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A Study of Computer Center Management

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A Study of Computer Center Management

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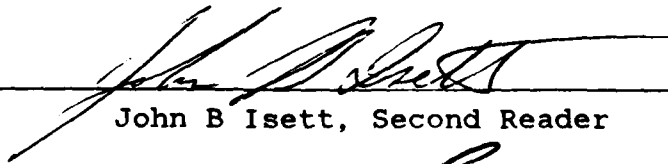from the

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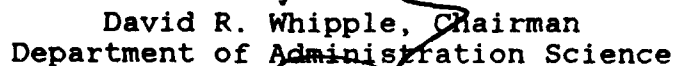Ting-Chun Teng

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ABSTRACT

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I. INTRODUCTION

A. INTRODUCTION

Few developments in history have had greater impact upon people and society than the computer. Today, computers are used as problem-solving tools in almost all occupations. Fields such as medicine, education, law enforcement, communications, space exploration, industry, sports, areas of entertainment, and the military are dependent on the computer to a degree unthought of few years ago. Most modern organizations are using the computer to aid in the completion of a unlimited number of tasks. Suffice to say that the computer was blamed for the crash of the stock market in October 1987.

This increased use of computers has changed the role of the computer center to one of a total information service function; a function designed to provide more accurate and timely information to help managers make better decisions. These changes, as well as the fast pace of technological development in the computer field, have created new computer center management problems. And as a result new management techniques are being introduced to efficiently run the center.

Technological and management changes are characterized by two important factors; they occur in developed countries,

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where capital and diversity allow for experimentation with the latest technology and management techniques. And they occur, more or less, in parallel, i.e., as new technology becomes available, new management techniques are introduced.

On the other hand, developing countries suffer from a number of problems. For example, there is a gap between the available technology in developed countries and what is being utilized in developing countries. A second problem is the fact that technology is introduced in a discontinuous fashion, i.e., when capital is available, various companies acquire the latest available which stays for a longer average time, then after a number of years another mass purchase takes place. In other words, it is a revolutionary process instead of evolutionary process. Hence, managers are expected to take drastic actions due to new technological acquisitions without the luxury of continuous growth with the technology. A third problem lies in the fact that most developments in either management techniques and technology do not take into consideration the various culture and social differences between the two worlds.

Undoubtedly a study in computer center management which benefits from the exposure to the latest trends in the United States, and a familiarity with a different culture will benefit computer centers abroad. This thesis is such an effort. It uses a Taiwanese military college computer center as an example, and recommends specific management

techniques while drawing upon a thorough understanding of the culture, an experience as one of the center employees and an exposure to the latest techniques in the United States.

B. A BRIEF HISTORY OF COMPUTER CENTERS

In the beginning it was dark, then there was the computer, under the control of the department of Finance and Accounting. As the various entities in organizations started using computers, a new group was founded under the name of data processing. This group assumed full responsibility of the computer and consequently total control of the machine. Management technique during these days were simple since there was an apprehension and a fascination on the part of organizations with the computers. It was easy for the data processing manager to say to the organization, "This is the way it must be done."

With the increase in understanding of the capability of the machine, there was a tremendous increase in its utilization. The computer became a problem-solving tool for many departments within large organizations. The diversity has created some problems for management, such as the priorities related to scheduling jobs, the increasing costs and the complexity of the computer system. Better techniques in managing computer center were developed, and software packages, which measure the utilization of the

machine and recommend various alternatives to improve it, appeared.

Recently, and due to the expansion of the role the computer plays in the organization, a major change occurred. This change, although not apparent on the outside, has to do with the type of service offered by the computer center. The center is now responsible for the organization information, as such it is not only computing but also the exchange of information between the various department within the organization. To reflect this change, the term data processing center has changed to Information Center. And instead of being part of a division, it is now an autonomous department within the organization.

With the increase responsibility of the center, a new administrative position has been created. The new position is given a variety of titles, the one used most frequently is the director of the Information Center (or Computer Center). The job description for this position, regardless of the title used, emphasizes management skills, a background and thorough understanding of computers and an understanding of the function of the organization. The director of the information center faces a new set of problems described in the next section.

C. RECENT DEVELOPMENT IN COMPUTER CENTER MANAGEMENT

With the expanded role of the information center, a new set of problems surfaced. This section outline some of the

salient ones, and the remaining chapters of the thesis will recommend a number of managerial techniques to overcome them.

Expenses related to the ongoing operation of the computer have increased rapidly as more and more computer applications are developed and implemented. The costs associated with operating the computer soon reached or exceeded the operating expenses of any other single division within the organization [Wagner, Crawford and Gruver, 1984]. At the same time, and due to the rapid development in hardware technology, a shift in cost items occurred in the center. The cost of personnel, supplies, and normal overhead for computer operations has exceeded the actual amount paid for the equipment.

The change in nature of the service offered by the center, from data processing to information processing, has created new requirements for specialized information experts as well as programmers. Recently new titles appeared such as System Analysts, Database Administrators, Information Engineers, etc. These titles reflect the change in the role of the center, and at the same time, require new groups within the center, new division of work, and new procedure to insure not only an adequate level of service to the users but also stronger communication between the various groups in the center to prevent duplication of effort and more seriously, incompatible systems.

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The life span of software increased and another shift in cost occurred. Today, statistics show that the cost of development of software amount to only 20% of its total cost. The remaining 80% is spent on software maintenance and update. This has created a new field which deals with managing software development and maintenance.

Another set of problems was created due to the popularity of the personal computers. Personal computers gained their acceptance in the business world with the introduction of the Spreadsheet. It is one of the most powerful business tools since it can, in a fairly short period of time and inexpensively, answers "What If?" type of questions. At the same time, there is no comparable package on the mainframe. The introduction of spreadsheet is not a problem in and by itself. It is the fact that personal computer users have their own set of organization data. An extremely difficult trend to control and a source of numerous problems since there are no means to insure that all sets are the same.

Another problem created by the personal computer is End User Computing. End User computing as a term was created after the increase of popularity of personal computers which allowed users to control their data and software packages. The ability to use a computer and to build models, e.g., spread sheets, databases, etc., became an prerequisite characteristic of employees. This expectation did not

consider whether the employee has the required education to develop software models or his/hers familiarity with the packages. A great deal of the time taken for software development is consumed in testing and documentation, two functions that are not given enough importance in end user computing. Thus there is the problem of losing the package if the developer, and the only one familiar with it due to lack of documentation, leaves the company. The other is inaccurate models, due to unfamiliarity with the software. This problem has caused millions of dollars in losses due to the fact that several of these models were wrong.

At the same time a new time of computing is gaining popularity. That is Networks and distributed computing. The manager of the center is responsible for more than one center spread over a large geographical area. A new type of software is being developed. These programs will reside in both the mainframe and in the personal computers and will connect the two together to determine which of the two computers is better equipped to execute a portion of the program. This type of programs will introduce new work load pattern on the mainframe, a pattern that cannot be predicted today. However, it cannot be prevented either since this may leave the organization in an uncompetitive position. Since the advanced network technology being developed rapidly, more and more organization prepare to change their central control systems to distributed systems in order to

fit the new environment changes, and this trend will increase the complexity of computer center management.

Furthermore, gaps still exist between the user and the information technician. This is due to the fact that there is no common language between the two. New jargon, specialist terminology, is being introduced in the information field. The user is neither familiar with it nor is he comfortable hearing it. This problem is causing users to stay away from the center and to become more and more dependent on his personal computer.

Another problem that has to be faced by top management is the complexity of the computer system. Each new generation of computers offer greater capabilities to the user. These additional capabilities of the new computers are not, in many instances, being used fully. The rapid advancements in computer technology make it very difficult for managers to keep up to date.

Needless to say there is a ongoing effort to deal with the various problems mentioned earlier. This effort is apparent in the research carried out in both universities and industry with some fruitful results, specially the field of network management and end user computing. However, these activities do not take into consideration some important aspects of the developing nations. The next section introduces these differences which play an important role in managerial decisions.

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D. DEVELOPING COUNTRY CHARACTERISTICS

Most technical development and new managerial techniques are developed in the United States and the rest of the developed nations. These changes occur and are dependent on a number of characteristics unique to the originating country. For example the adequacy infrastructure, the culture difference including communication models in organizations, motivations, etc., all play a role in the development. To try to transplant these into a foreign country without regards to other factors may not lead to the same success of the policy. There are numerous examples to prove this statement[1], and a number of American companies started realizing these culture difference in their business dealing overseas. One example of such company is Apple Corporation in Japan. As such, this section will identify salient factors in developing nations which the thesis has considered in the choice of recommended methodologies, or in introducing some changes to a methodology.

The Infrastructure in most developing nations is not as adequate as it is in the United States. Two aspects of the infrastructure play an important role in the computer field: Communications and Power. The popularity of communication is based on the fact that there is an excellent phone and wiring systems. This assumption is far from true in

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[1]A good reference is Hall, E.T., _Hidden Differences: Doing Business with the Japanese_, Anchor Press Doubleday, 1987.

developing countries. An example is the phone system in a developing country which reach a point of congestion that it was easier to personally go to see person you want to call than actually trying to phone him. The government run phone company purchased the latest system, which included services such as call forward, call waiting, etc. These services, although available, are not used because the phone company employees are not familiar with these services, etc. The second is the adequacy of the Power system. Developing nations is suffering from a shortage in power generation which is effecting their development effort. Power failure and voltage surge are common and require special attention when designing a computer center.

The Taiwanese communication system is characterized as an old, congested system. The present cabling system is overcrowded to the extent that one may have to go to microwave signal directly without passing through the normal evolution process. The power consumption in Taiwan is increasing as new industries are developed. This is causing a problem during peak hours, and should be given consideration in the computer field.

The Taiwanese government, which controls both communication and power generation, is aware of both these problems and the new economic plan reflect virtuous effort on its part to resolve them. However, any effort today must pay special attention to both problems.

The life span of capital expenditure items is longer than that in developed nations. This tends to put more importance on long range planning, since a decision to buy a certain equipment will have a longer influence on the organization. As such, a long range planners must increase their effort in studying potential changes in technology and predicts more accurately those viable trends. The Taiwanese government, realizing the importance of the information processing field, is financially supporting organizational efforts. However, there is a limited pool of funds and long range plans must be more rigorous than their counterpart in developed nations.

The cost of labor is less in developing nations, a trend which is rapidly being reversed. However, it is still true in the information processing field and it is of paramount importance that managers take advantage of this fact specially in long range planning.

Finally, there is a language problem in the computer industry. Computers are the product of western countries where Latin based languages are spoken, e.g., English. Software packages have to be customized for each country's language. This effort is time consuming and costly. With each new version of a software package, a customization effort is needed. Some developing nations are trying to establish their own software development center. However,

this effort is still in its infancy and requires managerial and government support.

E. OVERVIEW

1. Historv and Objective of the Computer Center

In 1982, two schools, a general management school and a financial management school, merged into one college. The college consists of five academic departments and one graduate school, plus other necessary administration departments. It offers a number of management programs including a Bachelor/Master degree and management training courses.

The computer center, one of the support departments in the college, offer a wide range of services to satisfy the general computational and information processing needs of the educational, research and administrative programs. Among these are:

1. Support of the compuitional requirements of the college mission.

2. Advise the educational, research and administrative departmental management on the adequacy of existing automated and manual systems, and feasible alternatives--in our case, the Computer center plays a key role in the whole organization, one of the organization's policy is to develop an effective information environment itself, so any department within the organization should support their S.O.P. (system operating processes) to the Center, includes the existing manual system which prepared to convert to automated system in future.

3. Formulate long- and short-range plans to identify, develop, and implement cost-effective solutions related above a,b.

4. Assure that approved plans are implemented in a cost-effective manner, from systems definition to acquisition and utilization of DP equipment.

5. Audit information systems to ensure that they continue to be cost-effective.

All of the equipment and services of the Center are available free of charge to students, faculty and staff in connection with official College work.

2. **Organization of the Computer Center**

The Computer Center, after two reorganizations in 1982 and 1983, is divided into three main groups; Operations, User Services, and Systems Support. The Operations group is responsible for all processing services and the efficient operation of the equipment. It is aided by an IBM equipment maintenance contract. The user services Group is staffed by professional programmers who are responsible for providing technical assistance to the Center's users. These services include: Consulting, Program Libraries, Documentation, Programming Assistance, Educational Services, and Microcomputer Support & Services. The Systems Support Group, supported by a contract with IBM, is responsible for providing technical assistance and maintenance of system software. Presently the Computer Center is headed by a Director, a member of the faculty. The Director is responsible to the dean directly

Most of the services provided by the Center are based on IBM 370 series, which supports both high-volume batch processing and general-purpose timesharing at local or

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remote terminals.   Figure 1.1 lists the major hardware/
software available at the center.

     Hardware of the Computer Center

         IBM 4361 (1)

         Data General minicomputer (1)

         IBM 5550 series; Chinese version (18)

         IBM PC AT/XT (21)

         IBM PC clones (82)

         APPLE series (5)

         Others (4)

    Software

         CAD/CAM software package, Programming Languages,

         Simulation,Statistics, General Libraries,

         Specialized Mathematics, Text Processing,

         Graphics, Accounting and Control.

    Figure 1.1   Major Hardware/Software in the
                Computer Center

The equipment contract will expire next year and the
center is in the process of launching a study to determine
its hardware requirements.

F. METHODOLOGY

This thesis research based on:

1. The management theories.

2. The author's experience in different positions at the military college computer center.

3. Interviews with managers, staff of a number of computer centers in various colleges in the United States.

G. SCOPE

A comprehensive treatment of computer center functions and activities, requires more space that what this thesis allows for. Hence, it will concentrate on a few basic and paramount issues such as performance evaluation of the computer, a methodology to determine the computing needs of the organization, vendor evaluation, facility design and security, documentation, organization structure for effectiveness.

The topics were chosen based on a number of interviews with several computer center. Most computer center personnel have had no opportunity to get acquainted with one or more of the topics discussed. They understandably will be hesitant to perform the new techniques introduced without adequate guidelines. Which may lead to some managers reject certain recommended techniques only because of poor prior experiences.

This brings us to the main point of the thesis. To be of value to a computer center, it is not enough to

intellectually agree with the worth of what is presented on the textbooks: To be of value, precepts must be put into practice. This thesis will study some practical solutions to help the director or staffs to improve the effectiveness of the Computer Center operations.

The specific research areas to be investigated include:

1. The history of the Computer Center.

2. Study of the generic components of the Computer Center (based on EDP or MIS)--hardware/software/operations.

3. Research of organizational relationsk.ps.

The research questions are:

1. What are the major objectives of the Computer Center?

2. What are the most important problems of managing automated resources in the Computer Center (or the same type of computer centers in Taiwan R.O.C.)?

3. How should the following resources be managed to maximize their effectiveness?

   a. computer hardware component,

   b. computer software component,

   c. manpower resources,

   d. operational resources.

H. ORGANIZATION OF THIS THESIS

This thesis is divided into seven chapters. Chapter II--Evaluation of existing system and identify new system requirements: discusses methods to determine the requirements and attributes of a computer installation. Chapter III--Vendor evaluation and Facility design:

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identifies a new methodology in choosing vendors and how to plan for a medium to large data processing installation. Chapter IV--Operations: discusses the most important operations within a computer center including operations documentation and production control. Chapter V--Staffing: discusses position requirements, recruiting, career progression, motivation, and performance evaluation. Chapter VI--Computer and Data security: covers the major security vulnerabilities and threats which may damage, alter or destroy a computer operation's hardware, data, or personnel. Finally a brief conclusion is included in Chapter VII.

The purpose of this thesis is to discuss and research a practical solution, based on theoretical as well as professional experience to improve the effectiveness of computer center management. There are no definitive answers to the problems discussed above, but we still must try to solve these problems as well as we can. For practice purpose, the thesis use a specific military college computer center as an example, and will recommend a number of practical solutions that may be used to improve the management of automated resources of the specific Computer Center.

II. PLANNING

A. OVERVIEW

Long-range systems planning is like an apple pie: everyone claims to believe in it, but few can make a great one. [Potter, 1987, p. 113]

Organizations require three types of plans: Strategic, Tactical and Operational. A strategic plan shapes the objectives and goals of the organization. A Strategic plan seldom changes over time. It should identify the general path, or intenTs, of the organization. Each department should have its own strategic plan which satisfy and support the organization's. A system plan must fit the business plan. This is one of the most important concepts in a Computer Center. Without full knowledge of the expected long range changes in the organization, no computer center can effectively and efficiently satisfy the computational needs.

Unfortunately, computer centers confuse long-range systems planning with capacity planning or systems development or even simple budgeting[2]. A strategic plan should and must not be that specific. For example, a strategic plan, albeit naive, may be a commitment to utilize

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[2]Doug Potter, "Long-Range System Planning," _DataMation_, May 13, 1987, pp. 113-116.

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the latest technological offerings. Another, and a more realistic example is a commitment to reach a paperless organization. This in fact is one of the strategic objectives of the United States Navy.

Based on the strategic objectives of the organization several plans must be developed, each covering a specific time span and must be based on the more general one, i.e., a one year plan must be developed in accordance with and after developing a three year one. Each plan must consider three major items: Software, Hardware and Manpower Requirements, and for each of these, the plan must consider the issues identified in Figure 2.1.

A computer center plan, which must be well document in a professional manner, may be defined as the development of information processing resources over a specified period of time in a manner that supports organizational growth and development [Potter, 1987]. It must include an objective, an estimate the information processing requirements over the plan period. An estimate of the computing resources requirements over the same period, as well as alternatives and trade-offs and recommendations for the cost of the acquisition of these resources. Finally, it must include criteria and milestones to evaluate the execution of the plan.

One of the important questions to consider when developing a plan is the length of time a plan should cover. Data

A.   Issues to be included in a plan:

1)   Evaluate the current system's performance and capability.

2)   Determine the current workload and resource utilization.

3)   Develop a current workload profile.

4)   Estimate future data processing requirements.

5)   Identify resources expected to be available in future.

6)   Develop a plan to cost/effectively meet the requirements.

7)   Document and communicate the planning results.

B.   How to determine current workload and resource utilization?

1)   Survey the work processed by time of day, week, and month.

2)   Determine resource utilization.

3)   Identify peak and non-peak periods.

4)   Choose periods for workload profile preparation.

Figure 2.1   The Planning Process

processing requirements can not be predicated with acceptable certainty beyond two to three years, beyond that estimates are a judicious combination of a projection of current requirements, educated guesses, allowance for the unforeseeable, and for the organization management style. On the other hand major hardware and software items may require five to ten years to justify their cost and to

minimize significant user eduction. Therefore, long range plans need consider resources that are state-of-the-art not only at the time of planning but also in the future.

The computer center strategic objectives were identified in the previous chapter. However, due to recent developments in the information processing field, a new objective should be added. That is a commitment to develop the computing environment to support a paperless organization. This objective satisfy a number of the college objectives. For example, it allows the college to be on the forefront of management concepts, and to offer its students a leading example in management techniques. It also reduces the cost and time taken in decision making.

To achieve this objective, the center must introduce a number of changes. The adoption of a new type of computing, that is networked/distributed[3] computing. This decision must have the support of all management levels in the college. It will also require a commitment to distributed computing during the software design and development phases as well as careful long and short range planing.

The computer center in our case has a major advantage since it is the department responsible for investigating which of the manual systems is candid for computerization.

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[3]The term distributed is used here to describe an environment where employees have access to computers and they can use it to communicate with each other instead of using official memo, etc.

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It also is responsible for the design and development of the computerized system. As such, the center can for all practical purposes, develop a fairly accurate long range plan.

A second important issue deals with the span of the plan. Technological developments in the computer field is rapid and prevents planning for more than five to seven years. Several authors[4] recommends a strategic plans covering ten years and the tactical plan to cover five years. Both of these estimates are reasonable since they commit the computer center to a specific strategic objective, e.g., commit to develop systems which can be implemented in a distributed computing and networked environment, while allowing it the flexibility to schedule the acquisition of the various hardware based on the budget constraints.

B. COST JUSTIFICATION OF CURRENT AND FUTURE COMPUTER
RESOURCES

There are numerous methods used for evaluation and cost justification of computers and information systems. Instead of listing them, we will concentrate of a single new method. The interested reader is referred to [Shoval and Lugasi, 1987, pp. 117-129.]

Of special interest to the center activity is the cost justification of the office systems. Traditional cost

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[4]See J. Martin, Distributed Processing Systems.

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justification methodologies have concentrated of labor cost savings, i.e., manpower reduction. Today, this type of argument can not be used for a number of reasons. An important one is the fact that the Information Systems improve the productivity of employees instead of reducing the manpower. The following section outline a methodology[5] which can be used in measuring cost savings due to improved productivity.

The method classifies the employees into categories, e.g., Managers, Senior Professionals, Junior Professionals, Administrators, and Secretaries. It also identifies the type of activities each category executes, see Figs. 2.2 and 2.3.

	Mgmt & Supv	Spec Prof.	Rout. Prof.	Admin Supp.	Cler'l	Non Prod.
Managers	30%	16%	13%	16%	7%	18%
Sr. Prof.	2	35	26	13	12	12
Jr. Prof.	1	10	50	13	14	12
Admin.	0	0	1	58	27	14
Secr.	0	0	0	10	76	14

Figure 2.2 Work Profile without New Office
           Automation System

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[5]P.G. Sassone, and A.P. Schwartz, "Cost-Justifying OA," Datamation, February 1986.

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	Mgmt & Supv	Spec Prof.	Rout. Prof.	Admin Supp.	Cler'l	Non Prod.
Managers	35%	20%	15%	15%	5%	10%
Sr. Prof.	2	42	29	11	8	8
Jr. Prof.	1	15	55	11	10	8
Admin.	0	0	1	65	25	10
Secr.	0	0	0	12	78	10

Figure 2.3   Work Profile with New Office
            Automation System

The next step is to calculate the cost of labor prior to the implementation of the new information system. Assume in our case that a manager annual salary is $60,000, i.e., $50 per hour. However, since a manager does not spend 100% of his time in managerial activities, there is an implicit value for the managerial work that is different than that of the $50 per hour. Assuming that the employees average $45, $40, $30 and $20 per hour, one can calculate the implicit cost of each activity, as seen in Figure 2.4.

Solving the matrix in Figure 4 gives the implicit value for each type of activity, i.e., $83.99 for management, $65.11 for specialized professionals, $48.75 for routine professionals, $41.15 for administrative personnel, and $20.90 for secretarial help. Using these values we can calculate the increase in productivity due to the information system. If the cost of the new system is greater than the increase, then the system should not be implemented.

	Mgmt & Supv	Spec Prof.	Rout. Prof.	Admin Supp.	Cler'l	Non Prod.		
Managers	.30*V1	.16*V2	.13*V3	.16*V4	.07*V5	.18*V6	=	50.00
Sr.Prof.	.02*V1	.35*V2	.26*V3	.13*V4	.12*V5	.12*V6	=	45.00
Jr.Prof.	.01*V1	.10*V2	.50*V3	.13*V4	.14*V5	.12*V6	=	40.00
Admin.	0	0	.01*V3	.58*V4	.27*V5	.14*V6	=	30.00
Secr.	0	0	0	.10*V4	.76*V5	.14*V6	=	20.00

Figure 2.4   Value/Labor Matrix

III. EVALUATION OF EXISTING SYSTEM AND IDENTIFYING OF NEW SYSTEM REQUIREMENTS

A. INTRODUCTION

The computer center, as a service organization, is responsible for providing the user the best performance possible in the most efficient manner. This means satisfying user requirements and needs. The user satisfaction is usually measured in time units and the ease with which he/she can achieve their objectives. For example, turn around time, response time, time since he requested addition of new software till the time the software is available, and how easy it is to use this software-man machine interface. The center has to be able to translate these requirements into machine capabilities, and has to make sure that the machine is being efficiently used. This section studies both aspects and introduces methods to implement them.

Performance evaluation, when effectively employed, has contributed substantially to bringing down the cost of data processing while increasing the level of user satisfaction. Unfortunately, only a small fraction of the organizations are using performance evaluation effectively. The large majority either are not using performance evaluation at all or are deriving, at most, only meager benefit from it.

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The basic reasons why so many organizations are not enjoying the benefits of performance evaluation appear to be two fold: First, data processing managers are not sufficiently knowledgeable of the contributions to cost reduction and improved user service that performance evaluation can make, and therefore, they are not demanding a cost-effective performance evaluation activity. Second, the data processing department management, unit and/or reporting level within the organization, are inhibiting a cost-effective performance evaluation activity.

We find that the management and organizational factors which appear most important in determining whether the potential benefits of performance evaluation can be realized are:

1. The organization of the data processing department.

2. The position of the data processing department within the organization.

3. The knowledge, effectiveness and interest of the senior data processing manager and/or the top level managers within the organization.

4. The human and computer resources dedicated.

5. The effectiveness of communications within the data processing department and between it and the users of services.

6. Whether 'real money' is charged for data processing services (especially for the government or military organizations), i.e., in our case the Computer Center one may classify performance evaluation into two areas; the first deals with identification of new system requirements and attributes and the second studies the existing system performance. Performance evaluation of existing systems is a continuous process which has to be performed on a periodical basis. The

computer is a dynamic environment, new users are added practically on a daily basis, existing users utilization pattern changes as more programs become available and as user requirements changes.

B. IDENTIFICATION OF NEW HARDWARE REQUIREMENTS

Requirement Analysis begins from "the primary functions" provided by the system, then generate the I/O data-transfer requirements. If some functions are lack of information, we have to make some assumptions, and follow the detailed functional analysis. Following I/O requirements analysis, we can derive a I/O machine that meets the requirements or at least the performance requirements of the computational requirements for the system environment [Thurber and Patton, 1983]. This section outlines the input needed to start the process and a systematic methodology to carry it out.

Requirements are constraints that the system must satisfy. They specify what the system must be able to do. Attributes are constraints or options and user desires that a good system should, and not must, satisfy. The system study must identify both requirements and attributes. The process of identifying requirements is divided into two phases: requirements analysis and requirements synthesis. Each user needs and application functional requirements are analyzed, projection of future needs, and the important functions identified

The next step is to translate the identified needs into requirements and attributes. Requirements may be defined in

terms in computational speed, I/O and memory requirements[6]. For example, assume that a system collects input from a number of terminals simultaneously. The key entry person can type X characters per minute and the screen consists of Y characters. We should also assume a certain refresh rate for the screen and whether each monitor has its own memory or whether it accesses the main computer memory. The next step is to calculate the computational, processor speed and memory requirements of the system.

In real memory systems, the main memory space requirement is the sum of resident supervisor, table, user program, and buffer space. Determining the supervisor space needed usually requires assistance from the vendor and other users. For a new product line bench marking may be necessary. The main memory space for a user programs is estimated using the average residence requirement per user program and the maximum level of multiprogramming needed to achieve the required performance. For example, suppose that, during batch production, an average multiprogramming level of four jobs has to be maintained to achieve the nightly job throughput. Depending upon the job arrival rate and job scheduling, there may be periods when seven jobs must execute simultaneously. If each job required an

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[6]See K.J. Thurber P.C. Patton, Computer-System Requirements, Lexington Books, 1983.

average of 200,000 bytes, 1.4 million bytes of main memory would be needed for user programs.

The real memory space requirements for virtual memory systems is somewhat more complex to estimate than for real memory systems. In virtual memory systems, pages are only removed from real memory when more space is needed by the operating system or a user program. Therefore, real memory is almost always 100% utilized. Here the important space measure is the relationship between the space available in real memory and the paging rate for a specified level of throughput rate and turn around time.

This process is carried out on all the available systems and the one expected to be installed during the life span of the hardware, for future systems certain assumptions must be made. The next step is to combine these calculations based on the time of day and number of users, etc. The result identify the specific system computational requirements. The same process is repeated for other requirements and trade offs are made.

Some of the issues which must be addressed during this phase are:

1. Processor Speed.

2. I/O capabilities.

3. Percentage Utilization of resources.

4. Cost/Performance ratio.

5. Memory Size.

6. Availability of Software.

7. Availability and Capability of Operation System.

8. Type and Availability of Peripherals.

9. Flexibility.

10. Expandability.

11. Bus Complexity.

12. Executive Complexity.

13. Availability.

The next step is to identify those characteristics that the system must have, Requirements, and those that the system should have, Attributes. A technical specification is developed and used in the request for bids.

C. HARDWARE UTILIZATION EFFICIENCY

The performance evaluation is a continuous process which measures current workload and resource utilization in order to assist center management in determining the system's current capability, the required future capabilities and to prevent potential bottleneck.

The efficiency of hardware utilization is performed using specialized software packages, called monitors, which not only identify areas requiring reviews in the software and hardware, e.g., reorganization of disks, but also system utilization charts which may be used to investigate growth pattern and to recommend updates.

A system performance analysis requires carrying out the time, space and allocation analysis. Usually, it is

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advantageous to carry out the time analysis first. Typical measurements are the percent busy of the processor and other devices, the systems throughput, average throughput rate, and turn around time.

The space analysis measure the ability of the main memory and secondary storage to simultaneously store the data, the software code, and the user program code needed to meet the performance requirements. The allocation analysis measure the efficiency of allocation of the system.

Other typical measurements are work load to be processed and turn around times to be met by month, day and hour. Periods of heaviest processing loads and shortest turn around time requirements are of special importance.

IV. VENDOR EVALUATION AND FACILITY DESIGN

A. INTRODUCTION

Early computers were stand alone systems. A company owned a machine which was located in a special room. One had to literally go to that room with a box of punched cards containing the program and data to run it. As more users started utilizing computers and terminals appeared, the development of terminals caused user dispersion, which increased with time in two different directions, remote terminals and personal computers. Today there is a strong trend towards combining terminals and personal computers into one entity. This trend is heading towards what one may call cooperative computing or distributed computing. The term means using a personal computer to execute those tasks where a personal computer is superior and a mainframe for those tasks where a mainframe is superior, while keeping a communication line between the two machines. The major software vendors have either produced or announced their support for this type of computing, for example Lotus Corporation have announced a spread sheet, to be released late this year or early the next, for the mainframe. It also has announced a blueprint for communication between different software packages. Ashton Tate, and numerous other data base management system vendors, have announced

their support to SQL, a main frame data base language and file structure. WordPerfect corporation supports multiple version on several computers, ranging from main frame to micro computer, of its popular word processor. Needless to say that all these companies support net ork versions of their packages.

The point the previous argument is underscoring is simple. A new type of computing is just around the corner. This type of computing will consists of personal computers on users desks. These personal computers will be grouped together using networks and all will be connected to the mainframe. Software packages will reside in the personal computers as well as the mainframe and the decision on which computer will execute which part of the program and where is data files will reside will be intelligently determined by the computers.

For a system such as the one described to succeed, the decision to choose a computer must be altered to a decision to choose a family of computers. One cannot overstate the importance of this logical change for a country like Taiwan where capital expenditures have a greater impact on strategic decisions than in a country like the United States.

One consequence of such a change is that a choice of vendor must now be determined not only on the

characteristics on a specific machine a vendor is offering, but also on his line of machines.

B. COMPUTER-FAMILY SELECTION METHODOLOGY

As computers continue to drop in cost, increase in power, and become more widely used, it is essential to develop new methodologies for the selection process. Computer systems have become more complex and in many cases require periodic reconfiguration to upgrade them. Management and DP staff must, therefore, adopt a new philosophy and techniques to adapt the selection process to the information systems policy.

It is necessary to change from "conventional" selection procedures to new methodologies that are more flexible and lead to a better solution of the organization's information problems. One such method is the selection of a computer-family.

The basic definition of a computer-family is,

A family of computers of the same type, consisting of several models from the same manufacturer's product line, ranging from microcomputer to mainframe, with full compatibility in the operating system and the system's software, to enable transfer of application software from one family member to another without changes.

Selecting a computer-family will enable the organization to better implement its DDP policy, and provide it with more capabilities.

A generic evaluation and selection methodology has been formulated to meet the specific demands of selecting a computer-family (Figure 4.1).

1. Identification of possible vendors and manufacturers.

2. Primary elimination of irrelevant candidates.

3. Determination of mandatory requirements.

4. Examination of vendors' compliance with mandatory requirements.

5. Setting quantitative and qualitative criteria and respective weighing scale.

6. Writing the RFP to be addressed to selected vendors.

7. Receiving, comparing and analyzing bids.

8. Concluding final list of vendors.

9. Performance of hardware and software benchmarks.

10. Drawing final conclusions and selection of best computer family.

Figure 4.1 Selecting a Computer-family: Work Flow Diagram

C. SELECTION PROCEDURES

On the surface, hardware and software acquisition decisions are the sole responsibility of the computer center manager. However, two factors effect this decision: Externally, there are armies of salesmen from the various vendors; Internally, there are the demands of users for processing power and from the technical staff for the latest advancements. The computer center manager must not delegate

the responsibility for establishing acquisition policy, determining the evaluation criteria, and controlling the thoroughness of the evaluation. It is important that the acquisition does not deviate from the strategic/tactical objectives of the Center. Management control should assure that the entire acquisition process is done with more precision and thoroughness than it customarily receives. That is the goal: To make the progress precise and thorough.

The acquisition procedure consists of five phases, [Schaeffer, 1987, p.144]:

1. Preparatory steps: forming an evaluation team.

2. Obtaining proposals: including (a) Prepare if necessary, request for information, (b) prepare request for proposals, (c) conduct bidders conference.

3. Evaluating proposals: how to select vendor?

4. Financing the acquisition.

5. Negotiating the contract.

In actual practice, financing and contract agreements affect evaluation and selection, as such we will limit the discussion to the first three phases only.

1. <u>Preparatory Steps</u>

Selecting computing equipment is a process of matching the desired functions to be performed against the capabilities of alternate configurations (Figure. 4.1). The first step was discussed in the previous chapter.

First step is that you have to find out wnat you
need. This has been discussed in Chapter II. It seems very
easy to do this job; in fact, it's not. The second step is
to study what vendors offer. After this step, state your
needs to vendors.

2. **Obtaining Proposals**

To obtain proposals to meet user requirements,
requests for proposals (RFPs) are prepared by users and
submitted to vendors. When many vendors are being
considered, an excessive amount of time may be needed to
evaluate RFPs. Some vendors are likely to be eliminated
because of doubts about their reliability or their inability
to provide services wanted. Other vendors are eliminated by
considering their ability to meet mandatory requirements (a
requirement that vendor must be met, without any
exceptions). RFPs must include the following:

1. Statement of purpose.

2. Deadline for proposals.

3. Date for the bidders conference.

4. Mandatory requirements.

5. Desirable requirements.

6. Request for proposal specifics.

7. Request for user-support requirements.

If too many vendors still qualify, they can be narrowed
further by obtaining more information by issuing a request
for information.

3. <u>State Your Needs to Vendors</u>

When we study many cases we find some problems arise in Computer Center because of the unadvised procurement specifications for new equipments, so it is very important to spell out clear procurement specifications to give bid guidance to suppliers, making sure to include coverage of areas of usage, job schedules, hardware, software communications, maintenance support, education/training and bid terms. It is the responsibility of the center to insure that vendor proposals in response to the procurement specification serve as the basis for sound decisions. The specification must therefore be as clear as possible in identifying system objectives and in accurately defining the set of performance requirements and attributes and the acceptance tests to meet these objectives.

D. HOW TO EVALUATE VENDOR PROPOSALS

To evaluate vendor proposals, review proposals on the basis of such factors as pricing, fit of proposed equipment to specific needs, future growth potential, vendor qualifications, equipment maintenance, installation, assistance and delivery, etc. Here we suggest the direction your rating analysis might take:

1. Vendor qualifications.

2. Differences in hardware implementation.

3. Software architecture.

4. Software availability.

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              ┌──────────────┐
              │ PERFORMANCE  │
              │ REQUIREMENTS │
              └──────┬───────┘
                     │
┌────────────┐  ┌────┴─────────┐  ┌─────────────┐
│  WORKLOAD  │──│   INITIAL    │──│   BUDGET    │
│PROJECTIONS │  │CONFIGURATION │  │ CONSTRAINTS │
└────────────┘  │ PARAMETERS   │  └─────────────┘
                └──────┬───────┘
           ┌───────────┴──────────┐
           │ CONFIGURATION PROGRAM│
           └───────────┬──────────┘
    ┌──────────────┐   │   ┌──────────────┐
    │PREDICATED vs.│   │   │   SYSTEM     │
    │   ACTUAL     │   └───│              │
    │ PERFORMANCE  │       │SPECIFICATIONS│
    └──────────────┘       └──────────────┘
┌─────────┐   ┌──────────────┐   ┌──────────────┐
│  FINE   │───│ INSTALLATION │───│ PERFORMANCE  │
│ TUNING  │   │              │   │  MONITORING  │
└─────────┘   └──────────────┘   └──────────────┘
```
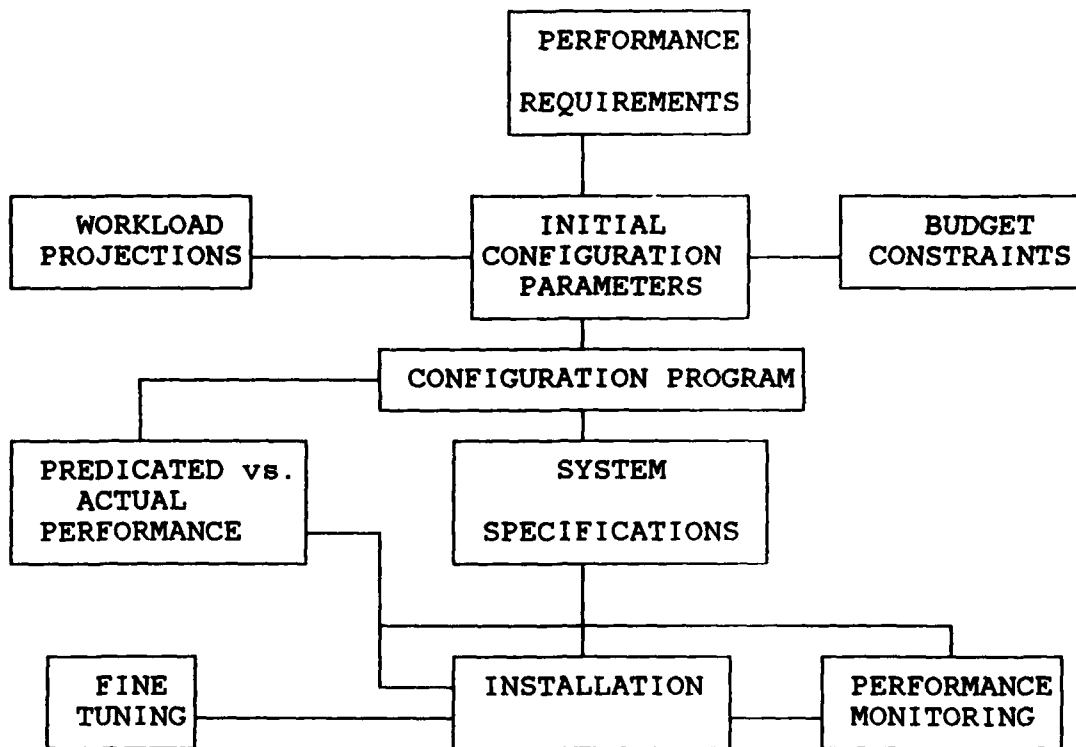
Figure 4.2   A Process View of System Configuration

5. Reliability and field engineering support.

6. Price/Performance.

7. Future growth potential.

8. Equipment compatibility.

9. Risk factors.

10. Scoring system and the preferred alternative.

11. Rent, lease, purchase decision.

E. FACILITIES DESIGN

In this section we will briefly introduce the basic
principles of facilities design which includes

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preinstallation planning, building requirements, environmental requirements, magnetic recording media storage, safety and fire precautions. In some cases, vendor will support proposals to help customer design their facilities, such as IBM wiring proposals.

1. **Preinstallation Site Planning**

Detailed planning and coordination are essential for the successful installation of a data processing system. The process may be divided into a number of sequent steps.

a. Establish Planning Group

Depending on the size of the system, user may establish a preinstallation consulting and service group which includes computer vendor representatives, engineering consultants, and other consultants. This group will consult with and advise the Computer center manager on the course of action, objectives, and progress of installation. The manger will be in charge of overall operation and will coordinate the physical planning with the procedures and general planning.

b. Location

User must decided on a suitable location for the computer area. Suitable facilities for installation may exist in some user's offices; while in others, minor or major changes to existing space will provide a suitable location. In the real world, we see that the location always decided by the manager of Computer Center (in spite

of other people's opinion), as the results, the unadvised decision will affect the operation of whole systems.

    c.   Schedule

When we study the DMC case, we see that because each data processing machine installation will differ in some respects from every other installation, and it is not possible to provide a detailed schedule. However, the manager of computer center still have to notice it and prepare an adequate schedule.

    2. **Building Requirements**

The computer vendor will have a representative available to assist in selecting a suitable area. If the installation of the system requires a new building design, or if the existing space is to be altered radically, a suggested machine layout should be made prior to any building planning.

In selecting a location for the computer installation, consideration should be given to the following:

1. Availability and location of proper and adequate power (including standby power where required).

2. Space to house air conditioning equipment (compressor and air handing location and placement of cooling tower or evaporative condenser).

3. Ceiling height, outside wall area, and glass area, because these factors will affect the ease of air conditioning the area, and maintaining the required humidity.

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4. Work flow to other areas such as academic department, etc.

5. Proper safety and fire prevention procedures.

3. Environment Requirements

Temperature and humidity in the computer room must be controlled within the limits given by the manufacturer. These limits are not the same for all computer cabinets and peripheral devices. The requirements of all equipment in the system must be considered in determining the temperature and humidity limits for the installation. The details will not be discussed here.

4. Magnetic Recording Media Storage

In determining the layout of computer system, the user should consider the requirement for storing magnetic tapes and disk packs. Tape reels should be stored vertically in steel bins; disk packs should be stored horizontally (never vertically) in steel cabinets. The reels of tape and disk packs should be stored in self-sealing cases for protection from dust and sharp environment changes.

Usually most of computer centers do this job very well, but for the computer center one problem is "how long will keep these tapes and disk packs (back up periods)?" There is no positive answer to this problem, it depended on different conditions. For the manager he should set up a cost-effective policy.

5. **Safety and Fire Precautions**

Safety is a vital factor in planning for a large computer installation. This consideration is reflected in the choice of a computer location, building materials used, fire prevention equipment, air conditioning and electrical systems, and personnel training. Specially for the very important data you should consider different storage place in case of accident happens (for example fires).

G. THEORY

In the early part of the century, Henri Fayol--a French industrialist, wrote that all managers perform five functions: planning, organizing, commanding, coordinating, and controlling. Today the most popular management functions still continue to be organized around four basic functions: planning, organizing, leading and controlling [Robbins, 1984]. This theory also can be used in computer center management.

In the late 1960s, Henry Mintzberg undertook a careful study of five executives at work. Based on his observations of actual managers on the job, he concluded that the management roles can be grouped as interpersonal roles, informational roles, and decisional roles [Robbins, 1984, pp. 6-7].

Management is both a science and an art. College course work covers the science of management, the art is learned on the job [Robbins, 1984]. This thesis combines the theory of

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computer center management and practical experience in that field.

This section of the thesis discussed a new approach in hardware selection process. This approach combines the requirements set due to new developments in the computer industry, such as networks, and the needs of developing countries. Prior to describing the approach, the next two sections outline those developments in technology and some of the unique characteristics of developing nations.

V. OPERATIONS

Information management is a complex and highly diverse activity. Not only it concern the management of wide variety of types of information (from operational data to high level analysis) but it must also provide many different types of access to the same information (from the simple compilation of data to complex, selective ad hoc data inquire). Such diversity can make the information manager's job extraordinarily difficult [Blair, 1984, pp. 1-23]. Especially for the manager and/or staffs of a computer center, the operations of a computer center are so complex and highly diverse activities. For most computer centers the problem is how to control operations effectively.

This chapter discusses the most important operations within a computer center--operations documentation and production control, which plays a key role in establishing standards and procedures of a computer center.

A. OPERATIONS DOCUMENTATION

Documentation is formalized, detailed records which describe the systems and procedures for performing a computing processing task. It is a means of communicating the standards for the system, the essential elements of the system and logic followed by the programs.

There is no doubt that documentation is an "additional cost" in both the area of origination and maintenance, and an workload to the employees, so it is frequently neglected. When an analyst is required to adhere to a rigid schedule, he "cut corners" by eliminating extensive documentation. A written record is necessary for the programmer and analyst will be tied to the system forever. This is a hidden cost that no efficient center can stand. In cases where documentation has not been maintained, there are frequent returns involve and program modification costs go up.

1. **Purposes of Documentation**

Some of us view documentation as records or papers only. It's not true, because there are many other uses of documentation, such as the following:

1. Management Tool--As a management tool to provide the necessary material to review a new system or program.

2. Communication Linkage--Simplify program revisions by providing details in support of each program, and since the most cost (80%) is the maintenance cost, program documentation can reduce the whole cost.

3. Reference--Provides the communication necessary for presenting a clear and detailed picture of the new system to all effected personnel.

4. Aids in instructing new personnel.

5. Documentation Standards--Serves as one basis for an evaluation of internal controls.

2. **Levels of Documentation**

a. Policy

Top management, which seeks to achieve maximum efficiency from it's computer operation, must prepare a

policy statement with respect to systems to be used in he reporting and operation of the business.

The policy should be written and concise and to the point. Too much detail will destroy the intent. The statement should cover the general policy, computer equipment use, and how the policy will be applied.

b.   Procedures [Schaeffer, 1987, pp. 169-188]

Procedural standards must be established by defining clearly and exactly how each job is to be done.

The standard method provides a discipline which reduce training difficulties, increases the effectiveness of review, and provides a basis for performance evaluation.

Implement a standard operating procedure manual which specifies for all personnel the standard methods to be used in the center. This will include standard procedures for system analysis, programming, and operations.

c.   Standards [Schaeffer, 1987, pp. 169-188]

A standard is a rule for the measure of quality in a computer center. Establish performance standards; they aid in planning, controlling costs, and in evaluating performance.

The computer center should also be active in setting standards for such things as:

1.   Common program language.

2.   Equipment selection procedures.

3.   Print character sets.

4. Flowcharting.

5. Documentation procedures.

6. Tape labeling.

3. Operating Documentation Requirements

The documentation requirements will vary according to size and complexity of the system, but a documentation package will usually contain:

1. A cover letter which describes the benefits of the system to management.

2. A table of contents which allows a quick reference to an individual area of concern.

3. Narrative that states objectives and constraints of the system.

4. Flowcharters, data flow diagrams, or data dictionary, etc.

5. File specifications that describe the master file creation, edits, updates, output creation, file clean up, and utility programs.

6. Test procedures including data that will be its alternatives.

7. Performance criteria.

4. Control

a. Review and Approval Cycle

The review and approval cycle for documentation must start early in the life of a system. To assert effective management control over a system and its documentation, checkpoints must be developed where either a management design review or a technical design review take place. The reviews are to provide planning visibility, assure technical quality, and insure timely resource

allocation. No system or job should be put into the production environment without total operational acceptance of the system. A sign-off sheet with signatures from each managerial level within the computer center, should be forwarded to the Director before he accepts the system. Within implementing a system, time for the documentation to flow through this loop must be planned.

b. Audit

When auditing your documentation plan there is some minimum acceptable set of documentation. A general rule is difficult to set but a minimum would include:

1. Problem statement.

2. System flowchart.

3. Operator instructions.

4. Record layouts.

5. Processing time.

6. Approval and change sheet.

7. Set-up information.

B. PRODUCTION CONTROL

1. Nature of Production Control

Many computer managers act as through computer centers are unique and the problems the centers face are unusual and defy standard production control techniques. The fact is that the basic principles of production control do apply to any computer center.

a. Objectives

1. Plan and control computer center resources.

2. Provide service at reasonable cost.

3. Be responsible to user needs.

b. Functions

1. Forecast demand.

2. Schedule.

3. Monitor.

4. Control must be established over the basic operations that need to be performed to process a job. These include: Job initiation, set-up, routing, dispatching and follow-up.

c. Relationship with Input/output

Operations means that you are involved in an input/output situation; therefore, we must exercise control over:

1. set guidelines on user input.

2. provide the user information on computer resources.

3. establish effective lines of communication within the organization and with the user.

4. establish a control system which provides job and resource status at regular intervals.

2. <u>Understanding the Product</u>

When you are operating a computer center, you are in a true production environment just like any manufacturing operation. What you must do is identify your products so that you will know where to place the emphasis for your controls.

Look for deliverable end items; these are your products. Your products may be: time, reports, or service, or you can also provide all three of these end items in various combinations.

3. **User Interface with Operations**

User interface with the computer center will take place at many levels and will run from management down through distribution. A major effort must be expended to control the impact of users exerting pressure on operating personnel to gain preferential service for their job.

a. Define the User

In order for the computer center to respond intelligently to user needs the responsible users must be identified. The source for user identification is the documentation package.

b. User Interfacing Area

In a large computer center you will have many systems that have multiple users who will have interface points throughout the center. This is often necessary but there must only be one point of interface that speaks with authority for all the users of the system when conflicts arise.

c. Controlling User Requests

A central authority should be established in the user community and all work requests must flow through this area. No work is accepted in the computer center without

the proper user approval.   The central area for accepting

work into the computer center should be the scheduling area.

The standard of not accepting work without proper scheduling

authorization is must if you expect to gain production.

4. Distribution

The distribution area is often over looked, but it is

an important part in the computer center process when you

realize that in a large center about 40,000 pounds of paper

are processed a week.

1. The end of the line for all the data preparation,
   processing both human and computer, and control is
   here in the distribution area. If they do not perform
   their tasks correctly and on time, the effort of all
   other areas is wasted.   The primary functions are:
   decollating, bursting, packaging.

2. Distribution must be prepared to communicate with the
   user community and with the I/O control, scheduling,
   and programming departments.   The primary question
   will concern job status and final quality checks by
   I/O control.

5. Quality Control [Garvin, 1984, pp. 25-39]

Control over quality in the computer center is not

just having correct programs but is established by a series

of controls which are applied at each stage of processing.

1. Standards--Quality will be improved if the computer
   center has established standard procedures which are
   followed by all personnel.   The center's standards
   should cover programming practices as well as
   operating and control procedures.

2. Procedural standards define clearly how each task is
   to be done.

3. Performance standards are used to aid planning and to
   evaluate performance.

4. The production control function consists of activities which monitor the processing and insure that no data is lost or mishandled.

   6. <u>Responsibility</u>

1. The primary responsibility rests with top management who must review organization and control practices, and evaluate the performance of the computer center. You as computer center managers, must keep top management informed as to your needs and the state of the art so that wise decisions can be made.

2. Systems and programming have the responsibility of defining the type of controls and the check points for each new system they install.

3. Quality control does pay off in improved and satisfied users.

4. The responsibility in the computer center starts when data is received in the input area, where it is logged and batched, and then moves to data preparation, and then back to input control, processing, output, and to distribution. Usually the input and data preparation areas are the most vulnerable to error.

VI. STAFFING

Important influences on individual behavior and motivation are [Ivancevich & Matteson, 1987]:

1. Individual characteristics.

2. Individual motivation.

3. Rewards.

4. Stress.

The Computer Center must project a professional, well-rounded image. This is done primarily by its staff [Kutnick, 1985, p. 15].

This chapter discusses position requirements, recruiting, carer progression, motivation, and performance evaluation as they relate to the computer center. Upon completion of this unit, you will have acquired an understanding of the types of positions and activity required to staff a computer center. You will also understand the process of career progression and the role that training plays in this process. In addition you will understand the concepts of motivation and performance appraisals and their goals.

A. POSITIONS REQUIRED

In the establishment of a computer center, great importance should be placed on the requirements for the positions at every level within the organizational

structure. Running a computer center is a very technical operation. In most areas, even in the lower levels of the organization, the personnel must be highly trained and techincally oriented. The higher you go in the organizational structure, the more important it is that the people who fill these positions, in addition to having a large amount of technical knowledge and skills, are extremely dedicated people with a high level of managerial capability. The successful running of a computer center, and even its survival, is dependent upon staffing at all levels with the highest quality personnel that is obtainable.

1. Organizational Structure

    a. Supervision and Administration

        Special aspects of data processing administration and supervision are as follows:

1. Good utilization of equipment is a constant concern since meeting schedules is very important.

2. A combination of rigid detailed operations and creative development work must often be simultaneously supervised.

3. Supervision of data processing work is very difficult without a thorough knowledge of its technical datails and technical skills used.

    b. Reporting

        The reporting function is an important part of any manager's job. Data processing management faces two special problems:

1. Translation of technical measures of process and performance into commonly understands.

2. Continual reporting on planning and on project performance.

c. Long-range Planning and Project Control

In the early days of a data processing organization, planning, project organization, and project control were the almost exclusive occupation of management. It is the unusual data processing unit in which such planning does not continue to occupy a very important part of the manager's time. Long-range plans are typically subject to periodic and often major revisions. Project must be scheduled and developed within the long-range plan, available budgets, and personnel availability; often in the face of conflicting pressures from the other departments served. Data processing management must keep constantly abreast of new developments in equipment and techniques. to see how these may alter planning.

d. Maintenance of Standards

As in any other function, keeping the standards of performance and product high is extremely important. In the relatively new and constantly growing field of data processing, the establishment of standards and the mantenance of high-quality level demand constant attention to:

1. Recruitment of qualified personnel.

2. Continual traing of new employees and updating the training of old employees.

3. Development of a quantity and quality evaluation system, based on meaningful standards.

4. Definition and publication of job descriptions.

5. Constant review of individual and group performance.

    e. Liaison

The unusual position of the data processing activity within the larger organization--half service, half operating--greatly heightens the importance of the liaison function at the management level. The data processing manager is faced with particularly difficult relationships: he often shares in making decisions that do not relate directly to his own department, and acts as an intermediary with other departments. The problem of translating technical information into management terms is always with him.

Finally, in day-to-day operations, he must act to assure a smooth, timely flow of data.

2. Position Descriptions and Qualifications of Personnel

Why does an organization institute a position description program? What are the reasons for position descriptions? Theses are generally the first questions that arise when the topic of a positive description program is brought up. To give some specific idea of the ways in which position descriptions have proved useful, "composite"

quotations have beem developed from responses to a question on the current uses of position descriptions. These composite quotations do not represent all the ways in which position description programs have developed in precisely the seqence that follows.

a. External Compensation Comparison

Position descriptions provide a foundation on which to compare jobs inside the organization with others outside in order to take full advantage of industry, community, interorganization, interdivision, and other compensation surveys.

b. Internal Compensation Comparison

Position descriptions provide a basis for job evaluation and represent an internal part of a soundly aligned salary administration program, since they crystallize the meaning of the jobs in the minds of the evaluators. Later, revisions of original descriptions are used to detect changes in job content sufficient to justify reevaluating and repricing the job.

c. Performance Appraisal

Position descriptions provide a way to measure how completely and how well the employees is carrying out the responsibilities of the job, his areas of strength and weakness can be located, and he can be counseled accordingly.

d. Management Development

Position descriptions are a necessary part of a management development program because they permit more accurate analysis of the requirements for satisfactorily filling a supervisory position. These "target" requirements then serve as a guide for selecting, training, and developing the men and women who may later fill the job.

e. Recruiting, Hiring, and Placement

Position descriptions are an aid to recruiting, hiring, and placement since they from the basis for written specifications listing the requirements for satisfactorily filling a job.

f. Orienting New Employees

Position descriptions quickly and efficiently orient new personnel to the job and its requirements. They are particularly helpful and comforting to two groups of newly promoted or hired employees: First, those who are placed in freshly created jobs with a description as their blueprint of responsibility and authority, and second, those who have been promoted into new posts embodying duties with which are not familiar.

(1) How to Work? Now that we have reviewed the reasons for using a position description program, let's take a look at the workings of a position description program.

The personnel department develops and maintains position descriptions on all positions utilized

throughout the organization. All jobs being filled should have a current position description on file. It is very important that position descriptions should be updated when responsibilities are added or deleted and reevaluated for the position as defined. Usually the position descriptions should be updated every year (at least every two years).

g. Evaluation of Position Descriptions

Descriptions should be evaluated to pre-established guidelines such as:

1. Education--Measures the basic knowledge or Scholastic Content" (however it may have been acquired) essential as background or training preliminary to learning the job. The background may have been acquired by formal education, by outside study, or by training on jobs of lesser degree. The rating is expressed in terms of equivalent formal education for convenience.

2. Experience--Measures the length of time usually or typically required by an individual with the specified educational background, to learn to perform the duties effectively under normal supervision. In rating a job on this factor, it should be remembered that experience is of two kinds:

    a. Previous qualifying experience on related work or less jobs, either within the organization or outside.

    b. The "breaking-in-time" or period of adjustment and adaption on the specific job itself.

    Both periods must be added together to serve the overall rating experience.

3. Complexity of duties--Measures the complexity of the duties involved, the degree of independent action, the extent to which the duties are circumscribed by standard practice, the exercise of judgement and the type of decisions made, the amount of resourcefulness and planning the job required, the creative effort in devising new methods, policies, procedures or roducts, scientific discoveries and original applications.

4. Supervision received--Measures the degree with which the immediate superior outlines the methods to be followed or the results to be attained, checks the progress of work or handles exceptional cases. Consider the proximity, extent, and closeness of supervision in rating this factor.

5. Errors--Measures the responsibility for preventing errors due to carelessness. Consider the probable effect of errors based on the degree to which the work is verified or checked, either in succeeding operations, by the procedures themselves, or by supervision. Consider the probable monetary loss, damage to equipment, labor, and material costs for correction, customer loss (especially for a military unit), etc.

6. Constacts with others--Measures the responsibility which goes with the job, for meetings, dealing with or influencing other persons. In rating this factor, consider the contacts are made, how often, whether the facts involve furnishing or obtaining information only, or whether they involve influencing others.

7. Proprietary data--Measures the integrity and discretion required in safeguarding proprietary data handled or obtained in the normal performance of duties. In rating the job, consider the character of the data, the degree to which the full impact of the data is apparent on the job in question, whether disclosure would affect internal relationships only, or external, competitive relationships.

Each factor has a weighted point evaluation for each degree. The sum total of all the points from each factor is associated with a particular rate range.

h. Qualification of Personnel

A modern program of employee selection, placement, training, upgrading, and compensation requires adequate position descriptions. Just as the architect, the building contractor, and the engineer must have blueprints before building a construction project, so the manager must have the position blueprints, called "position descriptions"

before he can hire the right employees for the right positions and decide on the proper rates of pay. It is by no means a f i t rule but is included as a guideline. Position descriptions may vary from one computer center to another depending on the requirements of each computer center.

B. RECRUITING--SOURCES OF PERSONNEL

1. Employees--Employees who are seeking advancement and new career paths look for opportunities within their organization. Posting job requistions gives the Personnel Department the communication link to employees and provides them with avenues for greater growth potential.

2. Data Processing School and Other Schools--Schools are excellent sources for entry level jobs and those positions which require specialized training.

3. Advertisements.

C. CAREER PROGRESSION

Career progression or career planning is a process designed to learn more and do more about our people's resources. It is in response to the need for a progress which will encourage and recognize the contribution and growth of individuals within the organization, and to help employees in developing their optimum potential. It is a continuous process involving the employee's participation in his/her professional growth and development.

The real effort must come from the employee. Basically, the manager or supervisor does not develop a subordinate but rather contributes to the subordinate's development. In

this sense, the manager or supervisor encourages and helps the employee to learn new skills, participate in training course, and improve by exposing the employee to more difficult problem-solving and decision-making situations. The manager or supervisor's contribution can probably be best made through the role of counselor or consultant rather than an all-knowing judge.

Today, it is realized that even a university education is inadequate and that additional opportunities must be provided by employees if each employee is to be permitted to grow and realize his potential contribution to himself, the organization, and society.

Upward mobility in the work force is desirable and necessary, and organization sponsored training programs will probably result in upward mobility of employees, so the systematic training programs are very important to a computer center, it can provide assistance in the following areas:

1. Ability to ensure a valuable supply of qualified personnel.

2. Provide progression to employees thereby avoiding career dead-ends.

3. Providing upward mobility, thereby, aiding in development of employee morale.

4. Lowering employee turnover, expanding and raising the caliber of the staff.

D. MOTIVATION

The topic of motivation is broad and unrestricted. Here we will reduce the theories on motivation to a dimension that can be of practical use in carrying out your duties and responsibilities as supervisors. To do this, we will raise and attempt to answer these specific questions:

1. What is a practical definition of motivation?

2. What is the role of supervisor in employee motivation?

3. What are the conditions which best promote motivation?

4. What can the supervisor do to promote good employee morale?

Let's begin by briefly reviewing several key points to the four questions we are attempting to answer.

1. What is a practical definition of motivation? Motivation can be defined in many ways. A practical definition of motivation might be the following: The art of getting people to recognize what needs to be done, to want to do it, to apply their skills in doing it will, and to want to do it willing, cheerfully, and with enthusiasm.

2. What is the role of the supervisor in motivating employees?

    a. Broadly stated, it is the role of the supervisor to maintain the morale of his unit.

    b. Since within the framework of any organization and within the makeup of each employee there are both positive and negative motivating factors, this is not an easy matter.

    c. But by recognizing and interpreting the positive factors of the organization and by identifying the personal goals of the individual employee, the goals of the organization and the goals of the employee can be made more compatible.

    d. This in turn, should improve morale. Through improved morale, the organization in the general

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and the supervisor's department in particular should benefit from increasing employee efficiency and effectiveness.

3. What are the conditions which best promote motivation? Within the limits of some restricting factors, listed below are some conditions which promote motivation in most people:

   b. Proper placement;

   b. Participation;

   c. Challenge;

   d. Competition;

   e. Leadership;

   f. Understanding.

4. What can a supervisor do to improve morale?

   a. Develop a positive attitude toward your organization and your employees. Work on yourself first, get yourself straightened out.

   b. Recognize the negative motivating factors of your organization and the negative emotions, feelings, and personal attitudes of your employees.

   c. Tell your employees why and give them reasons.

   d. Do your utmost to make jobs safe and healthful.

   e. Make a conscientious effort to improve working conditions.

   f. Place your employees where their training and experience can be used best.

   g. Use your employees' ideas, ask their opinion and what they think, develop a "we" attitude.

   h. Always give credit when it is due.

   i. Represent your organization and your employees fairly.

   j. Build up the job, show its importance, show the employee the end product of their efforts, where it goes, what it is used for.

Always remember you are both a leader and a follower. You lead your employees and follow your organization's policies. Look carefully in both directions, see both sides of the coin.

VII. COMPUTER AND DATA SECURITY
[Fighting Computer Crime, Donn B. Parker, 1983]

IBM recently published a two page advertisement concerned with computer security that appeared in many leading American magazines and newspapers. The ad showed a police line-up consisting of four men and a computer terminal. The ad copy was headlined, "The computer didn't do it!" the ad went on to explain that computers can't commit crimes, however, they can be misused. Computer crime, or more accurately, computer-related crime is not just one type of crime; it is a widespread variant of all crime.

This chapter covers the major security vulnerabilities and threats which may damage, alter or destroy a computer operation's hardware, data, or personnel. Upon completion of this chapter, we will be aware of the importance and scope of computer and data security as well as how to plan security into the data processing operation. This chapter will address the following areas of security:

1. Physical security.

2. Personnel security.

3. Contingency planning.

A. PHYSICAL SECURITY

1. Computer Room Location and Construction Considerations

1. The computer room should be located away from radar installations, flood areas, or other possible troublesome exposures.

2. Design the computer room to be located in or near the core of the building. Other walls should be avoided since they are usually more vulnerable. The partitions, walls, floors, doors, and ceilings should be constructed of non-combustible fire resistant materials.

3. All computer and data storage areas should be above grade if possible.

2. Physical Access Controls of a Computer Room

1. Access to the computer room should be controlled by a locked door. This lock can be a conventional cylinder lock, but in many respects various electromechanically operated locks are superior.

2. Access to the computer room should be directly available only to authorized operators, data processing managers having a need to enter, and the security force.

3. Entrance to the computer facility should be through a single door, although additional emergency exists should be provided.

4. Programmers should not have unescorted access to the computer and they should never be permitted to operate the computer. An exception might be made for a few carefully screened hardware and systems oriented programmers to assist operators in case of breakdowns.

5. Access controls should be designed so they do not impede the workflow.

3. Disk/Tape Library Construction and Access Controls

1. The library should be secure with access controls similar to that described for the computer room.

2. The library should be located near but in the computer room.

3. A separate alarm and fire extinguishing system should be installed in the library.

4. An Access to the library should be limited to library personnel only.

5. Authorization by library personnel should be required for users to remove tapes and/or disks.

4. Fire Detection, Notification and Suppression Equipment

1. In the computer room, there should be an alarm system using both ionization-type smoke detectors and rate of rise temperature sensors.

2. A distinct audible alarm should be installed in the computer room to alert personnel in the event a fire is detected.

3. Emergency shut-off switches for air conditioning, electric power to equipment, and fans must be clearly marked and easily accessible within the computer room.

4. In addition to providing mechanical safeguards, employees should be trained to take prompt, effective action to prevent or minimize damage and work interruptions at a time of emergency.

5. Electrical Power and Backup Considerations

1. Electrical power should be stable and adequate and available from at least two sources. That is, power from a local power company should preferably be supplied by feeders from at least two generating facilities with automatic switchover capabilities. In the event of failure by one, the other picks up the load without interruption.

2. Emergency power for lighting and other low power requirements can be provided by a diesel generator.

3. Uninterruptable Power System (UPS) are available utilizing battery and/or generator power. These system are very costly and might be considered for some extremely vital applications.

B. PERSONNEL SECURITY

The only problems with personnel are "people." Preventing and detecting the instigation and perpetration of computer fraud are personnel related problems. Here we will discuss some important areas of personnel security control.

1. Pre-employment Investigations

Character and emotional stability are the key personal factors that effect security. Any in-depth check of all schools attended during adult life, all former employers, and references will usually produce a true profile of the applicant (not only evaluate his technical ability and skills in terms of the job requirements). For further checking, obtain the names of secondary references from those interviewed initial. In contacting such references be certain to inform them that the applicant had not given their names. Local authorities should be contacted to determine if the applicant has a police record.

2. Separation of Duties/Limited Access

1. Access to the computer room should be limited to only those who require it to perform their jobs. This means that only equipment operators, some control personnel, library personnel, and few key programmers would be allowed in the computer area.

2. Where sensitive data are involved, if a single individual has total responsibility, all kinds of crimes can be perpetrated with little fear of exposure. If two are involved, a bargain might be struck that is satisfactory to both parties. If four or more are involved, be very cautious, it may be impossible to show that losses were not the result of coordination or communication problems among the workers.

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3. A strategy should be developed, where possible, such that a concept or piece of data must pass through three people from point of origin to final application. For example, three steps are involved in effective program development: design, implementation, and validation. While a number of a people may be involved in each stage, any specific process will be handled by a specific individual at each stage.

4. It is a good management practice, to rotate personnel assignments from time to time (includes computer operators and other equipment operators). Even though it may involve orientation and learning costs, the protection afforded by the change of personnel far outweighs the transitional costs. If irregularities could be discovered by incoming personnel, it would deter existing personnel from attempting any fraudulent actions.

3. **Personnel Authorization Controls**

Control of changes in programs is a critical area of any computer user's problems. Often associated with such changes is a requirement for rewriting the format or making other major alterations to input or output data files. Both of these areas are subject to possible abuse if not properly controlled.

The necessary elements for good program control are:

1. Written requests for change--Requests require approval of the programming manager and the user.

2. Responsibility for the change must be assigned to a programmer who will implement it.

3. After implementation and debugging it must be reviewed and checked for validity.

4. When certification is given, the introduction of the change must be scheduled, and the date must be documented to provide status for the program.

4. Computer Fraud, Trends and Patterns

1. Computer fraud has rarely been detected by auditing or conventional means. Discovery has usually been by sheer accident, and since it is impossible to say how many accidents have not happened, no one knows how high the annual take really is. Further, many cases discovered are never openly disclosed because of the embarrassment such a disclosure might bring to the victim.

2. Most computer frauds are detected only when either the system malfunctions, or the individual committing the crime makes an error.

3. Most computer frauds are committed by employees who know an organization's programs in detail and have relatively uncontrolled access to the computer. It may be a new employee exploiting his computeristic genius or an unhappy old employee out to get what the organization owes him.

C. CONTINGENCY PLANNING

Disasters--fire, flood, environmental problems, hardware and software failures, and sabotage can and do happen. Yet all too often management ignores this possibility and the security and protection that was given journals and ledgers in pre-computer days is not provided for computer files.

If management decides that the possibility of disaster to the computer center is not serious enough to warrant taking precautions, this may be a sound management decision. The important thing is that management should face the problem and decide what, if anything should be done.

1. Risk Evaluation

1. The first step management must take is to make a determination of the types and extent of the threats to which it is exposed. Risk analysis must consider the location of the computer center, location of the systems within the computer center, the type of

system, and the types of applications the system supports.

2. Risk analysis must also include an evaluation of the value of the system and system elements to others. Clearly no one will perpetrate a crime for profit knowing that the direct cost will exceed the expected benefits. Risk is directly related to the value that an instigator expects to receive.

3. Once risks have been identified and evaluated, the next step is to determine what measures can be taken to prevent or limit loss. Each possible measure must then be evaluated with respect to its anticipated effectiveness and its cost of implementation. Then a cost trade-off analysis can begin. Obviously any measure whose cost exceeds its anticipated return in terms of loss prevention is inadvisable. In other cases measures that may appear to be cost effective do not offer a satisfactory level of protection. In such cases, more than one measure may be required in order to obtain the desired level of protection. Often a combination of measures will be required to obtain full security protection against all risks.

2. **Emergency Procedures Development and Implementation**

1. All emergency procedures should be available in written form and distributed to all management and key employees.

2. All employees should be trained in emergency procedures and a program of continued education should be implemented. The recurring training will initiate new employees to procedures, refresh the training of others, and provide for the introduction of changes and/or additions to the procedures.

3. All emergency procedures should be reviewed periodically to keep them current. This is especially important in the event of equipment or facility changes and/or additions.

4. Periodic meetings should be held with management to establish and reconfirm their roles in a disaster situation.

3. **Vital Records Determination, Backup and Protection**

1. Management must determine which records are essential for the continued functioning of the organization.

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2. These vital records should be duplicated and then
    continuously updated to maintain a current position.

3. Even safes and vaults on-site cannot provide
    sufficient protection.   What is required is the
    storage of the most recent duplicates of machine
    readable records and programs at a highly secure
    remote location.   This location should be kept
    confidential and be known only to a few of the most
    senior employees with a need to know. The remote site
    should be adequately protected against fire and
    intruders.   Access must be limited to those who
    regularly update the records and periodic visits by
    internal auditors.

VIII. <u>CONCLUSION</u>

Ten axioms for a successful information center [Kutnick, 1985, pp. 15-17]:

1. Obtain top management support.

2. Run the information center as a business within a business.

3. Develop a microcomputer strategy.

4. Chargeback all costs.

5. Consider education critical to success.

6. Staff well.

7. Track success.

8. Carefully consider the product set.

9. Develop good relations with end user groups.

10. Learn from the past with an eye to the future.

The thesis has introduced a number of new management techniques. These techniques have been slightly modified to accommodate the culture and economic differences between the developing and developed nations. However, because of space limitations the thesis concentrated on basic issues such as Planning, Selection and Organization Structures. These were chosen based on Schaeffer's important factors in managing computer centers;

1. Controlled resource sufficiency

2. Controlled user service

3. Controlled data center costs.

The thesis has argued that changes in developing countries may be characterized as revolutionary instead of evolutionary. As such, one of the important points in this thesis lies in the fact that it has considered not only commercially existing and available technology but also some new ones that are expected to be introduced in the next few years. Thus it is giving managers of computer centers in developing countries an insight to what should be expected, allowing them the opportunity to plan and to change the development process from one that is revolutionary to an evolutionary one.

The thesis has benefited from the latest references and research material available in the United States, the advice and comments of managers of the computer center in a number of educational institutions, a familiarity of the computer center in Taiwan and from a thorough understanding of the country and its culture.

Future research may be carried out in a number of areas including methodologies in developing Information Systems and their architecture. Interested readers are referred to Devlin, B.A. and Murphy, P.T. An architecture for a business and information system, IBM Systems Journal, Vol 27, No 1, 1988. This paper deals with a number of culture issues which IBM researchers deemed as important in developing Information Systems for developing nations.

A second and equally important issue is managing personal computers in the organization. The end user computing phenomena is complicated and is currently of interest to a number of researchers. The new generation of software, which reside on both the mainframe and personal computer, may present a solution alternative. However, this software is still on the drawing board and an interim solution must be found.

APPENDIX

EVALUATION AIDS

The evaluation aids discusses here including hardware and software monitors, job logging routines, simulators, comparison, and benchmarking. When properly used, these aids can provide the necessary inputs to make performance evaluation and improvement more efficient. When improperly used, these aids have a history of being costly and time consuming, and leading to incorrect conclusions. When we try to use evaluation aids we should answer the following questions:

1. What are the capabilities and limitations of each aid?

2. Should an evaluation aid be used at all?

3. If so, which aid or aids should be used?

4. What staff, using what methods, will lead to cost-effective use of the selected aid or aids?

Here a brief description of each is given to help bring the similarities and differences into focus.

1. Monitors are hardware devices or software programs which are capable of accuretly measuring resource utilization; such as, processor busy, main memory utilization, paging rate, and the number of times selected events occur. Monitors can be used only with functioning systems.

2. Job logging routines are programs designed to gather sufficient data about each job processed to permit the billing of users for data processing services. One important difference between monitors and job logging routines is that monitors usually measure the sum of the resources utilized by all software and user jobs

executed during the evaluation period, while the job logging routines measure the resources utilized by each user job.

3. Simulators are software programs which permit the computer-aided modeling of a system. Simulated performance data for both operational and non-operational system may be obtained.

4. Comparison is an analysis technique used to evaluate the performance of one system relative to the performance of another system processing a similar work upgrade of a current system.

5. Benchmarking is the carrying out of limited tests, conducted in or a few days to provide sufficient data for useful estimation of the performance of the benchmarked system during its five to seven projected active life.

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