CONSULTANCY REPORT ON FEDECOOP COMPUTER SYSTEM ANALYSIS

FOR THE

Costa Rica Cooperative Strengthening Project
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EXECUTIVE SUMMARY

The current S/36 computer systems represent critical risks to FEDECOOP. Should either of them fail for more than a day or so, then FEDECOOP's ability to operate will be severely damaged.

Immediate steps can be taken to protect essential data and to provide for emergency data processing operations using microcomputers, staff and software now on hand. These steps can be taken with no additional allocations of funds, if necessary. However, to permit current operations to continue without interruption additional staffing may be required. Additional hardware, software and training would also make these steps much more effective, and would contribute towards a more permanent solution as described below. The total cost estimate to support these immediate steps is US$8,350. I emphasize, however, that FEDECOOP can, and if necessary should, take these steps with existing staff, equipment and hardware. This objective should take priority over all other computer department operations except the absolute essential ones.

The conclusions of this analysis indicate that the S/36 computer systems should be replaced with a microcomputer based network. This strategy will offer the most flexibility and power at the lowest cost. Excellent resources for these networks exist within Costa Rica. This should be done as soon as possible, but no later than during the next fiscal year. FEDECOOP should expect to rely on emergency microcomputer based processing as described above at any time. The total replacement cost estimate is US$50,000. This will provide essentially the same data processing capability that now exists using the two S/36 systems, but in a microcomputer based network environment.

During the four years following the initial replacement, FEDECOOP should budget approximately US$27,500 in each year to expand its data processing capability sufficiently to meet it's goals as now described.

In conclusion, I recommend an immediate allocation of approximately US$8,350 to take steps to protect essential data processing functions. I recommend that the S/36 systems be replaced with a microcomputer based network, the cost for which is approximately US$50,000. I recommend that FEDECOOP budget approximately US$27,500 per year for each of the four years following initial replacement of the S/36 in order to meet its expanding data processing needs related to goals as now stated.

1. BACKGROUND

FEDECOOP is a national cooperative which processes, markets and exports coffee and other agricultural products submitted by member cooperatives. FEDECOOP also provides technical assistance and administers loan and credit programs to member cooperatives. FEDECOOP procures and distributes agricultural inputs needed by member cooperatives.

More than five years ago, FEDECOOP acquired an IBM S/36 computer system through a USAID financed project. The system included accounting software written in BASIC computer programming language.

Approximately April of 1990 FEDECOOP purchased a second, smaller IBM PC S/36 system from a member cooperative. The member cooperative had purchased the system some years earlier and was unable to continue to use it effectively. The cooperative's needs grew to exceed the system's capabilities. FEDECOOP was able to transfer data and programs, with some difficulty, to this system from its primary S/36 system. This has relieved some of the burden from the main S/36 during this period while considering replacement and/or expansion options for the future.

At this time, FEDECOOP relies on these two S/36 computer systems for their essential data processing needs.

They also have purchased approximately nine desktop computers and five laptop computers. These microcomputers supplement the data processing capabilities of the S/36 systems. Six microcomputers have the capability of exchanging data directly with the S/36 through the File Transfer Utility (FTU). Other microcomputers have the capability of emulating a terminal, but without being able to transfer data to or from the PC environment. The laptops are used during visits to member cooperatives as well as at FEDECOOP main offices.

FEDECOOP management and the computer department staff recognize that the S/36 systems represent areas of some risk and vulnerability to their operation. They also feel that these systems cannot meet their current needs, nor allow them to respond adequately to the changing data processing needs of the organization.

The objectives of this assignment are:

- to describe and document these areas of risk and vulnerability;

- to determine options open to FEDECOOP for protecting, expanding and improving their data processing capability;
- to document estimated costs and benefits for these options;
- to chart a course of action for FEDECOOP leading to the appropriate upgrading or replacement of their data processing systems.

The purpose of this report is to document the findings and recommendations related to these objectives. (Refer to the "Scope of Work" of 1 February '91 as presented in the contract with Glenco Associates, Inc. for this assignment.)

2. IMPORTANT PROBLEMS AND DECISIONS FACING FEDECOOP MANAGEMENT

2.1 INTRODUCTION

I met extensively with Mayra Palencia, the head of the computer department (Jefe Departamento Computo) and her staff. I reviewed the existing data processing operations. This process included a review of equipment, operations and software documentation. She explained to me her perception of the current situation.

I attended a meeting with Gilberto Gutierrez, Assistant Manager and Manager of Technical Administration (Asiste de Gerencia y Gerente Tecnico-Administrativo). We discussed the broad management objectives of FEDECOOP and his perspective of current and future data processing needs. In the next five years, FEDECOOP hopes to increase its share of total national coffee marketing from last year's share of 45% up to 70% in 1996. FEDECOOP management hopes to achieve this without significant increase in staff or facilities. This will require existing staff to rely more heavily on efficient data processing capabilities.

The problems currently facing FEDECOOP include extreme vulnerability of the existing critical data processing systems, and limitations of the S/36 computers to address new information needs of FEDECOOP.

Decisions facing FEDECOOP management in this regard are mainly when to replace the existing S/36 systems, and with what to replace them.

2.2 PROBLEMS

2.2.1 Vulnerability of S/36

The S/36 computers are no longer manufactured. They are expensive and difficult to repair. They contain FEDECOOP's critical data processing systems (accounting and coffee marketing). They are being used at, or even beyond, their capacities.

FEDECOOP data processing staff feel that if a S/36 was out of operation for more than a day, it would be difficult, maybe impossible, to recover in such a way as to permit FEDECOOP to continue business as usual.

Effective backup and recovery procedures are in place. Backups of essential data are made regularly, and diskettes are stored off-site. However, if the S/36 were to fail beyond repair, these diskettes may be useless, since no other S/36 may be available on which they could be used. Even the PC S/36 cannot read the diskettes which come from the main S/36. The reverse is also true. The main S/36 cannot directly read the diskettes which come from the PC S/36. These two machines cannot serve as backup machines for each other.

In effect, if a S/36 were to fail beyond repair, FEDECOOP would face a crisis which may lead to virtual suspension of operations indefinitely.

I feel that this is the greatest problem currently facing FEDECOOP in the context of data processing.

2.2.2 Limitations to Growth of the S/36

These computer systems are now operating beyond capacity. Routine tasks must be scheduled in order to prevent situations where the Central Processing Unit (CPU) operates so slowly as to waste considerable user time. Where possible, data processing is done on microcomputers to avoid overloading the S/36. Given FEDECOOP's plan to expand while retaining essentially the same staff level, it is important to develop a strategy for further automating data processing activities.

The primary S/36 now includes 24 terminals and 12 printers, a total of 36 work stations. No additional work stations can be connected. It has two megabytes of Random Access Memory (RAM). It has 400 megabytes of disk storage capacity of which 70% is required for critical data processing.

The smaller PC S/36 now includes three terminals and two printers. It has only one megabyte of RAM and 80 megabytes of disk storage capacity of which approximately 20% is not used. If additional applications and work stations were added to this system, processing would probably slow to an unacceptable rate.

When initially designed, the S/36 was considered as a powerful minicomputer system. In truth, it has performed well. However, single microcomputers are now available

that easily exceed the S/36 in speed, RAM and disk storage capabilities.

Currently FEDECOOP retains about 2 years of accounting data and approximately 15 months of coffee processing data on their computer systems at any one time. FEDECOOP management expresses the wish to retain at least four years of accounting data, if storage and processing capability permitted. This will permit more effective historical analysis on which to base future planning.

New data processing needs of FEDECOOP are currently being addressed with microcomputers where this seems practical.

In reality, data processing functions are expanding beyond the S/36 capabilities.

2.2.3 Limitations to Progammability of S/36

All programs now operating on the S/36 are written in BASIC. However, the core accounting programs were provided with the computer system, and without any documentation. They are, therefore, very difficult to modify.

FEDECOOP data processing staff are highly skilled at programming additional applications in BASIC. However, this is not an efficient programming environment, even for highly skilled staff. Also, as noted earlier, additional applications will require additional data processing capability which seems to be unavailable on the S/36 computers. In meeting one application need, we therefore add to a system that is already operating beyond capacity. At least four additional applications have been identified that FEDECOOP needs on the S/36. They are needed on the S/36 because they directly depend upon the accounting information stored there.

If FEDECOOP were to introduce new activities, or radically change the nature of its business, it seems doubtful that new information systems could be developed on the S/36 within a reasonable amount of time, if at all.

2.2.4 Limitations to Data Communications

The S/36 cannot easily communicate with other computer systems, even another S/36. FEDECOOP has one PC S/36 in a remote location approximately 10 kilometers from their main offices. To establish effective communication between these two system would require a dedicated telephone line and expensive equipment. The cost estimates are above one million colones (approximately ten thousand US dollars.) A dedicated line apparently is not available in any case. Currently, data is transferred by first converting the data to microcomputer diskettes, physically carrying the diskettes from one site to the other, and then reconverting the data to S/36 format using the "File Transfer Utility".

2.3 DECISIONS

2.3.1 When to Replace Existing S/36?

The limitations and vulnerability of the S/36 seem to preclude any consideration of retaining it indefinitely. The S/36 cannot be considered as a long term data processing environment. I believe a strategy is required now to replace it. The real question is not whether to replace it, but when.

2.3.2 With What to Replace the S/36?

The data processing industry now offers a number of excellent options in both the PC microcomputer environment and the main frame or minicomputer environment. The scope of FEDECOOP's data processing needs is large enough to seriously consider both environments, or some combination of the two.

Each environment offers advantages and disadvantages. To address this decision, these will need to be investigated, documented and used as a basis for any plan of action.

3. TASKS TO ACCOMPLISH WITHIN THIS ASSIGNMENT

Document the specifications of FEDECOOP's future data processing needs given it's current plan. Specifications should indicate total data storage requirements, total number of terminals required, system design options, and software considerations.

Visit major vendors of computer systems in Costa Rica to determine costs, benefits and capabilities of replacement options. These will include mainframe/mini computer systems and also PC based networks. I will not identify myself as being associated with FEDECOOP in order to screen FEDECOOP from aggressive sales approaches and in order to receive more accurate information.

Visit other companies and organizations in Costa Rica who are using systems which may meet FEDECOOP needs. In this way we can learn from their experiences. They can reflect the current reputations of vendors.

Design and test a strategy for immediately protecting critical processing functions in case the S/36 is out of service for an extended period of time and a replacement system has not yet been installed.

Based on the findings from the above tasks, outline and document a strategy within a timetable for future action by FEDECOOP. This will address the following five areas:

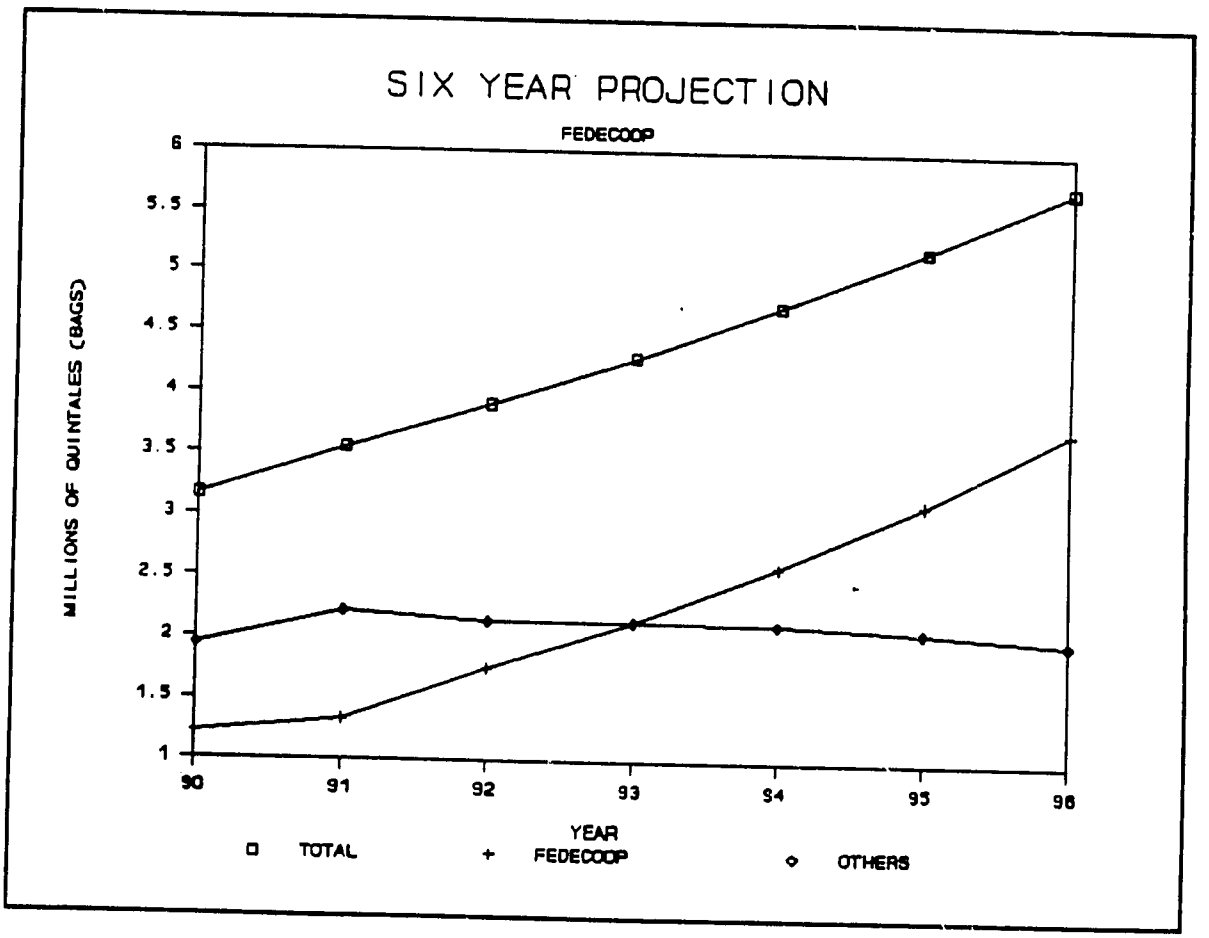
- Hardware
- Software
- Personnel and Training
- Data Communications
- Site Considerations and Operations

4. SPECIFICATIONS FOR FUTURE DATA PROCESSING NEEDS

4.1 INTRODUCTION

FEDECOOP plans to increase its operations from marketing approximately 40% of the nation's total coffee export to 70% in 1996. They hope to achieve this while minimizing the increase in staffing requirements. Clearly, their success will depend on the degree to which they can apply technology effectively.

For the purposes of this analysis, we are assuming that the total amount of coffee exported by Costa Rica will increase at a rate of about 10% per year. FEDECOOP must triple their sales in the next five years in order to achieve this objective relative to total annual coffee exports under these conditions.



FEDECOOP's data processing requirements may not increase to the same degree. The number of accounting transactions, for example, may not triple. The quantity of money and coffee that each transaction represents will certainly increase, but this does not represent an increase in data processing. It is certain, however, that in order to raise sales to this degree while minimizing increases in staffing levels, existing staff must be able to process information more effectively. Managers must be able to make higher quality decisions based on more accurate and more meaningful information. All areas of FEDECOOP's operation must benefit to the greatest degree possible from increased data processing capability.

The following projections take these concepts into consideration.

4.2 TERMINALS AND PRINTERS

FEDECOOP currently operates with 24 terminals connected to its primary S/36 and three terminals connected to the PC S/36. Approximately five microcomputers are in use but are not connected to either S/36. This total of 32 terminals and microcmputers should be sufficient for the immediate future, but should increase to a maximum of about 70 terminals in 1996. This will permit greater access to essential data processing information and processes by FEDECOOP management as well as staff. According to the Computer Department personnel, FEDECOOP management hopes to make better use of the data processing systems to support their decision making. This will require additional terminals for management access, beyond the operational levels now in effect. Ideally, each FEDECOOP manager should have a terminal at his desk, and he should use it regularly in his/her decision making process.

Currently, 12 printers are connected directly to the main S/36 and 2 to the PC S/36. At least an additional 11 printers are in use but are not connected directly to either S/36, but only to microcomputers. This total number of printers now in use is approximately 26. This number should grow to approximately 45 by 1996. Not all of them need to be connected directly to any centralized computer system or network.

In summary, we anticipate that FEDECOOP will need to at least double their access to computer work stations (terminals and microcomputers) and nearly double their access to printers in

the next five years. This increase reflects an effort to provide more data processing capability to more existing operational staff whose tasks can and will benefit from computer support. It also reflects a significant increase in direct access to and use of electronic data processing facilities by FEDECOOP management.

CURRENT VS FUTURE TERMINAL AND PRINTER NEEDS

CURRENT		1996	
TERMINALS	PRINTERS	TERMINALS	PRINTERS
32	26	70	45

(Note: In this context a terminal includes both microcomputers and terminals of the S/36. In other words, a terminal is a computer workstation regardless of where the central processing unit is located, either within a personal computer or in the S/36 or similar mini or mainframe computer.)

Options for replacing the S/36 may permit utilization of existing microcomputers, and gradual addition of workstations as needs increase.

4.3 DATA STORAGE CAPACITY

The total existing data storage capacity on the two S/36 systems is approximately 500 megabytes. This is roughly the equivalent of 500 million sheets of data and software printed on paper. In addition, nearly all of FEDECOOP's microcomputers have harddisks of about 30 megabytes each. However, the microcomputer harddisks are not considered as important data storage devices at this time.

Any system which replaces the S/36 systems should have a minimum of 500 megabytes of storage capacity with the potential to expand up to about one gigabyte (one billion bytes) by 1996. This future capacity will permit storage of up to five years of accounting and operations data, plus the increased number of transactions resulting from the intended growth in FEDECOOP's coffee marketing activity. This capacity is also intended to store any important software and data now stored on microcomputers and not on existing S/36 systems.

CURRENT VS FUTURE DATA STORAGE NEEDS

CURRENT	1996
500 MEGABYTES	ONE GIGABYTE

(Note: One gigabyte equals one thousand megabytes, or one billion bytes. One byte can represent one character of data.)

Some options for replacing the S/36 will permit a gradual increase in data storage as needs increase.

4.4 SOFTWARE CONSIDERATIONS

FEDECOOP already has a well defined data processing environment. It is very unlikely that the existing software used on the S/36 will be useful on any replacement system. However, the design and structure of the software and existing databases will provide a solid foundation on which new software can be written, if this be necessary.

The essential data processing applications will not change dramatically over the next five years. Accounting and related modules will be the cornerstone on which FEDECOOP's information system will rest. There are many such applications available as commercial packages. However, these packages will probably require that FEDECOOP use new data structures and procedures. For this reason, I recommend that replacement options for the S/36 have the capability of accepting and using existing data structures, otherwise all this data may be useless unless converted to the new structures. Conversion may be possible, but probably at considerable expense.

I also recommend that FEDECOOP seriously consider developing their own software for whatever replacement option is selected. FEDECOOP's computer staff are already highly skilled in several programming languages, although BASIC is the area in which they are most advanced. With sufficient time and training, they will be able to custom program whatever software FEDECOOP requires. This will provide the greatest degree of flexibility for FEDECOOP. The costs for training and staffing for this process may well be less than the cost of a commercial software package. One quote for a comprehensive commercially available software package is US$20,000.

FEDECOOP has also come to rely heavily on microcomputer based software for analysis and wordprocessing. Several applications have been programmed using Foxpro (a database management and programming environment) that operate mainly on a microcomputer. Whatever replacement option is selected, it should provide for continued use of these packages by permitting easy transfer of data between microcmputers and the central data storage system.

4.5 SYSTEM DESIGN OPTIONS

There are two fundamental design options available. One is a centralized design, and the other is a decentralized design. There are variations available that provide some aspects of a centralized design and some of a decentralized design.

4.5.1 CENTRALIZED SYSTEMS

In a centralized design all software and data are stored on a central processing unit and central data storage facility. This is the typical mainframe computer environment. Examples exist in the banking and airline industries. Users access the central data processing facility by means of a "dumb terminal" which has only a keyboard and a monitor. All processing and data storage is retained on the central facility. Users cannot introduce any data except through the keyboard. The only software available is what may exist on the central data processing facility.

There are a number of significant advantages to this system:

1. Data processing staff have full control over backups and operations.

2. Software is usually more easily integrated and maintained.

3. There is little risk of computer viruses or other forms of data contamination entering the system.

4. Users access the centralized database and therefore get the most current information available.

Disadvantages of this design are:

1. Such systems are very costly. The central data processing facility alone, capable of meeting FEDECOOP's needs, but without including software or terminals, may cost US$150,000. Software is expensive and in limited variety.

2. These systems are very closed. They do not communicate well with microcomputers or with other systems. This makes it difficult, and maybe impossible, to transfer the data and software from the S/36 to a new machine, even if the new machine is an IBM brand. One unconfirmed report we have received claims that an enterprise in Costa Rica tried to convert from a Data General computer system to an IBM computer system. After two years, and despite claims that it could be done, data and software still has not been successfully transferred to the IBM system.

3. Vendors are the only source for repair and modifications, and therefore the costs for these services and products are often very high.

4. All data and software for a centralized system is stored on a single physical processing facility, with appropriate backup devices as may seem appropriate. When the central facility fails, the entire data processing capability of the organization is lost. All eggs are in a single basket. It is more vulnerable to disasters such as earthquake and fire.

5. Centralized systems are more sensitive to environmental problems such as heat, dust, humidity and power fluctuations. They typically require a highly controlled environment.

4.5.2 DECENTRALIZED SYSTEM

A decentralized system is sometimes referred to as a distributed processing system. Microcomputer based networks are now the most popular example. Microcomputers in the network generally have some processing and data storage capability of their own, yet they are linked to each other and can access each other's

data and programs. They can share data easily. Users can add software and data to their own system, which then becomes available to everyone in the network. Passwords are used to restrict access where this is appropriate.

Advantages to a decentralized system include:

1. These systems are dramatically less expensive then centralized systems. Often the cost is one tenth to one half that of a centralized system serving the same number of users. Often, a decentralized system can be installed using many microcomputers that an organization already has purchased and with which it is familiar.

2. A decentralized system communicates easily with many devices. Data can easily be transferred, even by diskette, to other computers even in other organizations or remote facilities.

3. Users can take greater initiative in developing their own data processing capability. Data processing staff become trainers supporting and developing the skills of all users.

4. Software is available, cheap and in a great variety.

5. If one computer fails, all others can continue without interruption. All eggs are not in the same basket.

6. Data may be backed up more easily by users. The responsibility for this task is decentralized and becomes more manageable.

7. Repairs and modifications are easier and cheaper because the equipment is sold and supported by many vendors. Networks can grow dynamically with the needs of the organization.

Disadvantages of a decentralized system include:

1. Users require a higher level of skill and assume a higer responsibility. They may not recognize this and may fail to protect their data adequately.

2. Data may be contaminated easily or viruses introducted into the network since users can add software and data electronically from their workstation. Control is greatly reduced.

3. Users cannot as easily access data concurrently. There may be a delay between the time data is entered at one station and related databases are updated at other stations.

4. More problems in operations and maintenance may be expected because there is a greater variety of hardware and software in the system. Users have more power and control in this environment, and so the risk of operator error may be greater.

ADVANTAGES	DISADVANTAGES
CENTRALIZED SYSTEM	
1.Highly controlled 2.Integrated software 3.Secure from viruses and contamination 4.Access to most current information in central database	1.Very expensive 2.Inflexible- cannot communicate easily with micros or other computers 3.Limited repair options, dependent on dealer for modifications and repair 4.All eggs in one basket- cannot recover easily from massive system failure 5.Sensitive to environmental stress
DECENTRALIZED SYSTEM	
1.Inexpensive 2.Easily communicates with micros and other computors 3.Users can develop their own applications 4.Software is cheap 5.Less sensitive to system-wide failure 6.Data security responsibility is decentralized 7.Repairs and modifications are inexpensive	1.Less control - users may not adaquately accept responsibility for backups and data security 2.More vulnerable to viruses and data contamination 3.May be delay in accessing most current data 4.Operations may be subject to more problems due to wider variety of equipment and broad user involvement

4.5.3 COMBINING CENTRALIZED AND DECENTRALIZED DESIGN PRINCIPLES

Few installations are all decentralized or all centralized as described above. Most contain important components of both. This will be an important balance for whatever design FEDECOOP chooses in replacing the S/36 systems.

Virtually all microcomputer networks designate one computer as a "file server". This file server serves as a centralized source for databases and software that are required by other users in the network. The size and power of this server is defined by the number of users it must serve in the network and the type of application it will be running.

Some systems will have several file servers which are connected by a bridge. This is sometimes referred to as a "star cluster" network. Each server focuses on one main application. A portion of the data may be shared across the bridge with other servers. All users in the network, regardless of the server to which they are connected directly, can access data in other servers via the bridge.

In fact, FEDECOOP already has this type of system. The main S/36 is now a file server for accounting and related data. It is connected to a number of "dumb" terminals and also a number of microcomputers. Some of the microcomputers can transfer data between the S/36 and their own microcomputer environments. The PC S/36 serves a similar function for the coffee processing and marketing applications. A difficult bridge between these two systems is achieved by converting S/36 data to microcomputer formats on microcomputer diskettes. The diskettes are carried by hand to the other S/36 where the data is converted back to S/36 data.

FEDECOOP's needs require that more than one user be able to access data at any one time. This will become increasingly important as FEDECOOP management gain the ability to generate information directly on which to base their decisions. Therefore a file server will be required that is capable of accepting and storing all such current data and the software required to process it. Such file servers could relatively easily replace

the S/36 systems which now serve this function.

Since FEDECOOP already is accustomed to an essentially decentralized processing environment, it would be traumatic, radical, expensive and difficult to change to a completely centralized environment. I recommend that the S/36 systems be replaced in such a way as to retain a similar partially decentralized processing environment. There are effective means for addressing the disadvantages that accompany a decentralized data processing system.

In this case, the fundamental design consideration is what hardware and related operating environment will support a decentralized system. The primary characteristic for such hardware is the ability to communicate easily with microcomputers and other systems.

5. S/36 REPLACEMENT OPTIONS IN COSTA RICA COSTS, BENEFITS AND CAPABILITIES

5.1 LOCAL RESOURCES VISITED

As part of this analysis we made visits to a number of vendors in San Jose. FEDECOOP Computer Department staff identified these vendors as having a reasonably good reputation and as having been in existence for at least several years. In order to screen FEDECOOP from agressive sales approaches, and to gather information as accurately as possible, I did not identify FEDECOOP as my client. We also visited a company who has recently converted to a microcomputer based network.

These included the following:

Nexsys Corporation International. Nexsys markets comprehensive accounting software and also SCO operating system software (Unix/Zenix).

Systema Integrados. SI is an authorized IBM dealer. They sell the popular AS400 minicomputer system.

Continex S.A. Continex is an authorized dealer for IBM Personal System (PS) computers, Novell network products, communications products including modems.

Axioma International S. A. Axioma has one of the best reputations in San Jose for network sales, installation and support, and specializes in Novell networks. They market a full range of non-IBM hardware.

Productos de Concreto S. A. This is a company that has recently completed a conversion from a Data General centralized computer system to an extensive microcomputer based network consisting of about 22 terminals. Axioma is the company from whom they purchased their network and related support services. They are very pleased with their new system.

Sistemas Analiticos S. A. Data General. This company markets exclusively Data General super micro, mini and mainframe computers.

Sistemas L&S. This company markets IBM and NEC microcomputers, network environments and other business equipment.

Most vendors have provided documentation about their companies and their products. These have been submitted to FEDECOOP's Computer Department for future reference.

5.2 MINIMUM REPLACEMENT REQUIREMENTS

FEDECOOP's immediate need is to replace the S/36 systems in such a way as to prepare FEDECOOP for future expansion of their data processing capability, and to continue existing data processing without significant interruption or change.

Any option other than using an IBM AS400 or similar system will require the replacement of at least 10 terminals which are now dedicated "dumb" terminals that can only operate on S/36 systems. Approximately 17 PC microcomputers now serve as terminals for the S/36 computers. These microcomputers can continue to be used as terminals with only minor modification, regardless of the replacement option chosen.

In addition, two printers are dedicated S/36 printers that will not be able to continue to be used in a new environment, unless it is an IBM S/36 compatible environment (such as the AS400). These will need to be replaced with high speed printers of at least equivalent capability.

The S/36 systems themselves must each be replaced with a file server of at least equivalent specifications. A link may be established via a modem over dial-up existing phone lines. The line does may not have to be dedicated.

5.3 COST BENEFIT ANALYSIS

The following chart summarizes the conclusions drawn from the investigations and analysis. They were discussed in detail with the FEDECOOP computer department personnel and also Diego Sanchez, the former head of the computer department and currently head of the marketing department.

Each characteristic and the corresponding scores given to each of the three options are discussed in detail below.

In this analysis we consider two options that may be considered as minicomputers, having the capabity of a centralized data processing system as defined above. These are the IBM AS400 and Data General's (DG) AViiON AV4000 computers. "Micro" refers to the option of installing a microcomputer based network using microcomputer file servers.

Certainly other options are available. However, within the time allowed these were the best representative options which we were able to investigate.

We conclude from this analysis, that a microcomputer based network offers the most advantageous cost/benefit ratio of all options considered. Cost, expandability and compatibility with microcomputers are the three most important characteristics where a microcomputer based network offers significant advantage over any other option.

COMPARATIVE ANALYSIS SUMMARY

(Note: Scores are based on a scale of 1 to 10. 1 indicates the worst possible rating. 10 indicates the best possible rating.)

DESIRABLE CHARACTERISTICS	AS400	DG	micro
1.Low purchase cost	1	4	9
2.Low repair cost	4	4	8
3.Expandability	4	3	10
4.Security of data	7	7	5
5.Easy communication with micro's	6	4	10
6.Easy conversion of S/36 data	10	3	9
7.Easy transfer of software	10	0	0
8.Easy software development	7	7	8
9.Reliability	8	7	6
10.User friendly	7	7	5
TOTAL SCORES	64	46	70

1. Low Purchase Cost

An IBM AS400 will cost more than US$150,000. This provides only a file server to replace the existing main S/36. It will not provide for a replacement of the PC

S/36. All existing terminals and printers that FEDECOOP has can be used by the AS400. However, additional costs will be incurred in the future when expanding the system.

Data General's AViiON AV 4000 Multi-User System/Server will cost between US$70,000 and US$140,000 depending on the configuration chosen. I estimate that 15 terminals and a suitable server will cost US$140,000 or more. No S/36 equipment can be used with the Data General computer. The Microcomputers, however, can be used as terminals when suitable emulation cards are installed.

There are many options available in the microcomputer network environment. An essentially IBM configuration will cost about US$50,000 including microcomputer terminals to replace the S/36 "dumb terminals". A network consisting of reliable non-IBM hardware will cost approximately US$35,000. An additional $10,000 may be required to replace the two S/36 high speed heavy duty printers. I believe the lower cost non-IBM hardware is a better option, and so a figure of $50,000 including the two heavy duty printers, should be adequate.

Clearly, the micromputer based option is dramatically lower in cost than either of the other options.

Additional terminals can be added in any of these above options for an average cost of approximately US$2,000 each. This includes the purchase of additional file servers as needed in a microcomputer network. Printers will average about US$500 each.

Given these estimates, and the specifications for FEDECOOP's future data processing needs as noted above, FEDECOOP should budget approximately US$50,000 to replace their existing S/36 systems with a microcomputer based network in the coming fiscal year. In each of the four next fiscal years, FEDECOOP should budget approximately US$20,000 for ten additional terminals and US$2500 for five additional printers each year. The total estimated cost for replacing the S/36 systems with a microcomputer based network and expanding to the specified size by 1996 is US$140,000. Personnel, training and software development/conversion costs are extra and will be discussed below.

2. Low Repair Cost

In both the AS400 and Data General cases, FEDECOOP would be providing the dealer with a monopoly on all future services to FEDECOOP. Although such computers as the AS400 have a good reputation, FEDECOOP would face a similar situation in which it now finds itself. Only one source will be available for repairs, and that source can charge whatever fees it wishes. I do not accuse these vendors of criminal intent; however, the circumstances are disturbingly similar to those of extortion.

In a microcomputer environment, many resources are available for repair and support. This competitive context provides lower cost and better service resources.

3. Expandability

Microcomputer based networks are by nature essentially distributed processing environments. As such it is extremely easy to add a file server or terminal as and when needs arise. Start up costs can be low and the system can grow dynamically with the changing needs of the company.

In the AS400 and DG options, FEDECOOP must decide early on what the ultimate needs will be in order to purchase a sufficiently powerful centralized server to meet those needs. The result is an expensive startup cost, as described above, and a restricted environment in which to grow. Compatibility issues are not as great as they used to be, but are still greater with these systems than with a microcomputer based system.

Of course, the AS400 and DG computers could simply serve as file servers for a microcomputer network. In this case, none of the power for centralized processing for which they are designed can really be used. There would seem to be little reason to use them as simply file servers when a microcomputer option would be far more cost effrective.

4. Security of data

As discussed above, centralized environments inherently offer more control than do decentralized environments. therefore, the AS400 and DG systems have greater data

security built in.

While there is undoubtedly greater risk with a microcomputer based system, there are also many procedures and mechanisms available to manage this risk. The first line of defense is to train users in safe and responsible use of the network. Password security is also available, as with a centralized system. Microcomputer terminals can have their disk drives removed, sealed or disconnected so as to limit the opportunity for users to introduce viruses from diskettes. This does, however, reduce the advantage of a decentralized environment. Backups of the main file servers can and should still be maintained by professional data processing staff.

5. Easy Communication with Microcomputers

Obviously, a microcomputer based network will have the greatest ability to communicate with microcomputers. AS400 and DG options may also communicate easily, especially when they function essentially as file servers. The existing emulation cards and file transfer utilities now in place with the S/36 may also be compatible with the AS400.

However, if the AS400 and DG options were to be installed as a centralized system taking full advantage of their design capabilities in this context, than the ability to communicate with micros is seriously reduced.

6. Easy Conversion of S/36 Data

This characteristic is important when considering the costs of converting to a new system. There is considerable data stored in the S/36 environment which must be transferred to any new environment. The AS400 may accept this data directly with virtually no conversion modifications needed.

The DG system may accept the data if it were first converted to microcomputer format, then reconverted to DG format through whatever file transfer utility DG offers. It is not clear if even this is possible, or if easier options are available. There are reports of efforts that fail even after several years.

FEDECOOP already has the capability of converting all data to a microcomputer format. In fact, this is an important first step towards immediately protecting their data processing capability from fatal failure of the S/36 systems. This is discussed in greater detail below.

7. Easy Transfer of Software

As noted earlier in this report, the existing S/36 software will be useless on anything other than another IBM S/36 compatible machine. The AS400 may accept this software and operate it without modification. However, it should be noted that the existing software is very limited in the context of modern accounting and database applications. Nothing would be gained by continuing to use it in its present state, other than a short term savings in conversion costs.

The software itself will be completely useless on any other computer system. However, as pointed out earlier, FEDECOOP has a well-defined and well-documented data processing environment which will make the development of equivalent (and advanced) software applications very easy.

8. Easy Software Development

Advances in the computer hardware industry have permitted significant advances in the software industry. Any of the options selected will provide the opportunity for FEDECOOP to use more powerful programming languages for developing software.

However, the scales tip in favor of the microcomputer environment because here the software industry is more dynamic. The programming tools are available in wider variety. Also, many more programmers are available in the microcomputer environment than in the mainframe environment. At this level, even users can and do develop their own applications within such software packages as Lotus 123, Foxpro and Harvard Graphics (all of which are already in use by FEDECOOP personnel).

9. Reliability

In this case we are referring to the reliability of hardware, not of data integrity (which we consider below

as data security). IBM as a major corporation, and its AS400 as a product both have high reputations for reliability. Data General has a similar reputation to a slightly lesser degree.

Microcomputer based networks, because they are dynamic and incorporate a wider variety of products and permit a greater degree of user access, generally are less reliable. This factor can be improved through the use of high quality file servers and careful operations procedures.

10. User Friendly

Centralized systems generally are easier for users to understand and operate because their access is limited and controlled by the operating system and the system operators.

Microcomputer based networks offer users more control and more features. This also requires that they need to learn more in order to take full advantage of them. There are many ways to make these networks more user friendly, but the system operators must develop and use them. They do not come automatically with the operating systems themselves. Individual commercial applications software, such as Lotus 123, include their own user friendly help and tutorial features.

5.5 VALUE OF EXISTING S/36 SYSTEMS

Some note should be made here of the value of the existing S/36 systems. As described above, if replaced with an AS/400 virtually all the S/36 hardware except the central processing unit can continue to be used. However, the cost of an AS/400 does not permit much savings to be gained from this fact.

The current book value of the main S/36 and related dedicated equipment is approximately US$30,000. This is nearly the cost of replacing it with a microcomputer based network.

However, it is quite impossible to determine what the true market value is of the S/36 in Costa Rica. There are other companies who use this system and who may value the terminals and printers highly. They may also value having the S/36 CPU available to act as backup to their primary one.

I recommend that FEDECOOP budget for replacing the S/36 systems as if they had no value at all. Once the replacement is successfully completed, they may be sold for whatever the market will bring, if anything. Any income derived from the sale can be considered as unbudgeted income.

6. IMMEDIATE PROTECTION AGAINST S/36 FAILURE

As stated earlier, FEDECOOP currently is at critical risk of having their data processing capability interrupted indefinitely. There are some immediate, low cost steps that can be taken to protecting critical data and processing functions.

One option is to be prepared to rent a S/36, should one be available. This is a temporary measure that may permit FEDECOOP to resume operations until their own S/36 is either replaced or repaired. It does not contribute at all to a permanent solution. FEDECOOP data processing staff are already exploring this option.

In addition, I recommend that the following steps be taken immediately. If necessary, additional staff should be hired in order to permit these steps to be taken.

1. Identify all critical data files now existing on any S/36 system and also on S/36 backup diskettes. At a minimum, these should include all accounting data for the current fiscal year.

2. Transfer this data to a microcomputer environment. This environment should include at least a set of microcomputer formatted diskettes to be stored off-site, and a microcomputer harddisk. If necessary, purchase a larger harddisk for one microcomputer to store all this essential data.

   Institute procedures for updating these microcomputer based backups on a regular basis.

3. Identify all critical data processing functions which must be performed in order for FEDECOOP to continue operations. These will include at least the entry of all accounting transactions, include checks paid, funds received, and inventory activity (both coffee and supplies inventories).

4. Program these functions in a temporary manner using FoxPro software such that all this data processing could be continued, if necessary, on a single microcomputer. Appropriate departments should work closely with the Computer Department to outline the necessary procedures for using this alternative emergency data processing system in the event that the S/36 computer were to fail.

Analysis shows that there are no more than 6,000 critical transactions entered into FEDECOOP computer systems per month. These may be entered at an average rate of 40 transctions per hour on a single microcomputer system, working seven hours per day, 20 days per month. This is a comfortable rate for data entry. This will maintain FEDECOOP's critical databases until such time as a more permanent arrangement is made.

The costs for these emergency backup steps will be minimal. They include a large capacity harddisk, additional microcomputer diskettes to hold the backups (or a tape backup system), and possibly additional personnel in the computer department to handle the extra work load to implement this strategy.

7. ACTION CONSIDERATIONS

7.1 INTRODUCTION

Each section below discusses action oriented considerations grouped into five logical categories. Objectives and activities related to the conclusions and purposes of this assignment are then detailed, providing cost estimates, in Section 8. A GANTT chart summarizes these activities with suggested time frames for each of them.

7.2 HARDWARE

Ideally, in order to immediately protect critical data processing functions, FEDECOOP needs to install a harddisk of at least 60 megabytes in one of their existing microcomputers. This microcomputer should have File Transfer Utility capability with the main S/36. This harddisk capacity will be sufficient to store all critical data for emergency data processing in the event that the S/36 should fail. It will also permit temporary storage and handling of non-essential data that should be transferred to microcomputer compatible diskettes for future use. Cost estimate is US$1,000.

FEDECOOP should budget for replacing the existing PC S/36 and main S/36 computers with microcomputer network file servers and microcomputer terminals as soon as possible, but not later than the start of the very next fiscal year. Cost estimate is US$50,000.

In each of the four following years, FEDECOOP should budget for expanding their data processing environment by approximately 10 terminals and five printers. Cost estimate is US$22,500 per year.

7.3 SOFTWARE

FEDECOOP should immediately purchase an original copy of FoxPro LAN (Runtime version). This will provide full documentation for this important programming environment. I recommend this environment for developing critical data processing applications in the existing microcomputers, and in the future network. Without the original documentation, FEDECOOP programmers are seriously handicapped when trying to improve their skills in this powerful environment. Cost estimate is US$1,000.

As soon as possible, essential data processing functions should be programmed in this environment such that emergency data processing can be continued on a single microcomputer in the event that the S/36 system should fail. See Personnel and Training for cost estimates related to this activity.

7.4 PERSONNEL AND TRAINING

In recent years the FEDECOOP computer department has grown significantly. However, given FEDECOOP's ambitious objectives for the next five years, even more additional personnel may be required in this department.

In order to provide existing computer department staff sufficient time to implement this strategy, serious consideration should be given to immediately hiring one additional person on a full time basis. Cost estimate is US$5,000 for the remainder of this fiscal year.

At least two members of the computer department should immediately begin a training program in the areas of microcomputer network operations and programming in the FoxPro LAN language. This program may emphasize self-training combined with appropriate formal training as may be available in Costa Rica. Formal training, if available, should include at least eight hours of instruction. Typical costs in the United States would be at an approximate rate of US$40 per hour, or $320 per person per eight-hour course. Total estimated training cost is US$700.

In a decentralized, microcomputer based network, the role of a computer department changes significantly. User training and support becomes a much higher priority. FEDECOOP management especially need to begin a training program to enable them to take advantage of this technology. Adequate funds must be allocated for this increased training emphasis. I suggest that $500 per new workstation be budgeted. This means an additional $5,000 per year for four years beginning the year after the S/36 is replaced by a microcomputer based network.

7.5 COMMUNICATIONS

There is an immediate handicapp in communicating data between FEDECOOP's operations in San Joaquin and the Uruca offices. A modem connected to a microcomputer at each location with appropriate communications software would facilitate

electronic transfer of this data. At this time, this does not seem like a high priority, however the experience with modems will be important when linking these two facilities in a more effective manner when microcomputer based networks are in full operation in the future.

I recommend purchasing two 2400 buad Hayes compatible modems to implement this link. Resources exist in San Jose for training FEDECOOP staff to operate such a link. I believe the training and installation support could be provided in one day at local consulting rates. I estimate modems to cost US$250 each and consulting support for one day to cost US$150. Total estimated cost is $650.

7.6 SITE CONSIDERATIONS AND OPERATIONS

FEDECOOP has a well run computer operation. The S/36 is a fragile system relative to microcomputers. The room which houses the S/36 now will easily serve the environmental needs of a network file server. Cable routes already exist and will serve as an effective guide for installing network cables.

File servers should be protected from power fluctuations and interruptions. Individual microcomputers in the network may require them if they support significant operations. Generally, they are not necessary.

8. OBJECTIVES AND ACTIVITIES

8.1 PROTECT ESSENTIAL DATA PROCESSING FUNCTIONS

As described earlier, FEDECOOP is very vulnerable to failure of either S/36 computer systems. To provide for an emergency data processing capability of essential functions, the following should be accomplished:

8.1.1 Transfer all essential data from the S/36 machines to microcomputer harddisks and diskettes. Institute procedure for updating this data at least weekly.

(Note: Although it would be ideal to have at least a 60 MB harddisk in a microcomputer as described in section 7 above, this process can and should be initiated immediately with the equipment available.)

8.1.2 Develop necessary programs and procedures using FoxPro such that essential data processing may continue on a single microcomputer. Purchase FoxPro LAN.

8.1.3 Transfer all remaining data from S/36 harddisks and diskettes to microcomputer environment. This includes all archived accounting data available. This will insure that this data can be used in a future microcomputer based network. If the main S/36 were to fail, all of this data would now be lost.

8.2 REPLACE MAIN S/36 SYSTEMS WITH A MICROCOMPUTER BASED NETWORK

I am assuming that funds for this objective will not be available until the next fiscal year. If funds are available sooner, then the timetable should be adjusted accordingly.

8.2.1 Evaluate and Select a Vendor. Some groundwork has been accomplished as part of this assignment. However, additional research is advisable before selecting an vendor.

8.2.2 Train Data Processing Staff to use FoxPro and in network administration.

8.2.3 Install main file server to replace the main S/36 and transfer all data to the main file server. Continue operations as normal on S/36. Update data from the S/36 regularly. Install one network terminal.

8.2.4 Develop essential data processing functions for network operations using FoxPro LAN.

8.2.5 Install nine network terminals to support essential data processing functions.

8.2.6 Operate both network system and S/36 system in parallel for one month.

8.2.7 Discontinue processes on the main S/36 and depend completely on the microcomputer based network for essential processes.

8.2.8 Convert all remaining microcomputers which serve as main S/36 terminals to network workstations.

8.2.9 Sell main S/36.

8.2.10 Implement the same process for the PC S/36.

8.3 BUDGET SUMMARY (all figures are in US$)

8.3.1 Immediately Allocations

Additional staff	5,000
Training	700
FoxPro LAN	1,000
60 MB Harddisk	1,000
Modems and related support	650
TOTAL	8,350

8.3.2 1991-92 Fiscal year

Network Equipment and operating system software (two file servers, two heavy duty printers and ten additional terminals) sufficient to replace all S/36 systems.

TOTAL	50,000

8.3.3 1992-93 Fiscal Year

10 additional network terminals	20,000
5 additional printers	2,500
Training for 10 individuals	5,000
TOTAL	27,500

8.3.4 1993-94 Fiscal Year

10 additional network terminals	20,000
5 additional printers	2,500
Training for 10 individuals	5,000
TOTAL	27,500

8.3.5 1994-95 Fiscal Year

10 additional network terminals	20,000
5 additional printers	2,500
Training for 10 individuals	5,000
TOTAL	27,500

8.3.6 1995-96 Fiscal Year

10 additional network terminals	20,000
5 additional printers	2,500
Training for 10 individuals	5,000
TOTAL	27,500

ACTIVITIES WITHIN TIME FRAMES

Activity / Quarters	1990-91			1991-92			
	2	3	4	1	2	3	4
8.1.1 Transfer essential data	X	X					
8.1.2 Develop emergency programs and procedures	X	XXX					
8.1.3 Transfer all remaining S/36 data to micro's	X	XXX					
8.2.1 Evaluate and select vendor		XX	XXX				
8.2.2 FoxPro Training for Programming staff		XXX	XXX				
8.2.3 Install main file server to replace S/36				X			
8.2.4 Develop essential programs in FoxPro LAN		XXX	XXX	XXX	XXX		
8.2.5 Install nine more network terminals to replace S/36		XXX	XXX				
8.2.6 Parallel operations test						XXX	
8.2.7 Discontinue main S/36							XXX
8.2.8 Convert remain micros to network workstations						XXX	
8.2.9 Sell Main S/36							XXX
8.2.10 Replace PC S/36						XXX	XXX

9. FUTURE CONSIDERATIONS

A number of considerations come to light that are not directly related to the purposes of this assignment, but are worth noting.

9.1 TOP DOWN MANAGEMENT INFORMATION SYSTEMS ANALYSIS

FEDECOOP's immediate need is to protect their operational data processing capability, and to prepare for expanding this capability. This is the focus of this assignment and this report.

However, once this has been accomplished FEDECOOP should seriously consider a complete MIS analysis. In any organization, management decisions change in nature and scope. Objectives of the organization change. Information generated to meet these decisions and objectives must also change in nature and scope, especially when the capabilities of the data processing system become so more powerful and flexible.

It is very possible that information generated now is not supporting management decisions in the current context. Reports now generated out of the S/36 are probably operational in nature, rather than designed specifically to meet management decisions.

An MIS analysis will start with a review of the objectives of the organization at the highest management level. In this case, it is the General Assembly. It then defines the decisions that this group must make. These decisions must be based on certain specific bodies of information. With new, more powerful data processing capabilities, the opportunity is at hand to provide this information in a format, content and timeliness that has never before been possible.

The analysis will proceed downwards through the management hierarchy of the organization and into the operational levels. At each level, the same analysis will be performed. Define the purpose and objectives of the positions at that level, what decisions must be made, and what information is required to make these decisions.

When complete, this type of analysis can provide the basis for an entirely new, flexible and more effective information system that will precisely meet the decision requirements of management.

9.2 ORGANIZATIONAL STRUCTURE WITH RESPECT TO COMPUTER OPERATIONS

When electronic data processing capabilies are first introduced to an organization, they typically are applied at an operational level within the accounting departments. This is the most urgent application to which such data processing capability can be applied. Accounting functions are well defined and relatively easy to program as computer functions.

Inventory and similar database applications are next in line, and these have close ties to the accounting and department.

As a result, data processing support is often placed at a relatively low operational level within many organizations. However, the data processing power now is available to virtually all departments of an organization. Data processing capability has become one of the most important factors which determine and organization's ability to compete in the market place.

As such, it should be assigned a higher place within the organization's hierarchy. Data processing professionals need to be included in high level discussions regarding the organization's long range plans. Data processing support is needed to all departments, and needs to be coordinated at a department head level.

In order to provide the most effective means for supporting an organization's data processing capability throughout its many departments, the data processing unit should be an independant department reporting directly to senior management.

Such organizational changes are difficult with many important considerations regarding personnel roles, authorities and pay scales. It cannot and should not be implement abruptly without fully and fairly addressing these considerations. However, I believe the change is warranted and necessary in order to take full advantage of the powerful data processing technology available.

The services of an organizational consultant may be well worthwhile in reviewing FEDECOOP's organizational structure and developing a strategy for improving it.

9.3 COMPUTER MEDIATED COMMUNICATIONS

This application of computer technology is often overlooked,

yet contains the greatest potential for improving an organization's ability to work effectively as a team.

Electronic and voice mail is the most easily understood application. Computer technology can and now does assist people in communicating without having to be in either the same place, or without having to be available at the same time. This is extremely important since it dramatically reduces wasted time playing "telephone tag" and can also reduce the need for face to face meetings.

In addition, computer applications are now available which structure communications in such a way as to permit groups of people to work jointly on a project without regard to individual schedules. This often is overlooked as a useful application. It usually is assumed that it is easier to simply meet face to face. However, there is considerable documentation that shows that this is not the case.

I highly recommend that the microcomputer based network include at least an electronic mail facility. FEDECOOP is already accustomed to using such an application with their S/36. However, as management becomes connected directly to the network, this application can become very valuable.

I also recommend that FEDECOOP consider engaging a communications consultant in the future to assist in developing this aspect of their information processing capability.