COMPUTERIZATION OPTIONS FOR THE MOZAMBIQUE RAILROADS (CFM)

Prepared by:

RICHARD G. SHARP
TRANSPORT & MANAGEMENT CONSULTANTS, INC.

AND

PEDRO C. HERRERA
INFORMATION RESOURCES MANAGEMENT
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Prepared for:

REGIONAL RAILWAYS SYSTEM SUPPORT PROJECT
(690-0247)
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
MAPUTO, MOZAMBIQUE

OCTOBER, 1991

CONTENTS

INTRODUCTION

USAID/Mozambique's Regional Railways System Support (RRSS) project (690-0247) requested IRM assistance in conducting an assessment of the existing computer capabilities at the Empresa Nacional de Portos e Caminhos de Ferro de Mocambique, E.E. (CFM), the railroad and ports company of Mozambique.

The assessment was conducted by Mr. Pedro Herrera, an AID/W IRM management information systems consultant, and Mr. Richard Sharp, a railroad consultant with Transport & Management Consultants, Inc. The assessment was conducted during a two-week period from 9/17/91 to 10/1/91, and also involved developing recommendations for the project's future automation strategy.

EXECUTIVE SUMMARY

The IRM/T&MC assessment team reached five major conclusions concerning RRSS project support for computerization of CFM functions:

*   RRSS is correct in placing primary emphasis on direct computer support to CFM's departments and work units to which it is providing assistance, rather than channeling computer support through the central CFM Informatics (MIS) office.

*   RRSS should, in selecting hardware and software, place added emphasis on functionality (suitability to task) and on standardization (to reduce the number of disparate systems requiring maintenance, training and support). RRSS should place less emphasis in selection criteria on ability to customize at the program source code level (which increases reliance on foreign experts and decreases transferability), and on user interface language (which is relatively easy to translate and modify).

*   RRSS should initiate the remaining tasks necessary to attain its objective of a unitized cost system that will support commercial tariff development.

*   RRSS should not attempt to insulate its department-oriented computerization from the central CFM Informatics office, but should select computer solutions that can be enhanced by the hardware, software, and human resources available from Informatics.

*   RRSS should provide the equivalent of two full-time technical assistants to Informatics to (a) maintain existing capabilities during an impending staffing crisis, and to (b) reorient Informatics from a traditional centralized MIS department to a more effective and productive services and resources provider. RRSS should not support additional Informatics hardware initiatives at this time.

Consistent with the above conclusions, the IRM/T&MC assessment team makes the following specific recommendations:

(1) RRSS should instruct its existing advisory team to realign its computer support to CFM-Finance and Maintenance/Stores in order to install a

standardized and integrated accounting/management support system as soon as possible, consistent with existing RRSS commitments to CFM.

(2) RRSS should select an accounting/management support system that runs on standard IBM compatible microcomputers, can take advantage of distributed processing technologies, and can call on CFM's central hardware and software assets for transaction intensive applications as needed. A UNIX-based system utilizing the Informix database management software fulfills these requirements. In addition, MS-DOS capabilities should also be maintained.

(3) Pending adoption of the long term accounting/management support system, RRSS should require that urgent computerization tasks, to the maximum extent possible, be performed in standard application programs already in use at CFM railway and port operations (i.e. Lotus 123, DBase).

(4) RRSS should initiate efforts to computerize train performance and maintenance data and relate this information to other operating and cost data in order to provide a unitized cost base for developing commercially-oriented tariffs. (Although an RRSS project objective, the terms of reference for the existing contractor appear not to encompass the required tasks.) A project to establish a system of periodic reports on unit costs by commodity and line segments can be undertaken with a combination of the current advisory team and approximately 4-6 person-months of on-site TDY support over a one-year period.

(5) RRSS should recruit and assign a senior advisor to the Director-Informatics with experience in managing a commercially-oriented computer support center and in the minicomputer and microcomputer technologies used at CFM-Informatics. Arrival for assignment should take place no later than March 1992, and should extend for at least two years.

(6) RRSS should fund the equivalent of a one-person year in systems analysis support to Informatics, to be provided by Mozambique-based companies or individuals. The assistance could be evaluated after one year for possible extension.

Two points should be made regarding implementation strategy. First, moving toward a standardized, integrated system does not

5

mean that all functions will be implemented simultaneously. Component modules can be activated individually, with additional functions and data links systematically expanded in a deliberate step-by-step fashion. Second, the extent of software diversity and customization within CFM has a direct bearing on internal CFM requirements for computer expertise: adoption of more standard solutions in Finance and Stores, items (1) and (2), will reduce demands on Informatics and moderate the need for assistance beyond that called for in items (5) and (6). Thus, greater reliance on standard offerings of regional commercial vendors (whose rates should be largely determined by the marketplace) should be cost-effective. This approach should also provide CFM line departments (such as Finance) greater flexibility in finding off-the-shelf software solutions instead of relying on self-contained, self-developed computer capabilities.

RRSS PROJECT INVOLVEMENT AND OBJECTIVES

USAID/Maputo's Regional Rail System Support (RRSS) project is designed to address a number of deficiencies in the operations of the Empresa Nacional de Portos e Caminhos de Ferro de Mocambique, E.E. (CFM), the railroad and ports company of Mozambique, with a principal focus on the CFM-South rail sector. Other donors are focussing on CFM-Central (Beira Corridor) and CFM-North (Nacala lines). The primary RRSS effort has been placed on upgrading the motive power capability needed for CFM-South to rebuild traffic levels that have declined substantially since independence. With this in mind, assistance has largely been directed towards providing new GE locomotives, rebuilding older GE locomotives, providing spare parts for the new and older GE locomotives, and upgrading locomotive maintenance capabilities.

In addition to (and in support of) these objectives, RRSS is committed to upgrading the CFM-South accounting system to make accounts current and place the fixed account register, cash balances, revenue accounts, and procurement procedures in a satisfactory position for auditing. (Amplified Project Description, Item B:Outputs, No. 6). Improvements are to be made to CFM-South's income and expense accounts and budgets, and a cost accounting system is to be developed, of sufficient accuracy and specificity, to be useful in developing commercially reasonable tariff rates. (Amplified Project Description, Item B:Outputs, No. 7).

The accounting portion of the RRSS project was deemed to require information technology assistance. However, because of the extreme inadequacy of the existing system for controlling the inventory of spare parts for GE locomotives, the initial computerization effort in that area has already been made. The effort has been conducted by the project contractor, a largely Brazilian consulting team provided by Louis Berger International, Inc. (LBII). In addition to developing a simple spare parts inventory system, now being implemented, the LBII team is working on a microcomputer-based general ledger, accounts receivables, and accounts payable system, with the objective of applying the system initially to the CFM-South domestic traffic, then to CFM-South international traffic, then to other CFM line segments.

Computerizing the railway accounting system has brought the RRSS project into discussions with the CFM Informatics Directorate, which directs management information systems (MIS) for CFM. Informatics' resources have been developed to serve CFM as a whole, not just the CFM-South sector that is the focal point of the RRSS project. Some $2.5 million in computer facilities and supporting assistance was provided to Informatics by Kuwait in 1989, and

another $3 million has been requested of Kuwait for upgrading the existing computer system and for personnel training. The Director of Informatics has recently requested $2.5 million in USAID support for system-wide accounting applications (including software and additional technical assistance and personnel training). The Informatics plan is to implement such a system on the minicomputer currently in place. However, RRSS project management is skeptical of the productivity of the Informatics office (to date and prospectively), and of the centralized approach recommended.

Although the RRSS project is principally concerned with operations in CFM-South, it must consider the effects of system-wide development and computerization plans. During the time the central computer office was developed, CFM was detached from the Ministry of Transport and reorganized as a parastatal (quasi-governmental) company, with considerable regional autonomy. Within regions, plans are underway to implement separate "results centers" that will operate as largely independent enterprises with individual business (and profit) objectives. This raises the question of whether a central computer capability is compatible with CFM's new commercial orientation. A central office may conserve scarce human resources, by providing services for all parts of the system and avoiding redundancy. Linking regional business segments effectively, however, may require hardware and personnel sophistication that could worsen the current resource problem.

The following evaluation of the RRSS project's current computerization initiatives and the recommendations for its future directions, will consider and address each of these issues.

BACKGROUND ON CFM

RRSS strategy to upgrade the computer capabilities of CFM can be assessed only in light of the scope and configuration of the Mozambique railway system and its associated port operations. In evaluating CFM's computer needs, the IRM/T&MC assessment team considered the following background information.

Mozambique's railways were designed in the colonial period to provide access to ports from inland points principally beyond Mozambique's borders. Because of the export orientation, CFM has long had authority over port operations, as well as the rail network.

Port and railway traffic have been in decline since independence was achieved in 1975. Tonnage volume on all line segments combined, fell from 13.4 million tons in 1975, to below 4 million tons in 1989. 1991 tonnage could be half that level. This drop came about initially due to security problems, loss of experienced railway personnel, and negative attitudes of the white-ruled governments in Rhodesia and South Africa to the Marxist government of Mozambique. It continued because of the RENAMO insurgency, which was created in part by these external opponents to the Mozambique government, but which has taken on an independent and persistent life of its own. Continued violence in rural areas has had the dual adverse affect of direct disruption of rail service through sabotage and armed attack, and indirect erosion of the quality of rail services through constraints on financial, equipment, and human resources.

For rough comparative purposes, CFM's tonnage prior to independence (about 14-21 million tons per year) was comparable to that of a regional U.S., Class I railroad, such as the Florida East Coast (FEC). U.S. lines of FEC's size typically do employ centralized mini/mainframe computer capabilities. Moreover, CFM operations at independence were more complicated than those of U.S. regional railroads, in that (a) more carloads were handled due to small shipment size and carload capacity, (b) a significant volume of passenger traffic was carried, (c) the majority of traffic involved international financial transactions, (d) the number of individuals employed per unit volume was greater by a factor of ten or more, and (e) CFM responsibilities extend to port operations. Based on these characteristics, CFM reliance on centralized computer operations as the various railway functions became automated is understandable. Indeed, this direction was inevitable given the absence of microcomputer technology at the time of independence.

With the security disruptions noted above, today's CFM tonnage volume of about 2 million tons annually is more comparable to short line railroads. Most such short lines use microcomputers, although some still rely on manual systems. Nonetheless, all complicating factors mentioned above -- small shipment sizes, passenger traffic, international transactions, excessive employees, port operations -- still apply. Thus, the U.S. short lines experience may not be directly applicable to CFM.

CFM consists of four segments that have been operated as separate divisions since well before independence. CFM is planning to give these regions more autonomy. The ultimate extent of this autonomy will effect the nature of both hardware and software requirements.

* The largest segment, CFM-South, consists of three branches operating from the port of Maputo to connections with Swaziland, South Africa, and Zimbabwe at their respective borders. In 1989, only about one third of the traffic on these lines was national, the rest international. The direct Limpopo line to Zimbabwe is under rehabilitation, with Zimbabwe traffic moving via the South African branch. This Division carried over 70 percent of CFM tonnage in the year of independence. If preliminary estimates that 1991 traffic on CFM-South will be under 1 million tons prove correct, however, it could be surpassed by the Beira Corridor (850,000 tons in 1990). Because of its more diverse operations, CFM-South may well be the only segment that could independently justify computing power beyond the microcomputer level, and then only if port and rail operations revive substantially.

* The Beira Corridor is the second largest Division, linking the port of Beira to Zimbabwe and Malawi (although the Malawi line is essentially inoperable due to the civil conflict). In 1975, the Beira Corridor carried 3 million tons annually versus 10 million tons for CFM-South. As with CFM-South, the internal conflict has greatly reduced traffic, with recent volumes well under one million tons. Beira is approximately 500 miles north of Maputo and there is no significant interchange of traffic with CFM-South. (Apparently, a very small volume does move from Beira through Zimbabwe to Maputo.) The current and prospective level of business in the Beira Corridor would not justify computing power above the stand-alone microcomputer level.

* The Nacala line links the ports of Nacala and Lumbo to Malawi. With over 500,000 tons of traffic in 1975, Nacala traffic volume has in recent years fluctuated between 40,000 and almost 400,000 tons. Physical

10

deterioration of the line as well as internal conflict have contributed to traffic declines. Nacala is over 500 miles north of Beira and does not connect with the Beira lines (although rebuilding the Beira branch to Malawi could make this possible in the future). On a stand-alone basis, the Nacala line would require only a modest level of computer support, which would be readily accommodated by microcomputers.

*   The Zambezia branch links the port of Quelimane (located between Beira and Nacala) to the Mozambique town of Mocuba and is insignificant in traffic volume. Little, if any, computer support should be required for this segment.

Under the foreign assistance program of the Beira Corridor Authority, coordinated by the World Bank, the concept of "results centers" has been developed and accepted by CFM management. Under this concept, profit responsibility would devolve from the current CFM-Central unified structure to six separate centers: a multi-purpose container terminal, a general cargo terminal, port infrastructure maintenance, maritime services, railway operations, and railway workshops. If this concept should also be applied to CFM-South, a similar number of separate "results centers" would be created. Two entities would be created in CFM-North if port and railway operations are separated. Obviously, if these operations were run as fully independent stand-alone businesses, computing capabilities beyond the microcomputer level would be impractical and unnecessary. At the same time, establishing "full service" microcomputer-based computing capabilities at each result center could be highly wasteful of human resources.

Because of the current scope of CFM operations, the prospective increase of autonomy of CFM business units, and the uncertain access to efficiently operated central computer resources, the RRSS project's focus on individual CFM-South departments and work places is an appropriate computerization strategy. However, some degree of standardization and consolidation of resources appears merited in order to reduce resource demands.

CURRENT CFM COMPUTERIZATION

A. - Hardware/Software

The Maintenance Shops, Stores, and Finance areas, in which the RRSS project is currently working, has a very limited base of existing computerization. The LBII team presently developing such applications has five RRSS-provided MS-DOS microcomputers. Four have 40 megabyte hard disks, one has a larger disk and was intended for use as a file server. Due to maintenance problems, only three of these machines (all with the smaller drives) are currently operational. All of these machines are currently operated independently (no LAN interconnections). They are not connected to the central Informatics (Siemens) machine and do not employ the UNIX operating system that would permit compatibility with software being used on the Siemens minicomputer. All RRSS provided computers are expected to be transferred to CFM at the end of the RRSS project.

LBII has only one program presently fully operational for CFM applications. This is a stock control program written in PC COBOL that was developed by a member of the LBII team for warehouse applications in Brazil (and therefore provided screens in Portuguese). Outdated information on GE spare parts contained in an Informatics program and manual data were combined into a database in this program, and provided the basis for an inventory of the GE parts stock which was completed just after the LBII team arrived in Maputo. Corrections are being made to the database on the basis of the inventory. The program is expected to be very useful in keeping GE spare parts stock records up to date, and in planning reorders. While the program is written in an outdated computer language and is not part of a broader accounting/finance computerization strategy, it is providing a valuable stop-gap service. A copy of the program has been given to the CFM-Central (Beira) GE parts warehouse for possible use in their similar facilities.

During the IRM/T&MC assessment, the LBII team finalized a contract for a simple microcomputer-based accounting package with a local vendor (SysCoop). The program, also used by the local electricity company and other smaller companies, was selected because its user interface was in Portuguese and because it was the only vendor willing to make the source code available to LBII. (The owner of the company was also a former CFM official.)

The LBII individual responsible for cost accounting has concluded that the cost accounting portion of the SysCoop program does not meet CFM needs. He plans to design and develop a cost accounting module from scratch (in Clipper), possibly using some of

the modifications SysCoop has made for the electricity company. It should also be noted that the SysCoop program appears to lack a payroll module. (An program residing at the Informatics' Siemens presently handles some basic payroll activities, although many traditional payroll functions remain non-computerized.)

The SysCoop program is written in Clipper, an MS-DOS based programming language. This package is **NOT** compatible with the UNIX-based Siemens machine used in Informatics. LBII has stated that it plans to transfer accounting functions from the stand-alone microcomputers to the Informatics' Siemens minicomputer when coverage of the accounting program expands from its initial focus on CFM-South domestic traffic to all CFM-South traffic, and later to other regions. LBII plans to modify, implement, and utilize the SysCoop accounting program for the next two to three years. It will then have to either adapt a new accounting program, or undertake a major software conversion project to run the SysCoop program in the UNIX environment. LBII believes software conversion to a UNIX-compatible system can be accomplished at a later stage. However, in the IRM/T&MC assessment team's view, the disadvantage of this approach is the creation of another non-standard application.

According to interviews with LBII personnel, no effort has been made thus far to computerize train operation and locomotive data that is compiled by locomotive drivers and maintenance personnel. The RRSS project apparently has not specifically tasked LBII with work in this area. Nonetheless, this data is required, along with other operating data, to compute unitized costs for tariff development purposes. (Output 7, RRSS Project Description) That is, costs per wagon or per train, required to set unit rates, must be completed for specific commodities and line segments based on the actual operating experience. If this RRSS project output objective is to be met, efforts to organize the data must be initiated by RRSS soon.

British technical assistance personnel at the port of Maputo have developed a variety of microcomputer applications for port operations and procurement using off-the-shelf microcomputer software such as Lotus 123 and DBase. (Most were written in English and the user interfaces were translated from English to Portuguese.) These port microcomputers (22 in all) are connected via Novell LANs and located in Port Operations, the container terminal, and the port's commercial department. The microcomputers are not connected to either Informatics or the RRSS computers, and little effort has been made to ensure program compatibility with either Informatics or other donor activities in Maputo or elsewhere within CFM. There is, however, considerable contact between the British team and two or three technical personnel from Informatics, both on software design and on matters such as computer maintenance and repair. The British team leader commented favorably on these few senior qualified Informatics staff and also noted that the

modified Informatics Payroll program currently being used is an improvement to the program previously used.

The principle computer now in use at CFM headquarters in Maputo is a Siemens MX500 Model 60 minicomputer located in the Informatics Directorate (i.e. the management information services department). In 1989, this machine replaced an IBM mainframe computer that initially was under the exclusive control of the Railways and Ports Authority, but in 1983 was transferred to the Ministry of Planning and used by CFM on a timesharing basis. The Kuwait government provided the Siemens, as a replacement machine dedicated solely to CFM utilization. The computer was part of a package that included a wide array of supporting equipment, including a backup generator, air conditioned environment, physical security controls, and microwave and modem hookups. The package was worth approximately $2.5 million. CFM is approaching Kuwait for "Phase 2" funding of approximately $3 million to replace the current computer with an upgraded model, reassign the current computer as a backup (there are no other computers of this type in Mozambique that could be used in event of main system failure), and expand microwave connections to all major rail points in the country. According to the Informatics Director, this could all be accomplished by late 1992.

The Informatics Siemens computer runs SINIX, a UNIX type multiuser operating system, and includes FORTRAN, and COBOL programming languages, the Informix database management system, and other utility software used to design customized applications in minicomputer/mainframe environments. Nine customized programs have been developed and are presently in use:

(a) a payroll program for CFM Finance, which contains some 60-70 sub-programs and computes housing allotments and other benefits in addition to wages (but leaves many functions to be performed manually at Finance);

(b) a program for apportioning freight revenues and costs that is used for settlements on international traffic transactions;

(c) "Traccao" -- a statistical program analyzing commodity and passenger flows;

(d) "Percurso" -- a statistical program concerning gasoline, diesel fuel and lubricants;

(e) "Navios" -- a statistical program dealing with ship traffic;

(f) "Mercadorias" -- a statistical program summarizing all international and domestic tonnage by commodity, tonnage, revenues and costs;

14

(g) a stock control program for locomotive maintenance (This is out of date and has been suspended while the LBII team is completing its GE locomotive parts inventory. CFM plans to update the system based on LBII produced data);

(h) a wagon hire charge program that traces the days foreign cars spend on line by individual car, and is used in monthly settlements of car hire accounts on international traffic with neighbcring rail systems. Active since January 1990, the program is credited with reducing the time required to compile monthly accounts by 2-3 months; and

(i) a wagon interchange program that provides data by country and wagon type (and individual wagon) identifying the foreign wagons that are on CFM lines at any given time, as well as the CFM wagons that are on foreign lines.

Programs (a) through (g) were adapted from programs used on the old IBM computer. They are written in COBOL, and most appear to have been originally developed prior to independence. Programs (h) and (i) have been developed for the Siemens computer by a two-person Rail India (RITES) foreign assistance team. They are written in Informix (a 4th generation database management system), and are part of a nine program wagon control package being developed by the RITES team. The RITES team initially planned to develop the software in COBOL, but were convinced by a local software firm (EXI) to use Informix as the development tool. Programs (a), (h) and (i) are currently being used for CFM-South only. The statistical programs, (b) through (f), cover all CFM traffic. Program (g) was used for CFM-South, but is now inactive.

In addition to the wagon hire and wagon interchange programs already in use, programs (h) and (i), other portions of the wagon control system currently in development are:

(j) wagon location and status -- a program to pinpoint wagon locations to specific tracks and points in particular yards;

(k) wagon tracing -- a program to query the current status of a wagon in transit, as well as in yards;

(l) advance train consist -- a program to inform stations (particularly international interchanges) of the pending departure of a train and the nature of its contents;

(m) allocation of empties -- identifies locations of empty wagons and provides the method of determining efficient routings of empties to pick up loads;

15

(n) wagon history -- provides running record of the last three locations of individual CFM and foreign wagons;

(o) periodic maintenance and overhaul -- identifies maintenance schedules for individual wagons; and

(p) tarpaulin and chains location -- tracks these materials used in covering open-top rolling stock.

Programs (j), (k) and (m) are expected to become operational on at least part of CFM-South between December 1991 and March 1992. Program (l) is far along, but depends on establishing station terminals and communications links outside of Maputo, as does program (n). Operational dates for programs (o) and (p) are not clear. The plan is to establish the operational validity of all or most systems on CFM-South and then install the same systems, linked to Informatics in Maputo, on the Beira and Nacala lines. Total costs for all ten systems (implemented at all locations) were estimated at $9 million, an amount well beyond available CFM financial resources. The wagon control system appears functionally suited to CFM train operations and interchange requirements, but may well be over designed for a railroad the size of CFM. The slow development period and the hesitancy to release sub-programs for early use by CFM departments, is fairly typical of traditional railroad MIS departments.

In addition to the programs outlined above, Informatics has worked with EXI to develop a warehouse management program for tracking pallets of citrus fruit. The software was developed as a response to urgent problems which were threatening continued business. Program development was funded as an extra module under the wagon control program, although it clearly does not involve wagon control. EXI expressed frustration that even though the program is fully developed, it has not been implemented due to the lack of terminals at the citrus warehouse. (EXI does not believe this would involve a major expense or any complex technical problems).

As noted above, the Informatics office has requested the RRSS project fund an integrated finance, accounting, payroll, workshop maintenance, and inventory control package to use on the Siemens machine, as well as the hardware necessary to link the machine to the Nacala line facilities. The request also includes extensive computer training and educational support for Informatics personnel. Except for the Nacala link, the request depends on Informatics' receipt of the "Phase 2" aid package requested from Kuwait (or an equivalent package from another donor). This appears to be assured (as final contracts are ready for signature) but in the absence of such support, Informatics would be hard pressed to maintain and implement the existing payroll, statistical, and wagon control packages that are used on the system, much less expand operations to new functional requirements (see Human Resources

Issues, below). Given the slow pace at which Informatics develops application software, we do not recommend giving it control of the development and implementation of an integrated accounting package.

B - Human Resources Issues

One of the critical issues that has affected CFM since independence has been the lack of an experienced and capable human resource base. Prior to independence, most CFM managers and skilled laborers were Portuguese. The entire staff was replaced when the Portuguese departed soon after independence. Thereafter, the quality of personnel seems to have steadily declined.

The lack of an educated and skilled labor force is, however, a problem that is widespread throughout Mozambique. For example, out of a population of over 13 million, the 1990 graduating high school class numbered roughly 200 students. Employees tend learn basic job skills at CFM, then move on to better paying employment in the private sector.

As a parastatal company, CFM pay scales are set by the Mozambique Government. Needless to say, these pay scales are very low and do not attract the best or the brightest of the Mozambique labor force. For example, an average employee at CFM makes the equivalent of $15 U.S. dollars a month. The Director General of CFM makes the equivalent of $175 U.S. dollars a month. CFM executive's salaries are soon to be increased by as much as a factor of ten. However, technical personnel wages are expected to remain low. The low wages are a major constraint when trying to identify skilled personnel, retain trained personnel, and when motivating existing personnel.

Another major human resource constraint is the overabundance of employees at CFM. CFM staff currently numbers in excess of 35,000 employees, including ports and railways, of which the railways employs roughly 20,000. For comparison purposes, TransNamib, the railway operations of Namibia, which has roughly the same track length, and carries roughly the same yearly tonnage, is very efficiently managed and operated with 2,500 employees. As can be seen by the estimates presented here, the combination of the lack of basic educational skills, the present over employment levels, and the low wages paid to those who do develop useful skills, combine to present a very bleak picture of the human resource potential at CFM.

Another factor that affects the human resources at CFM is the presence of expatriate technical assistance personnel working in the various divisions within CFM. There are presently individuals with USAID, the British Overseas Development Agency, the RITES of India group, and a French auditing team with Coopers & Lybrand, assisting CFM in the areas of inventory control, maintenance shop

17

management, finance and accounting, and information systems. In some instances, the CFM staff counterparts seem to have excessively delegated the day-to-day responsibilities to the technical assistance teams. For example, the CFM section manager for inventory control rarely ever shows up at his place of duty, while USAID personnel have been immersed in conducting a detailed inventory of the available spare parts. At this point, it is not clear whether CFM staff would be able to handle the day-to-day management and operations of activities if technical assistance personnel depart.

Even though human resources issues are critical to the overall efficient management and operation of CFM, it is unlikely that CFM can alleviate the issues of illiteracy, over employment, and low wages to the point of achieving a balanced, skilled, and well remunerated labor force. Since the problems are due to the social, economic, and political policies and constraints of the Government of Mozambique, our human resources options and recommendations take into consideration the present composition of the labor force and the existing environment within CFM. Nonetheless, the international donor community and technical assistance teams presently working with CFM may influence the development of policies that may result in more appropriate levels of employment and composition of the labor force. The IRM/T&MC assessment team is concerned that the approach presently taken towards computerization of Finance and Stores may reinforce the dependence on foreign advisors through excessive use of diverse customized software, and insufficient use of standardized resources that are available regionally.

Informatics has probably the most computer literate group of individuals within CFM. The staff of 53, including guards, typists, and miscellaneous office help, has 18 individuals categorized as programmers, data entry clerks, and other basic computer operating positions, as well as 16 individuals in higher level positions, plus the 2 RITES technical assistance expatriates. Of the 16 higher level Mozambican personnel however, only perhaps four or five (including the director) can be considered fully qualified professionals. Two of these individuals, including the Director, are expected to take long-term educational leave within the next year.

In areas such as computer systems development, administration, and operations, the Informatics staff capabilities are not readily apparent since most existing applications were developed by the RITES technical assistance team, one of whom also serves as the systems administrator. Although most CFM staffers at Informatics have titles such as systems analysts, programmers, and systems engineers, how knowledgeable and effective these individuals are at their respective positions, particularly in the absence of expatriate supervision, is unclear.

Any effort to increase the level of computerization within CFM must be coupled with extensive training for Informatics personnel, as well as for CFM personnel within the departments to be automated (i.e. Stores, Maintenance Shops, Finance). Training must range from the basic introduction to computers, to training programs in database management, database design and development, systems administration, networking communications, programming languages, etc. Furthermore, at the initial stages of any computerization effort within CFM, a great deal of "hand-holding" by the project implementors must take place.

A goal of any computerization effort within CFM must be to enhance the computer knowledge base to the point that CFM information systems personnel become fully professionally qualified, independent, and self-sufficient, once the expatriate technical assistance teams and the project implementors depart. As thin as its staff may be, CFM-Informatics is a unique resource within CFM that the RRSS project should seek to maintain and upgrade.

At the same time, greater reliance on standard computer applications secured through commercial vendors is needed to reduce the demand for increased computer expertise within Informatics and the line departments such as Finance (as well as to decrease potential interdepartmental conflicts). Given the fragile human resource base within CFM and the transitory nature of foreign assistance, this would be the pragmatic course to take. While dependence on commercial vendors involves some risk, this is considerably moderated by the highly competitive nature of the computer software and services industry (even within Mozambique).

GENERAL EVALUATION OF MCBA

At RRSS project's request, a meeting was conducted in Maputo with representatives of Maclove Computer Systems Ltd., the South African representative for MCBA, an American software company which produces an integrated accounting/inventory/manufacturing software package. The IRM/T&MC assessment team also visited Maclove's installations in Johannesburg.

MCBA is an integrated software package that runs on most popular operating environments (i.e. MS-DOS, UNIX, LANs, microcomputers, minicomputers). MCBA is composed of a variety of modules for specific applications. For example, the MCBA accounting module has capabilities for accounts payable, accounts receivable, fixed assets and depreciation, general ledger, and payroll, all applications that are required by CFM. The MCBA distribution module has capabilities for customer order processing, inventory management, bill of material processing, purchase order and receiving, accounts receivable, lost and serial number tracking, and sales history. In addition, MCBA has modules for capacity requirements planning and job costing. All the previously mentioned modules are fully integrated.

Furthermore, Maclove has been involved, through a subsidiary in Namibia, with implementing MCBA in the TransNamib railway system. (Maclove also has non-railway MCBA installations in Malawi and Lesotho). Maclove has installed MCBA at Transwerk, the workshop division of Transnet, which provides maintenance services to the South African Railways. The IRM/T&MC assessment team visited the Transwerk site. Transwerk management selected MCBA over its competitors for this assignment, which includes stores, maintenance, and finance requirements, largely because of ease of use and the foreseen technical support to be provided by Maclove. The functions which were computerized had previously been largely done manually, or undertaken elsewhere. Maclove provided the training necessary to use MCBA effectively, working with Transwerk employees of all skill levels.

MCBA appears to be an attractive choice for standardization and implementation within CFM. The variety of modules encompass all CFM requirements, although minor modifications and translation of screens to Portuguese may be necessary. (The LBII cost accountant indicated that Portuguese accounting standards do not differ substantially from systems used in the U.S. or elsewhere.) MCBA runs on UNIX microcomputer-based multiuser systems as well as in the Informatics' SINIX-based Siemens, and allows for data management via the Informix database management system. Maclove also offers the added benefit of being apparently well established

in the southern Africa region, and has a direct relationship with the U.S. vendor.

In addition to Maclove and the MCBA package, a local software company, EXI, is a viable option to team with Maclove in any systems implementation effort. EXI has English/Portuguese speaking technical personnel well versed in UNIX and Informix, as well as experience in Siemens and microcomputer environments. Moreover, EXI has experience in the CFM environment, since they developed CFM's citrus warehouse management system. RRSS project should explore the possibility of obtaining a joint Maclove/EXI solution for the project design, implementation, and training stages. Clearly, EXI involvement would involve less costs to project, would foster a local computer services industry, and provide readily available local resources to CFM. Also, EXI has the local resources necessary to be involved with the cabling and electrical connections that would be necessary for system installation.

The source of the accounting package currently used by LBII (SysCoop) is stated to be developing a UNIX capability and may offer an alternative source of support, as may other Mozambiqan companies not investigated.

RECOMMENDATIONS

A - Appropriate Extent of Computerization

The characteristics of CFM's line segments, described earlier, are essential background to addressing the railroad's computer requirements as they relate to USAID/Maputo's RRSS project.

First, there is very little synergy between CFM's line segments, which each serve fundamentally different markets. This has been recognized in the long-prevailing Divisional status of the lines, although, as a state operated system, administrative and financial data flowed to the center. Recently, CFM was spun off from direct governmental control to become an independent parastatal company, and has undertaken a program to reorganize its Divisions into autonomous profit centers. This plan is appropriate to the individualized characteristics of the separate line segments. Under these circumstances, the critical information flows to support viable commercial operation are:

(1) linking shippers, ports, and partner railroads of a given line segment to that line segment's management, and

(2) tying marketing, planning, operating, maintenance and other management functions together to permit line managers to make coherent and well-informed decisions.

In the first instance, computerizing commercially relevant information flows should be promoted. The RRSS project should continue to support business unit computerization for the most urgent information needs.

Second, centralization of computer assets in the headquarters, "parent" CFM entity, involves risk, because (a) the center can interfere with the natural information flows needed to be commercially responsive, and (b) it can require an added level of sophistication in both hardware and software that is expensive and demanding on limited resources. While Informatics can play a major role in system planning and design to avoid duplicative use of scarce resources, development of expensive communications that would permit real time involvement by Maputo in day-to-day information flows of diverse business units is of dubious value and possibly counterproductive. We therefore recommend that the RRSS project not fund additional hardware to enhance MIS control of activities outside the CFM-South region.

Third, while pre-independence traffic volumes of all the lines combined would make CFM of comparable size to a United States

regional railroad, at current volume levels, CFM is more like a moderate sized U.S. short line railroad. If CFM lines were operated as independent traffic centers, mini/mainframe computers would not be merited on any of the lines. The need for computer services on CFM's individual line segments would be further reduced if railway operations became the exclusive or core business. The primary justification, therefore, in coordinating software development through the Informatics center is not raw computing power, but efficiency in the use of scarce human and physical resources. We recommend that RRSS assistance to Informatics be oriented toward enhancing its coordination, technical assistance and support functions.

Fourth, assuming that computing services can be acquired from outside Mozambique with little or no development or training is unrealistic. For example, despite the quality of wagon control, accounting, procurement and warehousing systems used by South African Railways, transferring these systems to CFM would not be simple. Differences in scale and specific applications would require modifications and technical training. In addition, site preparation and hardware installation would still be required to make the systems operate properly. Informatics' and CFM's user departments simply could not cope with an entirely new payroll system or wagon control brought in from the outside without considerable assistance, even though the new product might be technically superior to the products now in use or in development. Because South African Railways has an economic conflict of interest to enhancing CFM capabilities over all but the Ressano Garcia line, haulage-type arrangements relying heavily on remote use of South African computer assets are impractical for all but that corridor (if politically acceptable even there). We recommend therefore, that the RRSS project continue to support the LBII computerization efforts within Finance and Stores, with the understanding that what is implemented is a short-term stop-gap measure, while the long-term recommendations put forth by the IRM/T&MC assessment team are in the design and development phases.

Finally, to the extent that CFM requires customized applications, customization should, to the maximum extent possible, be accomplished through user applications of standard programs, rather than through ground-up programming. Today's UNIX-compatible microcomputer software typically provide for substantial user modifications and adaptations without alteration to the program's source code. Each time CFM can take advantage of the flexibility of proven, off-the-shelf software packages, it will lessen the strain on its own scarce resources.

B - Hardware/Software

In addressing the computerization objectives of the RRSS project, CFM-South has three distinct organizational and physical

divisions that should be taken into consideration. The first is Informatics, located about a mile away from the main CFM building, which houses the Siemens machine and all its peripheral devices. The second is the Finance and Accounting office, located in the main CFM building. The third is the Stores and Maintenance shops, located within the port, about two miles from the main CFM building, and about three miles from the Informatics center.

The physical location of the three environments is critical to the computerization strategy pursued. For instance, even though the Informatics Director is requesting a centralized system based on the Siemens computer, the physical connections to actually achieve this would be costly and technically complex, since telecommunications capabilities are not currently well developed. Moreover, we do not believe that a centralized organizational structure would necessarily benefit CFM. Therefore, the basic recommendations for CFM computerization are based on the methodology/strategy called distributed processing.

The distributed processing methodology/strategy for CFM's information systems organization should be designed and implemented as follows.

(1) Establish a multiuser system within CFM's main building to serve Finance and Accounting.

(2) Establish a multiuser system within CFM's Stores and Maintenance Shops to serve the Stores, Maintenance, and Inventory.

(3) Provide support to Informatics to encourage conversion of its role within CFM to technical services provider and setter of information systems policy, rather than controller of CFM's computer resources. At this point, we do not recommended investing in hardware and software resources to maintain and/or increases Informatics' central control function. Technical assistance and training, however, should be provided (more on this below).

To maintain some type of uniformity among computer resources, we recommended that certain standards be maintained among Finance and Accounting, Maintenance and Stores, and Informatics. UNIX should be the operating system running on all computers installed, and Informix should be the database management system used for the development of application software. (Installing UNIX on a microcomputer does not eliminate the capability to run MS-DOS programs. All MS-DOS programs currently in use would continue to be available on the microcomputers. Functions would be somewhat limited only on the "dumb" terminals installed for specific data entry functions.)

24

Adhering to an open systems strategy will, in the long term, facilitate the integration of all CFM computer resources, and the computer resources being currently introduced by a variety of donor agencies. We also recommended that any off-the-shelf applications procured, be compatible with a UNIX environment, and with the Informix database management system. The following are more specific recommendations for items (1) and (2) above.

Finance/Accounting. The IRM/T&MC assessment team recommends the adoption by CFM of an integrated finance, accounting, inventory, and maintenance software package, such as the MCBA system investigated in South Africa. The built-in capability of such a system, allowing CFM to tie together separate accounting functions and avoid redundant data entry, is an important asset in instituting workable financial controls. In a modular system such as MCBA, however, not all functional components need be implemented simultaneously, and typically are not. Individual modules can be activated as the LBII team proceeds systematically to analyze and convert manual procedures and records in particular accounting areas. Thus, although a modular system lends itself to comprehensive integration in consistent formats, the adoption of such a system does not undermine the step-by-step approach sensibly advocated by LBII.

The system the IRM/T&MC assessment team recommends for finance/accounting is a multiuser system based on the UNIX operating system, running on a 386 or 486 central file server, to which a variety of "dumb" terminals and stand-alone microcomputers would connect. The required integrated finance/accounting modules of MCBA or of an equivalent package would be installed on the file server, and would be accessible to all users on the system (actual access privileges would be set by the system administrator). Other packages that could be installed on the file server are WordPerfect for word processing, and Lotus 123 for spreadsheet capabilities. Maintaining the data within the Informix database (which MCBA permits) is preferable, to permit future transfer to the Informatics minicomputer, although this design decision is left to the project implementors. (The extensive use of DBase at the CFM port and the comparatively broad base of experience with this package makes it the next best database choice.)

The multiuser system would also have a high speed printer (600+ CPS) attached, to be shared by all users. The actual number of terminals and microcomputers to be attached would depend on functional requirements, and should be determined by CFM Finance personnel, with advice from the LBII technical assistance team. As requested by RRSS, however, IRM will provide a base configuration in order to expedite procurement and implementation. The actual location of the file server, printer, terminals, and microcomputers should also be determined by CFM Finance personnel, and should be driven by the actual location of users, the flow of information, and the physical security of the resources. The implementation of

an off-the-shelf integrated package such as MCBA (software) should be the driving force behind the multiuser system (hardware) to be installed within finance/accounting. IRM will provide RRSS project with detailed specifications and prices for the implementation of such a system.

Maintenance Shops/Stores. The IRM/T&MC assessment team recommends a similar system for the Maintenance Shops and Stores. At this point, the requirement for connectivity between the Maintenance Shops and Stores is not well defined, because the actual data flows between Shops and Stores are not clear. We therefore suggest introducing a stand-alone microcomputer in the Maintenance Shop to allow for computerization of locomotive maintenance records, and installing a simple multiuser system (file server with at most three workstations and a printer) in the Stores area. Both the stand-alone microcomputer at the Maintenance Shop and the multiuser system at Stores, would run the applicable modules from MCBA or equivalent integrated software package. This would allow for simple connectivity and data transfer once the information flows have been established. Also, by initially installing a simple multiuser system at the Stores, the basic hardware and software needed for connecting the Maintenance Shops to Stores will be in place. Again, modular software design will permit functions to be implemented at a measured pace calculated not to overload CFM's existing human resources.

Conversion Process. The IRM/T&MC assessment team's recommendations are designed to improve uniformity of software and application resources (UNIX, Informix, MCBA) among the three areas identified. This uniformity and compatibility will allow CFM, if the situation requires in the future, to easily and readily integrate application programs and data. Also, by identifying and fostering personnel within the three environments to become familiar with, and knowledgeable of, a standard set of software tools, CFM would be creating and enlarging a pool of individuals that could be utilized throughout the institution as needs arise.

The IRM/T&MC assessment team recognizes and congratulates the LBII team on the significant efforts conducted in implementing the stop-gap solutions for Stores, and in initiating a general ledger, receivables, and payables computerization program. Both initiatives are serving a useful purpose. However, we believe LBII should move toward adapting a modular, UNIX-based, integrated accounting package as soon as possible. We recommend that a cost accounting module not be developed from scratch, as is currently planned, but instead be adapted from whatever UNIX-compatible integrated package is selected. Similarly, any steps toward computerizing payroll functions now performed manually at Finance should employ a module compatible with the integrated accounting package. Repetitive data entry functions associated with maintaining payroll records are a particular candidate for the "dumb" terminals available in the UNIX environment, rather than

26

stand-alone microcomputers. Hardware procurement should reflect this fact.

LBII personnel indicated that the SysCoop accounting software would be used for the next two to three years. Two to three years, however, seems to be an extended period for a solution to still be categorized as short-term and stop-gap. In addition, the Stock program being implemented is written in COBOL, an out-of-date programming language and tool that is less efficient than a variety of off-the-shelf packages available on the market today.

The issue of the LBII-procured accounting software (SysCoop) versus the recommendations of the IRM/T&MC assessment team (and the nature and pace of any transition) should be resolved by RRSS project management as soon as possible. It is inadvisable to have duplicative software development and implementation efforts ongoing. If the IRM/T&MC assessment team's recommendations are to be implemented, the RRSS project should develop an expeditious conversion process and schedule, while trying to avoid undue disruptions to existing commitments to CFM.

As an initial step to implementing the recommendations herein, the RRSS project could request an effort from the team of vendors described, to perform a combination requirements/site analysis of the Finance and Maintenance Shops/Stores function within CFM. This analysis would fall within the framework discussed above (i.e. a multiuser system based on 386/486 file servers, UNIX-based, with Informix as the database management system, and MCBA, or similar product, as the integrated application software). The analysis would determine the following:

(1) Number of workstations (microcomputers as well as "dumb" terminals) required.

(2) Specific characteristics of the workstations, printers, and software to be procured.

(3) Specific requirements for connecting the existing microcomputers to the multiuser system (controller boards, software, cables, etc.)

(4) Physical location of the central file server and of each workstation and printer.

(5) Specific infrastructure requirements for the physical installation of the machines.

As an alternative, and with the purpose of expediting procurement and implementation, IRM will provide RRSS project with a basic hardware/software configuration, including the detailed technical specifications and costs. IRM will also provide an example statement-of-work that the RRSS project could use to

27

request technical and cost proposals from prospective vendors, in order to determine the vendors that will implement the project (needed in addition to the existing LBII team). Implementation would include electrical installations, installing the hardware and operating system software, modifying, translating, and installing the integrated accounting system, and training CFM personnel to properly manage and use the resources at their disposal. (More on training below.) IRM will also provide a statement-of-work for the RRSS project to obtain the services of an individual/firm to conduct the unitized costs for tariff development analysis.

Vendors would provide RRSS with a report/proposal which would include the above mentioned information, together with the costs to complete such an installation/implementation. RRSS could forward this information to IRM for evaluation, comments, and for obtaining U.S. pricing for all hardware and software required. All commodities can be procured in the U.S., with the understanding that the local vendors would provide the installation and implementation support required by CFM. These issues were discussed during meetings with the vendors. Details could be finalized once the RRSS project determines the strategy to pursue.

C - Technical Assistance and Training

There is widespread agreement among virtually all individuals interviewed that skills in computer use, in programming and systems analysis, and in the substantive fields (accounting, maintenance, inventory) for which computers are used are extremely thin at all levels of CFM. The problems of securing, training, and retaining adequate staff, and of developing counterpart skills essential to a successful phase-out of expatriate assistance, are crucial at all stages of the RRSS-CFM project.

The IRM/T&MC assessment team's overall perspective on improving the training effort is that increased reliance should be placed on standardized systems, and that the use of custom programming (particularly in outdated "3rd Generation" computer languages, i.e. COBOL) should be minimized. Devoting CFM's scarce computer expertise to maintaining such systems is a misuse of human resources. It is also safe to conclude that the availability of a pre-designed Portuguese interface is less important in facilitating system transfer than what was originally imagined. If a modern database language is employed (i.e. DBase, Informix), the user interface may be readily translated into the host-country language. In addition, qualified programmers are likely to have a reasonable command of English because of the prevalence of English in instructional materials, manuals, and computer courses.

From the perspective of user training, we do not believe that the use of multiuser technologies adds significantly to the training burden. Novell LANs have been successfully implemented by

28

CFM at various Maputo Port operations with no apparent problems. In addition, CFM-Informatics personnel have been working in the Siemens UNIX environment for over two years. Moreover, in many instances, terminals serving specific dedicated functions can reduce training requirements. Nonetheless, particular attention must be paid to training individuals to become the UNIX system managers/administrators at both Stores and Finance sites. Once the system is implemented, each site will require a full-time systems manager/administrator. Individuals must be identified at the project's outset, and trained accordingly to fulfill these positions. Finally, as emphasized above, modular software design is compatible with the step-by-step implementation procedures advocated by LBII, and with which the IRM/T&MC assessment team concurs.

In addition to the interim staffing and counterpart training efforts now being undertaken through LBII, we believe that four staffing/training areas merit near term RRSS support.

First, as described above, provision must be made for conversion of the user interfaces into Portuguese for any standard UNIX-based system adopted, and for any modifications required by CFM (or to the Portuguese accounting standards employed by CFM). LBII should be invited to review proposed vendor software as an input to a selection decision, and should be tasked for providing modification criteria after selection. The vendor should be tasked with making required modifications, either directly or (if involving interface language) through a subcontractor. Use of CFM or other Mozambique software resources should be encouraged.

Second, the RRSS project should devote additional resources to CFM's commercial tariff development objectives. Additional technical assistance must be provided to ensure that train performance and maintenance records are computerized. These, and other unit operating data, should be reported to Finance in a form that will permit unitized cost studies to be conducted in support of commercially-oriented tariff development. Although the combination of operational and cost data is essential to the RRSS objective of developing unit costs for tariff guidance, RRSS appears not to have provided for this function within the LBII terms of reference. Consequently, this project area appears to be a "black hole", with no computerization of records being undertaken, no railroad experience in this area encompassed in the LBII project team composition, and (given LBII staff levels) no near term plans to initiate work in this area. This assistance effort could be implemented through short-term research support to the LBII team, since (a) the LBII individuals responsible for computerizing the GE stock area may be able to turn to computerizing the basic driver reports and maintenance data now compiled manually, and (b) the LBII cost accounting advisor is a permanent expert on site who can coordinate unitized cost data and help define counterpart assignments. (Unitized costing for tariff

purposes should fall within the responsibility of the CFM cost accounting section of Finance, which would report results to the Commercial Directorate and/or Planning Directorate for policy decisions.)

As a rough estimate, 4-6 person-months of professional research effort over a twelve month period on the part of an individual or individuals experienced in railway costing and pricing procedures should permit a rudimentary system to be designed for CFM-South that would enable direct costs to be assigned to commodity categories for the Ressano Garcia (South Africa) and Goba (Swaziland) lines. (Data availability for the Limpopo line is uncertain.) In conjunction with LBII, development of a system for routine compilation of essential operating data needed to develop movement-specific, commodity-specific unit costs should be possible. RRSS would need to modify the LBII terms of reference to the extent required to enable LBII to support this task. In accord with recommendations in the June 1990 Project Paper Amendment (Annex F, page 5) the initial objective should be to institutionalize a routine study report (quarterly, or semi-annually), which could be upgraded over time. This could be issued by Cost Accounting using the available hardware and software resources (spreadsheet and/or database).

Third, a senior on-site technical/management advisor to Informatics is needed. Despite a mixed performance record, CFM Informatics represents the most concentrated source of computer skills in the company, as well as a repository of existing hardware and software assets. CFM can ill afford to let this capability deteriorate, which is a distinct possibility within the next year due to prospective staff losses. We have been told that both foreign (RITES) advisors are scheduled to depart next year, the senior programmer is leaving for a four year educational program, and that the Informatics director (Mr. Simao L. Muhai) may enter a one year program abroad at mid-year. This will strip Informatics of much of its senior staff.

The Informatics Director has requested that the RRSS project provide one senior analyst with experience in organization and management of information services to serve as a senior advisor to the Director of Informatics. The individual would assist the director in management, standards development, project design and coordination, and development of plans and strategy. In discussions, the Director indicated (modifying his written request) that knowledge of Portuguese would be an asset but is not necessarily required.

We support the provision of a senior technical advisor to CFM and recommend that the advisor be made a Senior Advisor to the Informatics Director. The mission of the Senior Advisor to the Informatics Director should be to enhance Informatics' ability to provide technical support and computer resources to other CFM

departments.   We recommend that RRSS provide a person with experience in:

(1) the commercial operation of a computer services center with non-captive clientele;

(2) the UNIX/Informix environments presently used in Informatics, and to be installed at the Stores and Finance; and

(3) supporting microcomputer users and systems, as well as minicomputer/mainframe systems, including data transfer between microcomputers and more powerful machines.

The role of the senior advisor would be to provide technical support to CFM, and to train other Informatics personnel to provide such technical support.   The client departments should be responsible for determining what functions to computerize, specifying priorities for information systems improvement, and for actual operating the systems.   The senior advisor would counsel client departments on hardware configuration, system design, administration of distributed systems, provide training, and respond to client department requests.   The senior advisor would also train Informatics staff to supply such computer center services.   If RRSS solicits MCBA software and associated services from Maclove, Ltd., as recommended, Maclove could be asked to fill this position.   The prospect that Maclove could quickly provide a qualified individual, familiar with MCBA software and UNIX applications, enhances the prospect of successfully implementing this recommendation.

Housing the senior technical advisor in one of the main client departments (such as Finance), would be a possible alternative structure.   However, since RRSS would be funding this advisor to support its project objectives in several departments (including Finance, Maintenance Shops and Stores), the advisor is best not tied to one line department.   Also, the senior advisor's training functions are best carried out from within Informatics.   RRSS should retain the authority to task the senior advisor to support RRSS projects outside of the Informatics framework, should that prove necessary.

This individual should be recruited and assigned to Mozambique no later than March 1992, for a tour of duty of no less than two years, in order for there to be a six-month overlap prior to the departure of the current Director, and to allow the individual to participate in the transition to interim management of the Informatics center.   Such a position can have a major effect on giving Informatics the support services orientation it is now lacking.

Fourth, funding for at least one year should be provided to support the equivalent of one full-time Systems Analyst at Informatics, through retention of qualified Mozambique-resident computer firms and/or individual systems analysts. We are confident, based on our interviews, that a thin but appropriately qualified base of expertise does exist in Mozambique, that retention of such expertise at Mozambique consulting market rates would be a considerable savings over expatriate consultants, and that RRSS support to the nascent Mozambique computer services market is a superior development strategy to wholesale reliance on temporary external advisors. The in-country individual(s) retained for this function should have both UNIX/Informix qualifications, be experienced in both microcomputer and minicomputer environments, and be qualified to provide support to distributed UNIX installations at the various CFM sites. This capability, in conjunction with the senior advisory position noted above, should assure the continued transfer of current generation technologies to CFM, and provide reasonable assurances that CFM's investment in Informatics facilities and human resources will be protected and be available to support both minicomputer and microcomputer-based applications.

Although increased reliance on standardized software from regional vendors can moderate requirements, the IRM/T&MC assessment team considers the need for on-site technical assistance critical to the success of any computerization effort within CFM. Even though we believe the roles of the additional technical assistance individuals recommended should initially be within Informatics, RRSS project managers may deem necessary to encourage the individuals to provide technical assistance to the Finance and Stores at critical times during their computerization stages. The resources available to CFM and to the RRSS project should be utilized where needed, and for the benefit of the institution as a whole.

D - Long Term Structure

The recommendations above provide the basis for a structuring of CFM's computer assets in a way in which Informatics serves as a computer support service, rather than as a traditional centralized railroad MIS department with an exclusive franchise on company information services. Informatics would:

(a) maintain the hardware capabilities for transaction intensive processing, such as payroll and (when more fully developed) other accounting applications;

(b) manage any remote station-to-station computer communications linkages required by CFM;

32

(c) provide a resource for developing railway-specific applications (such as wagon control) that may not be available commercially, or may be available only with substantial modifications;

(d) advise CFM directorates, "results centers", and other business units on the selection of hardware and software solutions with a view toward maintaining a level of standardization that will utilize existing resources efficiently;

(e) provide a vehicle through which Mozambique computer resources in the private sector can be brought to bear on specific CFM applications problems.

With the decentralization of the CFM port and railroad activities, CFM-Informatics should not be viewed as the exclusive source of computer support for Directorates, Results Centers and other business units. As privatization becomes more complete, the prospect should be that these units may be charged for services other than those mandated by the parent CFM organization, that Informatics may compete with other firms for certain CFM services and may offer services to other government organizations and companies, and may even evolve into a fully independent profit center. Informatics should be prepared to abandon internally developed systems (such as wagon control) for commercially available off-the-shelf alternatives, should internal systems not satisfy business unit demand.

RRSS project support to CFM-Finance encompasses efforts to upgrade accounting capabilities at the CFM-South division and at CFM headquarters. It is envisioned that the same accounting modules developed for CFM-South would be applied to other CFM divisions and employed in the consolidation of accounts. The responsibilities of Finance for CFM-South appear sufficiently complex that integration and connectivity of computer assets is required for efficiency. Because many accounting functions involve basic data entry tasks that can be accommodated by remote terminals, and because strict central control is necessary for accountability and accurate results, we recommend above that the computer system in Finance be developed around a UNIX-based environment with central file servers at key control points and remote terminals for clerical functions. In other words, a structure based on independent (stand-alone), full-function microcomputers is not the recommended long-term structure.

The relationship of Finance computer assets to Informatics should be that of a client to a data processing service. Should CFM remain a consolidated entity for financial purposes, the greater computing power of Informatics hardware may be called upon to replace or supplement individual file servers, and Informatics staff may be called upon to support networks within Finance.

33

Software specifications and requirements, however, would be determined by Finance.

To the maximum extent possible, CFM computer needs should be met by off-the-shelf products, with customization provided by local Mozambique computer firms or, where appropriate, by Informatics. Extensive program development by expatriate foreign advisors should be avoided, since it increases reliance on such foreign assistance, impedes local ability to maintain systems, discourages the development of local capabilities, and is likely to add to project expense.

Intense competition in international software and computer service markets, on the other hand, should enable CFM to avoid excessive dependence on particular suppliers and allow it to take advantage of current technical developments. Supporting the nascent computer services infrastructure in Mozambique, beyond railway and port operations specifically, would also constitute a valuable institutional development benefit.

CONCLUSIONS

The successful implementation of an integrated computer system within CFM functions is critical to the role CFM will play in the economic rehabilitation of Mozambique. The proper utilization of information technology will greatly enhance the basic management capabilities of the organization, while at the same time provide a knowledge base to the organization's labor force. To achieve this result, the RRSS project must place primary emphasis on the functionality of the proposed computer solutions, avoid options that tend to increase donor dependence, and preserve and effectively make use of the scarce computer assets and human resources that are available in Mozambique.

It is therefore critical to the success of any computerization effort, that emphasis be directed toward great cooperation and integration among all the CFM players. With this in mind, RRSS project should also attempt to closely coordinate all initiatives with other international donor agencies, with the objective of developing integrated and closely related solutions to similar problems.

Even though the Mozambique and CFM environments clearly make RRSS project achievements that much more challenging, IRM/T&MC assessment team believes that a thoughtfully designed, carefully developed, and closely supervised computerization effort, would guarantee an effective and efficient information technology component within CFM.

ACKNOWLEDGEMENTS

PEOPLE INTERVIEWED

Timothy Born, USAID/Mozambique, Project Coordinator

Peter Argo, USAID/Mozambique, Project Engineer

Simao Muhai, CFM, Director of Informatics

Oscar Diniz, CFM, Director of Finance

Luiz Dahlila, Louis Berger International, Chief of Party

Almir Moreira, Louis Berger International, Systems Analyst

Roberto Ramires, Louis Berger International, Systems Analyst

Terry Lodge, Louis Berger International, Inventory Analyst

Satish Kumar, RITES of India, Systems Analyst

A. K. Munshi, RITES of India, System Administrator

Avito Jequicene, CFM, Computer Maintenance Engineer

Giovanni Mottalini, Maclove Computer Systems Ltd.

Pierre de Reuck, Maclove Computer Systems Ltd.

Jose Murta, EXI, Managing Director

Joe Williams, British Overseas Development Agency

Rui Lobo, Louis Berger International, Cost Accountant