existing one. Separate and overlapped files are newly created;
- recording of the same type of data is done by different services according to their needs.
(iii) **Data processing**:

- most data processing is manual and concerns only the basic and regular information needs for the functioning of the Ministry;

- the present automatic data processing capacity within the MoE refers only to certain statistical data. The processing of relevant financial information (payroll, grants) is done outside (NCA) and that referring to examinations is mostly done abroad;

- the slowness of the data processing generates the need for duplicating several data and information files concerning the same subject, by different Divisions, either because of the confidential aspect of certain types of information or because of the specific needs of certain Divisions.

(iv) **Data retrieval**:

- there is a small data retrieval capacity due to the manual processing. Often the retrieval of a given data obliges the organization of specific enquiries or surveys, given the difficulty and the time needed for a manual retrieval of such existing data.

(v) **Summary of the main shortfalls for the MoE**

- the present management information system leads to a situation in which certain relevant functions of the Ministry are almost non-existent: micro-planning/school mapping, research;

- the decision-making process is sometimes too long due to the time needed to process the required information; it is also limited by the lack of relevant information. Personal knowledge of a given problem plays a major role in the decision-making.
V. Possible consequences of the implementation of a CAMISE

13. As far as the information process is concerned:

- greater availability of data
- greater processing and storing capacities
- improvement of information quality
- access to more relevant information
- permanent up-dating of the required data
- greater rationality of the management process

14. As far as the planning process is concerned:

- immediate servicing of the required information;
- possibility of developing other planning cum research activities;
- improvement of the quality and validity of project proposal and policy formulation;
- better allocation of time to the planning activities requiring the use of information;
- better use of staff qualifications and potentials.

15. As far as the management process is concerned:

- simplification/rationalization of the administrative information flows;
- greater management performances;
- better staff allocation and utilization;
- important decrease of general operational costs;
- improved capacity of managing the development of the educational system, namely most functions of a qualitative nature.

16. As far as the decision-making process is concerned:

- greater rapidity in decision-making;
- improved quality and relevance of decisions;
- improved monitoring capacity of the decisions' implementation;
- proper use of up-to-date and reliable information.
V. Information needs and information system

17. The Planning Division and the Organization & Management Unit of the MoE have prepared technical papers (*) in which the main information requirements as well as the information flows are clearly formulated. It is important that the same type of documents be prepared for every single division/unit of the Ministry.

18. Following the analysis of these documents and the interviews made by the Unesco mission to some Division/units of the MoE, it has been possible to identify the type of information requiring greater collection, processing and retrieval capacities, as well as that which will have to be newly collected to meet with the specific needs of some units.

(*) "Main planning and management functions of the divisions of the MoE and the number, type and distribution of hardware material with special reference to micro-computers" and "Work paper on the information needs of the Personnel and Industrial Relations Unit of the Ministry of Education"
19. The attempt to implement a CAMISE implies approaching the organization (MoE) in its totality, including the interactions among the services. As an organizational resource, information must also be viewed in its totality, although its use may be partial or specialized by this or that division/unit.

20. In this context, the design and implementation of the management information system will have to be gradual and learning/adaptive, so that each phase will only be implemented when the preceding one has proved to have attained a given "maturity".

21. In general terms, the implementation of the CAMISE could be phased as follows:

   Phase I: CAMISE referring to the basic planning and management processes;
   Phase II: Expanding CAMISE to the district levels and to other managerial/administrative routines;
   Phase III: Expanding CAMISE to post-primary schools;
   Phase IV: Generalizing CAMISE to primary schools.

22. Phase I should then refer to the following type of information (general categories):

   I 1  Pupil's data (enrolments, sex, age, etc)
   I 2  Teachers' data - personal
   I 3  Teachers' data - professional
   I 4  Non-teacher staff records
   I 5  School buildings records
   I 6  School facilities records
   I 7  School performance records
   I 8  Finance/accounts records
   I 9  School directory
   I 10 Examinations records
   I 11 Occupations dictionary
   I 12 Manpower data
   I 13 Demographic data
VI. Global architecture of CAMISE

23. A flexible, less costly and optimized use of these data can be possible through the implementation of a system combining the centralization of information and the decentralization of its processing and multiple use. As an illustration it could be said that the financial/accounts records can be processed and used for payroll or grants purposes by the Finance Division and for statistical or research purposes by the Planning Division.

24. Actually one of the dominant characteristics of an MIS is its heavy reliance on stored data. This requires the design of a common DATA BASE defined as a structured set of files containing data required for the processing of several different applications of the Ministry of Education, in a selective way. The data base provides a formal analogue of the organization and its environment.

25. Furthermore, it should be noted that the processing flow involves the retrieval of data set, the execution of filters, the translation of codes, the extraction and calculation of the required variable, updating and doing the relational operation. The whole process is repetitive and varies according to the size of data set file. The several types of information which the MoE is dealing with are interrelated to one another with different file structures. The best way to interrelate this information is by a relational model of data base.
26. A major advantage of such an approach is that it facilitates the integration of information processing through the data entry, the database organization (consolidated vs. fragmented records), the resource sharing and the integration of the organizational objectives.

27. Besides the centralized database approach to CAMISE, it is worth considering the interest of a distributed database approach, which might be implemented within the framework of a networked system. According to this approach, the database would be "specialized" and distributed to different working-information stations in line with their major fields of responsibility within the MoE. A comparative analysis of both approaches including approximate cost elements is presented in chapter VIII of this report.

28. Having in mind that the processing and use of the data can be accomplished by multiple services, it is however important to define which station (Division, Unit) will be responsible for the different data collection, entry and updating.

29. As far as the school based information is concerned it is recommended to design a package of all the data sheets to be dealt with by the schools, following a pre-established calendar. The existing set of data sheets should therefore be harmonized in order to avoid duplication of required data by different services and including new data as required by some divisions/units (eg: EFMU is willing to have more complete and comprehensive information on school buildings, facilities, space utilization, etc).

30. The school supervisors should continue to be the main mediators in the data collection process and should be briefed on all aspects regarding the purpose and use of the information requested from schools, with a view to being able to provide assistance to the school heads in the completion of such data sheets.

31. During Phase III of the implementation of CAMISE, part of these data sheets can be collected and even partially processed through the expanded network.
32. Recalling the type of information and data which have been defined before:

I 1   Pupils data (enrolments, sex, age, etc)
I 2   Teachers' data - personal
I 3   Teachers' data - professional
I 4   Non-teacher staff records
I 5   School buildings records
I 6   School facilities records
I 7   School performance records
I 8   Finance/accounts records
I 9   School directory
I 10  Examinations records
I 11  Occupations dictionary
I 12  Manpower data
I 13  Demographic data

It is possible to design a matrix showing the divisions/units of the MoE which should be responsible for the various information functions (C - data collection, E - data entry/updating, P - data processing) for each type of information. This matrix (cf next page) also presents the mission's recommendation regarding the distribution of the several workstations of the CAMISE.

33. It should be noted that it refers to a basic CAMISE configuration. Actually, the Educational Facilities Management Unit has not been considered as a "regular" workstation given its present location and distance from the MoE headquarters, which will likely affect the quality of communication. As an alternative it is suggested to provide a micro-computer in order to improve the EFMU's efficiency and quality of work and which should be connected, by modem, to the CAMISE central processing unit (CPU).

34. It is also recommended that the existing IBM-PC's at the Educational Planning Division, Finance and Accounts Division and Technical and Vocational Education and Training Division be connected to the CAMISE CPU in order to benefit from the central data base. Further to their own potential and specialized applications, these micro-computers can also operate as terminals. At least, there should be compatibility between both operating systems so that the floppy disks can be mutually used.
### Matrix of information functions by unit and type of information

<table>
<thead>
<tr>
<th>DIVISIONS/UNITS</th>
<th>Work station</th>
<th>I 1</th>
<th>I 2</th>
<th>I 3</th>
<th>I 4</th>
<th>I 5</th>
<th>I 6</th>
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<th>I 9</th>
<th>I 10</th>
<th>I 11</th>
<th>I 12</th>
<th>I 13</th>
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<tr>
<td>EDUCATIONAL PLANNING</td>
<td>2</td>
<td>E/P</td>
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<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C/E</td>
<td>P</td>
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<td>1</td>
<td>P</td>
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<tr>
<td>SCHOOL SUPERVISION</td>
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<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
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<td>CURRICULUM DIVISION</td>
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<td>EDUCATIONAL FACILITIES</td>
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<td>E/P</td>
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<td>TEC/VOCATIONAL EDUCATION</td>
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<td>C/E/P</td>
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<tr>
<td>FINANCE AND ACCOUNTS</td>
<td>2</td>
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<td>C/E/</td>
<td>P</td>
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<tr>
<td>PERSONNEL &amp; IND.RELATIONS</td>
<td>2</td>
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<td>C/E/</td>
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<tr>
<td>GENERAL ADMINISTRATION</td>
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</table>
VII. CAMISE training requirements

35. Following the installation of CAMISE it will be necessary to organize a staff training programme for two different categories of personnel:

(a) the regular users of CAMISE, i.e., the 1 to 3 main operator officers in each division/unit of the MoE;

(b) the data administrators (2/3 officers) who will be in charge of supervising the implementation, regular functioning and maintenance of the Data Base Management System.

36. The nature of the training required can be summarized as follows (cf. content description in annexes 2 and 3):

<table>
<thead>
<tr>
<th>Subject</th>
<th>Participants</th>
<th>Duration</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to CAMISE</td>
<td>Regular users</td>
<td>3 weeks</td>
<td>Country</td>
</tr>
<tr>
<td>Data base administration</td>
<td>2/3 selected</td>
<td>3 months</td>
<td>Country or Abroad</td>
</tr>
<tr>
<td></td>
<td>officers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

37. Although the training on data base administration can be organized abroad through the granting of the necessary fellowships, it is worth noting that it could be also organized as on-the-job training, to be conducted by the expert who would be in charge of designing the data base and installing the CAMISE. As this training programme refers only to the initial training needed to run CAMISE, the above-mentioned expert should also conduct a survey on further training needs with a view to designing and elaborating the corresponding expanded training programme. This includes, namely, the need for the training on simple programming language (BASIC, for example), in order to complete and concretize the background concepts of a computer tool.
VIII. Analysis of alternative configurations

38. As it was stated in the previous chapter the Computer Assisted Management Information System for Education can be designed according to two possible approaches:

(i) centralized data base approach based on a computer of the "mini" range, having terminals connected to it;

(ii) distributed data base approach based on a network of micro computers.

39. In both approaches, the hardware should be based on a Relational Data Base Management System cooperating with integrated tools such as spreadsheets, business graphics, reports facilities and statistical functions processing.

40. A Relational Data Base is easy to design and understand. Data is organized in tables of columns and rows and the set of basic operations to perform for the manipulation of data is very small (the three basic operations are the relational Job, Select and Project). The great advantage of this type of structure is that the user can retrieve data by combining relations with the operators without using predefined access path.

41. The choice of the computer configuration has to be determined according to the following factors:

- cost
- gradualness of the implementation (step by step approach)
- limits of the system
- ease of use
- staff required to service the system in terms of skills and training local support
- completeness of the system and growth possibilities.
The analysis of the flow of data and distribution of the different sections of the ministry has shown that the configuration for a CAMISE should not be less than 10 workstations with a minimum of one per Division/Unit which could be upgraded later if the workload of data capture would require it, at least for some of them.

A. The micro-computer network configuration

One of the main advantages of this approach is that it is possible to start with a small number of micro computers, automatizing only a subset of the tasks to be performed in the ministry and then extend the system to obtain a fully integrated management and planning information system. In spite of this advantage which allows the spreading of the investment over a longer period of time, a careful analysis of the system has to be undertaken in order not to jeopardize the final quality of the overall system. This study has to be developed following these points:

Configuration guidelines

Although a P.C. network allows the sharing of data disseminated on a set of distinct micro computers, very few Data Base Management Systems (DBMS) can run satisfactorily on a network. The main restrictions arise from the amount of data to process and also from the number of servers. By server is meant a machine sharing its resources (hard disk and/or printer) and not a dedicated server to manage the network. If it becomes necessary to go over 4 or 5 such servers, the micro solution is still valid. However, the price of the IAN (Local Area Network) card and the associated software will increase drastically (in a range from 1 up to 15). In fact, the two possible solutions to keep the price of software reasonable are to have either 4 servers with 40 M Bytes each (around US$5,000 each) or 2 "Super servers" with 75 Mega Bytes hard disk streamer and extended memory (around $ 18,000) and a number of workstations with the minimum requirements, i.e. no hard disk necessary and minimum memory (around $ 2,500 each).
45. Of course, if some of the divisions/units have particular needs, not requiring the use of the common DB, it is possible to have a workstation with a hard disk not shared on the network. However, this would increase the basic price of a workstation.

46. The type of network to implement should be a bus configuration network because it does not require either closing the loop as for a ring (the amount of cable is halved) or to reconfigure the network when a station fails (as for the ring for example).

47. A backup driver is mandatory in the network. If the "super server" having an integrated streamer is not implemented, a separate streamer is to be provided (US$6 000). The streamer is also mandatory because backing up the D.B periodically on floppy disk is so long that it could become dissuasive and be neglected.

Gradualness of the implementation

48. In the micro computer network approach, a minimum configuration should be set up to begin with, in order to spread the cost of hardware over a longer period of time. Nevertheless, in order to reach a good quality level of the overall system, the minimum number of micros to be linked to the network should not be too low. This point is important in order to give an effective meaning to the notion of INTEGRATED System and avoid the temptation of the different units of the Ministry to develop specific systems for their particular needs, leading to the situation where the same information would be found in different places and would not be updated at the same time, which would imply a lack of coherence of the system seen as a whole. It is to be noted that this temptation to set up parallel systems is common in the micro computer network configuration and should be closely controlled even when the complete system is in operation.

49. It has to be emphasized that one of the advantages of an integrated system is not only to reflect the organization of the ministry and make it mandatory to respect the rules, but also to take care of the flow of information inside the ministry. Actually, once the information has been updated by the unit in charge, it is available as such to all the others.
Ease of use

50. The CAMISE is meant to be used in the different units of the Ministry by officers who are not computer software specialists. Although a minimal training will be necessary, the system has to be as "user friendly" as possible. This can be achieved by choosing a software respecting at least the following requirements:

51. The DBMS will not require the user to give the location (disk identification) of the data which is not ending on its own station (transparency of locations). It will if possible take care by itself of the concurrent access to data (as explicit lock). The manipulation of the DB will be based on an application environment menu driven interface to guide the user.

Limits of the system

52. The major shortfalls of DBMS on a micro computer network are security and performance. As far as security is concerned, the following aspects should be emphasized:

   (i) the possibility of restoring the DB in case of failure, which is not really well developed on this type of machine;

   (ii) the confidentiality of information is not satisfactory, although it is claimed on some systems. The only safe way to have confidentiality is to have private files (not shared) which would be contradictory to the configuration constraints stated before for the number of servers.

53. The performance of a DBMS on micro computer is limited by the volume of data to process and also by the type of access to a same set of data. The first part of this report shows that some data (on staff for example) is updated by many different users in a read only mode by an even larger set of users. This could lead, in some cases, to a crash in terms of performance of the system.
Another limit of the software on micro computers is that, despite the possibility of using information from the data base in spreadsheets and other tools of the same type, these tools are not completely integrated in the DBMS. This means that a file has to be prepared with the usual operation of the DBMS using an interface, before using it with external tools.

Staff requirements

Staff requirements in terms of skills and training will depend on the quality of the selected software and network. While examining this aspect of the requirements, it is very important to avoid being impressed by the evolution of micro-computers making available a set of integrated tools as spreadsheets, business graphics and word processing or other type of specialized applications. Networks of micro-computers are mainly used as a communication tool, allowing to share data and giving the possibility to exchange data (by copying data on one's own micro-computer) for local processing.

In fact, in the MoE the problem is more complex, and, when the proposal is completely implemented, it will be close to the maximum of the possibilities of both the network and software. The difficulty comes from the fact that the network is not meant here to have a local processing power together with the possibility "when needed" of access and copy some common data, but rather to set up a complete and integrated information management system, reflecting the structure of data processed by the MoE. The use of micro-computers being more based on a cost factor than formulated in efficiency terms. Actually, when the capacity and sophistication of the machine are limited, a greater part of the work relies on the operator.

Another important aspect of the skills required, specific to the network approach, refers to the basic knowledge to set up the network in terms of declaring the shared resources (at power-on time) and a first level of diagnosis in case of failure. Failure of a workstation in a network can derive from the station itself, the LAN card or the cable. Test tools exist on some networks allowing location of the
failure. Further to a short period of training for the "common users" of the system, this implies a more complete training for 2/3 officers of the MoE in order to be able to set up and maintain the structure of the data base, to service the network and to be able to give a first level of support on the use of software for data retrieval and manipulation.

Local support

58. Local support in a non-specialist environment is of major importance. This should not be a problem for the micro-computers because MS-DOS micro-computer suppliers are available in the country. The major difficulty would probably arise for the LAN cards and software. The particularity of a network has to be considered in the selection of a solution for CAMISE because when a failure occurs in terms of troubleshooting or maintenance, many parameters have to be considered:

- the micro-computers
- physical structure of the network
- type(s) of software used
- distribution of data on the network

It should be noted that if each one of the above-mentioned parameters can be analyzed individually, within a network system they are strictly combined, each network becoming a particular case.

B. The mini-computer configuration

59. The other approach for CAMISE refers to an integrated environment software for inexperienced users on a multitasking "super micro-computer", belonging to the mini-computer range, in terms of processing capacity. In this configuration there is only one computer with disk capacity, central memory and processing power able to serve the needs of up to 32 users (a user being here either a VDU terminal to access the system or a printer). There is also only one version of the software and one data base reflecting the information structure of the Ministry.
Configuration guidelines

60. The hardware configuration should be based on a 32 bit computer with a virtual memory operating system (VMS) with central processing unit (CPU) as follows:

- 5 Mbytes memory
- 160 Mbytes fixed disk
- Streamers (cartridge tape for backup)
- Dual floppy disks (IBM compatible)
- 8 asynchronous lines

61. However, a complete configuration would require the following additional elements:

- 8 asynchronous lines
- 10 VDU terminals
- 2 medium speed printers
- 1 high speed printer

62. This configuration should be sufficient to cover the needs of the MoE. It is important to note that it is still possible to extend the main memory, the disk storage capacity and the number of asynchronous users if needed for specific application in any sector of the Ministry.

Gradualness of the implementation

63. In this approach, the maximum part of the investment is required at the beginning. The gradualness of the development of the system becomes strictly a matter of implementing new functionalities rather than spreading the cost over a period of time.
64. The major cost factors are:

- Purchase of the computer,

- Purchase of the software distribution and licenses,

- Basic requirements or terminals:
  - VDU
  - Regular printers (shared by all users)
  - One heavy duty fast printer (optional: this feature does not exist on PC's and is useful for long reports). This printer has a capacity of 300 lines per minute.

65. This type of solution, starting with a limited number of workstations is not as cost-efficient as in the PC network solution due to the low price of each station. But it is important to note that when the system has reached a certain level of configuration (around 10 to 12 users), adding a new station becomes more cost-effective (US$ 800 only vs US$ 2,500).

Ease of use

66. The complete processing power being available from the beginning, the physical configuration does not interfere any more with the structure of data. This fact is even strengthened by the confidentiality features of DBMS on this type of system which can be described not only at the relation level but at a field level. Consequently, the DB layout can be designed according to the structure of data and all the security requirements can be further added by updating or modifying the DB structure.

67. With the extra power and storage of this type of machine, it is possible to build "views" of the DB. A view is a contribution of records and fields synthetized from different relations using the relational operation and logically appearing as a single relation. Using views of the DB built for specific operations can strongly simplify a great number of functions to be performed in the MoE.
68. For planning and decision making, it is easier to have a centrally located DB, instead of a collection of various parts in various locations and depending on the accesses to the server (connected or not to the network).

69. Other important advantages of this DB organization are that the location and use of data do not have to be considered in the process of designing the structure of the DB, this applies also to the need for eventual modification of the DB structure. The design of the DB and the maintenance of its structure is therefore a much simpler task.

70. The user environment tools such as spreadsheets, graphics, facilities to access data guiding the operator are built around the DBMS. Instead of having to prepare data in order to process it in a spreadsheet, for example, the overall product will be completely integrated, giving the users an interface of the level of spreadsheet complexity to retrieve data from the base and the possibility to use it directly in the "side" functions. This type of approach is closer to the notion of information management and decision support system designed for the inexperienced user.

71. It is also possible to have a "companion" product (development product) to the user environment facility providing a powerful menu driven interface for developing applications. This product provides user friendly tools necessary to built up the DB, screen forms, complex reports, menus and on-line help. This feature is not absolutely mandatory, as it is by far the most expensive software package but is very useful and efficient in a non specialized environment in order to achieve autonomy in using and managing the DBMS.

Limits of the system

72. On a mini-computer, the DBMS can afford to be extremely complete, offering not only the completeness of relational operations and user environment but also a complete security system featuring facilities to protect data for accidental loss or unauthorized use journaling (facility used to memorize the status of each record before and/or after a modification occurs) to allow an easy rollback and recovery of the data base, as well as integrity checking down to the field level through a "define constraint" type of statement.
It is possible to say that the limits of this approach are relatively weak, given the completeness of software functions available and possibility to add additional machines of the same type and double at once the processing and storage capacity as well as the number of potential users.

Other important possibilities of the system refers to the multitasking feature to run different software at the same time as the DBMS and also to add a synchronous line and a IBM 2780 emulator in order to transmit information (sequential files) to the National Computing Agency (NCA)'s computer, directly or through a modem, should this facility become convenient for any reason.

Staff requirements

The completeness of the software makes the training and skill requirements identical to the micro-computer solution. Of course no network training is required here.

Local support

Local agencies of some major computer manufacturers exist in Trinidad and Tobago which are in a position to grant the necessary support should this configuration be implemented. Actually, the contacts made by the mission with some local agencies have shown that adequate support and maintenance can be granted as well as the possibility of providing technical assistance for the development of applications when needed.

Finally, as a similar system has been implemented by the West Indies University, it would be important to establish a close cooperation with the university specialists for eventual technical assistance or training needs. The National Commission for Unesco is also in a position to coordinate and advise on any eventual need for further developing the cooperation with Unesco.
C. **Summary of alternative configurations**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Configuration</th>
<th>Configuration</th>
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<tr>
<td></td>
<td>A1</td>
<td>A2</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>No. Unit cost</td>
<td>Tot. cost</td>
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<td>SCREENS</td>
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<tr>
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<td>5000</td>
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<tr>
<td>Servers (75 MB+ streamer)</td>
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<td>Computer package:</td>
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<td>(a) 32 bit CPU 5 MB memory</td>
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<td>(b) 159 MB hard disk</td>
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<tr>
<td>(c) 95 MB streamer</td>
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<td></td>
</tr>
<tr>
<td>(d) Dual floppy drive</td>
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<td></td>
</tr>
<tr>
<td>(e) 8 asynchronous lines</td>
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<tr>
<td>(RS 232) multiplexes</td>
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<tr>
<td>8 asynchronous lines</td>
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<td>1800</td>
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<tr>
<td>VDU(terminals)</td>
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<tr>
<td>Medium speed printers</td>
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<td>High speed printer</td>
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<td>COMMUNICATIONS</td>
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<tr>
<td>Cables (twisted pair)*</td>
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<tr>
<td>Connectors (Co-axial cable)*</td>
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<td>Sub-Total :</td>
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<td>SOFTWARE</td>
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<td>User environment</td>
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<td>6000</td>
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<tr>
<td>Development product</td>
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<td>21300</td>
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<td>GRAND TOTAL :</td>
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<td>84000</td>
<td>75300</td>
</tr>
</tbody>
</table>

(*) Depending on the type of network.

N.B. The costs have been based on the information provided by local computer distributing agencies.
SYNOPTIC OF THE DIFFERENT SOLUTIONS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Network with four 40MB servers (micro)</th>
<th>Network with two super servers (micro)</th>
<th>Centralized DBMS (mini)</th>
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<td>Cost hardware</td>
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<td>$74000.00</td>
<td>$58000.00</td>
</tr>
<tr>
<td>Cost software</td>
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<td>$10000.00</td>
<td>$21300.00</td>
</tr>
<tr>
<td>Cost optional software</td>
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<td>-</td>
<td>$20000.00</td>
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<tr>
<td>Completeness</td>
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<td>5</td>
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<tr>
<td>Security</td>
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<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Confidentiality</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Ease of use</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Transparency of integrated tools</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Available power for local exten­sions (limits)</td>
<td>1</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Possibility of intelligent remote connections</td>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Performance</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Scores: 1 - lack of performance to 5 - excellent performance
ANNEX 1

List of persons and services contacted by the mission

Mr. J. Carrington
   Senior Education Officer

National Commission for Unesco
Mrs. S. Solomon
   Director

Educational Planning Division
H. Gift
   Director
C. Douglas
   Senior Planning Officer
M. Chin-Aleong
   Project Educator
D. Ramanrine
   Research Officer I
Mrs. J. Hussain
   Research Officer I
Mrs. V. Bissessar
   Economist I
L. Kalloo
   Clerk III

Organization and Management Unit
K. Lange
   Officer I
T. Browne
   Officer

Educational Facilities Management Unit
Mrs. J. Lyons
   Acting Project Unit Manager
Mrs. M. Small
   Project Unit Accountant
D. Dolly
   Accountant II
A. Romain
   Project Coordinator
I. Babb
   Asst. Project Coordinator
R. Ali
   Asst. Project Coordinator

Educational Services Division
Dr. P. Dyer
   Director

Personnel and Industrial Relations Division
Mrs. E. Delgovia
   Head, Secondary/Further Education Section

Finance and Accounts Division
C. Edwards
   Director

Schools Supervision Unit
R. Attong
   Director
Technical and Vocational Training Division.

National Training Board

A. Alleywe                        Director
M. Alexander                      Secretary, NTB
Mrs. J. Sampson                   Senior Occupational Analyst
Mrs. J. Brown-Chen                Manpower Research Officer
Mrs. B-Anne King                  Librarian
K. Martin                         Evaluation Officer
N. Ali                            Curriculum Officer

United Nations Development Programme

H. Greenidge                      Resident Representative
ANNEX 2

C.A.M.I.S.E TRAINING PROGRAMME

Introduction to CAMISE
(for regular users)

1. The education management system in Trinidad and Tobago
   1.1 The organizational environment and structure
   1.2 The information rationale

2. What is CAMISE?
   2.1 The importance of Management Information Systems
   2.2 The characteristics and organization of CAMISE

3. Introduction to Relational Data Base Management Systems
   3.1 The notion of file
   3.2 Data representations
   3.3 The relational operation

4. Practical applications
   4.1 Relational operations on the Data Base
   4.2 The use of integrated tools
ANNEX 3

C.A.M.I.S.E TRAINING PROGRAMME

Data Base Administration
(for specialized officers)

1. Computer basics
   1.1 Notion of information systems
   1.2 Notion of files
   1.3 Notion of Data Base Management Systems

2. Relational Data Base Management Systems
   2.1 Data representation as tables with columns and rows
   2.2 Links between tables
   2.3 Relational operations, manipulative language
   2.4 Definition languages
      2.4.1 Basic laws of construction of a DB
      2.4.2 Introduction to Normal forms (1 to 3)
      2.4.3 Notion of keys and indexes

3. Approaching the modelization process
   3.1 Construction of a model
   3.2 Exercise: building up a DB with a step by step approach

4. The target system (software)
   4.1 Data definition language
   4.2 Data manipulation language

5. The system's environment
   5.1 Security
   5.2 Confidentiality
   5.3 Integrity
   5.4 Notion of views

6. Exercise: development of a sample DB based on final application with extensive manipulations.
7. Maintenance of the Data Base
   7.1 Adding relations
   7.2 Modifying relations
   7.3 Declaring new indexes
   7.4 Reorganization of the Data Base

8. The use of integrated tools
   8.1 Spreadsheets
   8.2 Graphics
   8.3 Word processing and report facilities

9. Backup of the Data Base
   9.1 Importance of backup
   9.2 Side effects of backup
   9.3 Periodicity

10. The use of security facilities

11. Networking environment
    11.1 Principles of networking
    11.2 Architecture
    11.3 Start up procedures
    11.4 Security settlements
    11.5 Parameters of the network (configuration)
    11.6 Physical aspects (card installation)
    11.7 Basic troubleshooting

12. Application development package (optional)

13. Basics of target machine operating system
    13.1 Principles
    13.2 Job command language
Country: TRINIDAD AND TOBAGO

Title: IMPLEMENTING A COMPUTER-ASSISTED MANAGEMENT INFORMATION SYSTEM FOR EDUCATION (CAMISE)

Sector: EDUCATION

Executing Agency: UNESCO

Duration: 1 year (1988)

Starting date: January 1988

Donor inputs: US $ 377 027
A. Development objectives

(1) Modernization of the educational information management process through the introduction of mass information and communication technologies, especially computer-based applications;

(2) Improvement of the efficiency and effectiveness of the educational planning and management processes, through the implementation of a computer-assisted information collection, processing, analysis and dissemination system, as well as the corresponding training of personnel.

B. Immediate objectives

(1) To build up competencies and capacities for handling and using information at all its process stages, in order to promote an effective intra-sectoral and multi-level educational planning and management;

(2) To organize a national education data base for multiplier use by educational planners and managers;

(3) To develop computer applications for an efficient and effective educational planning and management process.

C. Background and justification

Cf. chapters III and IV of the mission's report.
D. Project activities

1- Preparation of organizational management and information diagnostic studies for each division/unit of the Ministry of Education;

2- Purchase and installation of the computer hardware and software for the CAMISE;

3- Design and preparation of the national education data base;

4- Revision and reformulation of the regular statistical data sheets for information collection;

5- Organization of a training workshop for the regular users of CAMISE;

6- Organization of a three-month training course for the data base administrators;

7- Organization of a national workshop for central and district level education officers on the role of CAMISE;

8- Assessment of the individual/departmental first six-month experience of use of CAMISE.

E. Expected results

(1) 8 organizational/informational diagnostic studies prepared;

(2) One data base established in the central computer and 10 terminals installed in 7/8 divisions/units;

(3) 25 education and administrative officers trained on the use of CAMISE;

(4) 3 data base administrators trained;

(5) The collection of statistical data improved and rationalized, including the reformulation of the regular statistical data sheets;
(6) more performant data collection, entry, processing, retrieval and dissemination processes.

F. Inputs

F1- Government inputs:

(a) Personnel:
- Project coordinator (full time)
- Resource personnel for the local training on MIS;

(b) Support staff:
- Typist
- Clerical officer
- Driver

(c) Office space, furniture, supplies and training facilities;

(d) Computer supplies

(e) Local transport running costs and maintenance.

F2- Donor (UNDP?) inputs:

(a) Personnel:
- Chief technical adviser in educational management and management information systems (12 m/m);
- Consultant in computer applications and data base management (5 m/m);

(b) Equipment and materials:
- Project vehicle $ 20 000
- Computer equipment $ 104 300
(c) Training:
- Group training $30 000
- Fellowships (4 m/m) $17 300

(d) Local consultants $10 000

(e) Miscellaneous $39 000

G. Work Plan

<table>
<thead>
<tr>
<th>Activity</th>
<th>Starting date</th>
<th>Final date</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>1. Diagnostic studies</td>
<td>January 1988</td>
<td>May 1988</td>
<td>CTA + O&amp;M Unit</td>
</tr>
<tr>
<td>6. Training on DB administration</td>
<td>June 1988</td>
<td>October 1988</td>
<td>CTA + Cons. + local resource persons</td>
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</tbody>
</table>
H. Prior obligations and prerequisites

No prior obligations are required. A prerequisite is however for the Government to signify its interest to implement the project, to designate national project coordinator and to facilitate the inter-departmental cooperation.

I. Future assistance

To be defined, if necessary, after the project's assessment.
### K. Project budget estimates (external funding)
(US dollars)

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<td></td>
<td>m/m $</td>
<td>m/m $</td>
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<tr>
<td><strong>PROJECT PERSONNEL</strong></td>
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<tr>
<td><strong>11. Experts</strong></td>
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<td><strong>11.01 Chief Technical Adv. (P5)</strong></td>
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<td><strong>11.40 Consultants (P5)</strong></td>
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<td><strong>11.41 Computer Consultant</strong></td>
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APPENDIX

International consultant's basic profile

(i) Good knowledge of Data Base Management Systems, especially the relational model;

(ii) Knowledge of operating systems;

(iii) Knowledge of mini and micro-computers and network systems;

(iv) Experience in the teaching of and in the installation of systems in a non-specialist environment is an asset;