

**AN ADVISORY EXPERT SYSTEM ON  
COMPUTER PROCUREMENT**

**BY**

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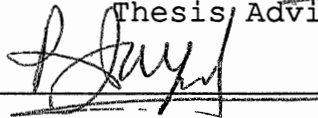
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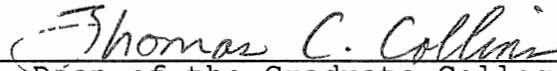
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## PREFACE

This thesis suggests to formalize the use of an integrated computer system procurement approach for government departments. Within the agency, this integrated approach fortifies understanding and cooperation between the executives and the data processing professionals during the procurement exercise. Externally, it encourages more formal interactions between the acquiring agencies and the vendors. The pre-qualification presentation and preliminary short-listing stage in this integrated procurement approach is also aimed at tapping up-to-date computing technology information from the vendors. This will enhance the chance of securing a good computer system. To streamline the implementation of this integrated procurement approach, an Advisory Computer Procurement and Evaluation System (ACPES) was developed using VP-Expert Shell. ACPES gives advice and guidelines on initial system study, request for solutions from vendors, short-listing of vendors, tender document preparation, and selection of proposal evaluation methodology. A copy of ACPES is available through the Computer Science Department of Oklahoma State University.

I would like to express my most sincere appreciation to my major adviser, Dr. K. M. George, for his counsel and encouragement throughout my graduate program. I am also

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## CHAPTER I

### INTRODUCTION

#### Background

In this age, more and more organizations are selecting computerization to improve operational efficiency, to promote business innovation, and to build corporate strategic information resources. As a result, it has been reported that the annual growth rate in terms of computer population (excluding stand alone microcomputers) in a typical developing country such as Malaysia, is around 25% [15,22]. Other Asian countries like China (24%), Philippines (15%), and Singapore (20%) are also achieving rapid annual growth rates of computerization in recent years [23,25,26]. Hence, there is an increasing interest in studies pertaining to computer proliferation, utilization, as well as computer acquisition and evaluation methods. This is particularly apparent in the public sectors as, traditionally, government is the biggest single computer purchaser in a country. However, a severe setback has been noted in the course of computerization. According to Henry Norton, there is no computer procurement procedure in the less developed nations and in smaller organizations. Under such circumstances which are further crippled by the lack of

computer expertise, the computer management manages the procurement process as best it can. Unfortunately, this situation has resulted in many major procurement errors [13].

### Problem Statement

In general, computer procurement is not a routine task performed by an organization. A major procurement may occur only once in 5, 7 or 10 years in an organization. Therefore, it is not a profitable practice to send personnel to attend formal training in this area [2]. Furthermore, the skill and technique required in computer acquisition cannot be learned ad hoc. It needs a consistent follow-up on the latest development in the computer world. Moreover, critical factors to be considered in a procurement exercise now might not be the same at all as a few years ago. For instance, people may not consider the open system concept as an important issue in the evaluation a decade ago simply because it was not provided by the vendors during that time. However, it may be a mandatory requirement now. Some other external factors include the availability of better telecommunication services, wider range of machine models for selection in the market, changes in the marketing strategy, financial standing, and after sales customer support services of the manufacturers and the vendors. All these make computer procurement and evaluation even more difficult. In fact, top management should not expect to

have the best computer system for the organization by the time the computer is being installed because procurement and evaluation processes may take a few months or years to complete while new products are being introduced in the market.

There is yet another serious problem in computer acquisition and evaluation. The non-committal attitude of some executives who play the key role in approving the computerization program of the corporation, tends to delegate the entire authority of procurement to the data processing professionals [10]. Unfortunately, procurements carried out by data processing professionals are usually made in favor of the bidder with the best technical performance only. Without the views of the executives to provide a clear functions and business strategies of the corporation, this approach may lead to failure in achieving the objectives of the corporation.

On the other hand, there are executives who seldom relinquish their management prerogatives to consult their technically more competent professionals. Their insistence on this approach is to maintain their status as the most knowledgeable group in all matters related to corporate affairs. To certain extent, they rather consult and believe what the sales representatives tell them. Briefly, they find no reasons to share the authority in deciding what the corporate computer should be, after all the computer is to solve the management problems. Adopting either attitude

will not bring any good to the organization. In the long run, the organization may have to pay for the maintenance of the system with low utilization rate due to unsatisfactory performance of the machine. Insofar as organizational computerization project is concerned, a compromise has to be reached between the user requirements, the current state of technology, the availability of resources, and the organizational objectives. Certainly, these required the input of both managerial and technical personnel.

In short, the problems in computer system procurement faced by the prospective user organizations, especially those from less developed countries are:

- \* Computer procurement requires much more technical knowledge compared to other types of office equipment procurement;
- \* Computer acquisition knowledge cannot be learned ad hoc;
- \* People managing computer procurement in a corporation receive very little formal training in this area;
- \* It is difficult to retain computer procurement expertise in an organization;
- \* There is generally a lack of computer procurement procedure in smaller organizations;
- \* The external computer procurement environment is always changing due to the fast-moving computer technology, and this makes procurement even more challenging; and
- \* The non-committal and over enthusiastic attitudes of some executives.

To alleviate the problems of government computer system procurement, this study is to suggest a two-pronged solution. Firstly, an integrated procurement procedure is recommended and secondly, an advisory expert system based on the recommended procurement procedure is designed. A formalization of the procurement process is also be given in this thesis.

### The Procurement Issue

In view of the procurement problems, an integrated procurement approach which fortifies greater cooperation between the executives and the technocrats in computer acquisition is recommended. This integrated approach consists of 6 main stages:

- (a) Initial System Study (ISS)
- (b) Request For Solution (RFS)
- (c) Pre-qualification Presentation and Preliminary Short-listing
- (d) Tender Specification Preparation
- (e) Tender Invitation, and
- (f) Proposal Evaluation.

Details of each stage will be presented in Chapter II.

### The Implementation Issue

In order to strengthen the implementation of the suggested procurement procedure, an Advisory Computer Procurement Expert System (ACPES) is being developed which

includes the following five modules:

1. Guidelines on ISS
2. Guidelines on RFS
3. Advice on Short-listing
4. Guidelines on Tender Specification
5. Advice on Evaluation Methodology Selection.

To develop ACPES, an expert system development tool called VP-Expert Shell is employed. To get a better insight of what and how this expert system shell can be used, a simple example is given. Suppose the module that gives advice on short-listing vendors consists of two questions. One is on whether a vendor understands the organization's problems, and the other asks about the annual turnover sale of the vendor for the last three years. The sample program may look like in figure 1.

```
! Action Block

ACTIONS

DISPLAY "This expert system advises you on matters
related to the short-listing of vendors during the pre-
qualification stage in computer system procurement.

Press any key to start the consultation.~"

DISPLAY ""
FIND List
DISPLAY ""
```

Figure 1. Sample Program Code of an Expert System  
Using VP-Expert Shell

```

DISPLAY "The expert advises that this vendor {List}."
DISPLAY ""
DISPLAY "Press the SPACEBAR to exit the consultation.~"

```

### 'Rule Block

```

RULE 1
IF Understanding = No
THEN List = should_not_be_shortlisted
DISPLAY "It can be extremely difficult and time consuming
for a vendor who cannot perceive your problems and the
objectives of computerizing your organization.";

RULE 2
IF Sale = Decreasing
THEN List = should_not_be_shortlisted
DISPLAY "There is a risk of discontinued support from the
vendor as the company may be sold, taken over or wind up
if sales continue to decline.";

RULE 3
IF Understanding = Yes AND Sale = Fluctuating
THEN List = can_be_considered_for_shortlisting
DISPLAY "Fluctuation in sale is quite common, however,
there is usually a reason for it. You may want to verify
the reasons and examine the employee turnover rate before
you make your decision to short-list this vendor or
not.";

RULE 4
IF Understanding = Yes AND Sale = Increasing
THEN List = should_be_shortlisted
DISPLAY "Engaging a vendor who understands your problems
can provide good advices and design better application
systems. In addition, less attention is needed while
developing the systems. An increasing annual sale
generally indicates healthy growth of a company, thus, the
downward side is reduced.";

```

### ' Statement Block

```

ASK Understanding : "Do you think this vendor
understands your organization problems?";
CHOICES Understanding : Yes, No;

ASK Sale : "How is the annual turnover sale for the last
three years of the company?";
CHOICES Sale : Increasing, Fluctuating, Decreasing;

```

Figure 1 (Continue)



As can be seen from the above example, the program is structured into three blocks. The Action Block contains the executable commands. On encountering the FIND command, control is transferred to the inference engine to find out the value or conclusion for the variable named after the FIND clause. In this case the variable name is List. There may be more than one FIND commands in an Action Block.

The Rule Block contains the expertise of the system is the knowledge domain of the expert system. In the above example, there are four rules written in the IF-THEN format. Which rule is to fire depends on the values of the variables, Understanding and Sale. When a rule is fired, its corresponding sentence in quotes will be displayed.

The Statement Block contains the questions that the users will respond to when prompted by the inference engine. Subsequently, the answers provided by the users become the facts that will be kept in the knowledge domain and used by the inference engine in making decisions. There are two questions in the example each corresponds to a variable. The key word ASK is followed by the variable name and the question proper, whereas CHOICES provides a list of possible answers to a particular question. Finally, Appendix A shows some of the consultation screens on short-listing of vendors. Greater detail of the expert system will be discussed in chapters IV and V.

## Organization Of Study

This thesis contains 6 chapters with the following organization. The first chapter provides the necessary background, problem statement leading to the proposed study, and a brief outline of the suggested solution. Chapter II is dedicated to describing the recommended procurement procedure. Detailed descriptions of various evaluation methodologies such as Cost-only, Weighted-scoring and Cost-effectiveness-ratio [17] are presented in chapter III. Chapter IV is an overview of expert system and the VP-Expert Shell as system development tool. Chapter V is devoted to the design and implementation of the ACPES. The final chapter, chapter VI, concludes the study and provides some insight into research that can be undertaken in the future which includes the use of fuzzy logic. Throughout this thesis, examples will be used wherever appropriate for clarification.

## Summary

The traditional computer acquisition process has caused some frustration among government agencies as well as the vendors. At one end the agencies often fail to describe precisely what they want due to the lack of market information. At the other end, the vendors usually fail to sell their best solutions due to the restrictive specification in the tender documents. To arrest this lose-lose situation, it has been suggested that the present procurement procedure

be revised to suit this fast moving information technology. Thus, formalization of the integrated computer procurement approach is imperative. In addition, an advisory expert system is proposed to streamline the implementation of this new procurement procedure.

CHAPTER II  
THE INTEGRATED APPROACH  
IN SYSTEM PROCUREMENT

Introduction

Traditionally, organizations use technical approach or managerial approach in system acquisitions and evaluations. These two approaches are developed from two different perspectives:

- (a) The technical point of view;
- (b) The managerial point of view.

As revealed in the previous chapter, these two approaches working alone will more often than not attribute to computerization failures in many organizations. Indeed, both approaches bias towards their respective professionals; the data processing professionals favour the technical approach and the managers, the managerial approach. In general, the technical approach is too restrictive and lack of stress on final results, whereas the managerial problem-solving approach is solution oriented but has simply neglected the technical related issues.

This chapter discusses the technical approach and the managerial approach, and briefly evaluates their shortcomings. Finally, an integrated approach is recommended for

system procurement.

### The Technical Approach

In the technical approach, a feasibility study will be conducted following a proposal for computerization. If the study concludes positively and the project is approved by the top management, then a pure technical tender specification requesting for proposals is issued. Evaluation of proposals will be done on the basis of technical comparative analysis of hardware components, software packages and even vendor support. The final choice recommended to the Tender Board is usually the proposed system that gives the best in the cost benefit analysis. The letter of intent is then sent to the chosen vendor for further negotiations. The flow of the technical procurement approach is depicted in figure 2.

From the surface value, the technical approach sounds logical. However, there is one serious assumption made in adopting this approach, that the success of a computerization project is solely depending on the superiority or the power of the equipment acquired. Unfortunately, in real life there are many other factors needed to be considered in order to secure success. Some of the shortcomings in the technical approach are:

- \* Underestimate the importance of human factor attributed to the success of a computerization project;
- \* Underestimate the vital role played by the executives

- in making a computerization project successful;
- \* The technical specification calling for proposals can be very restrictive and merely based on the knowledge within the group of technical professionals in the organization;
  - \* Evaluation based on this restrictive specification can be disastrous later.

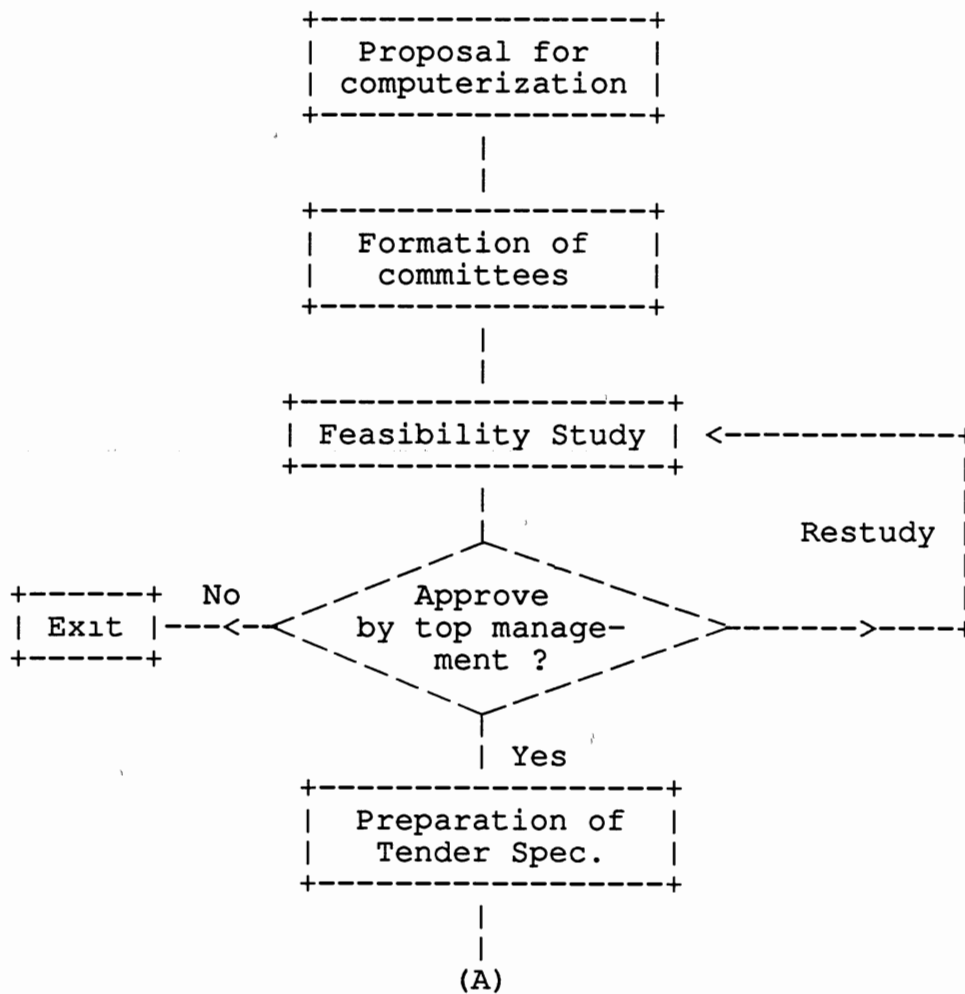


Figure 2. The Technical Computer Procurement Approach

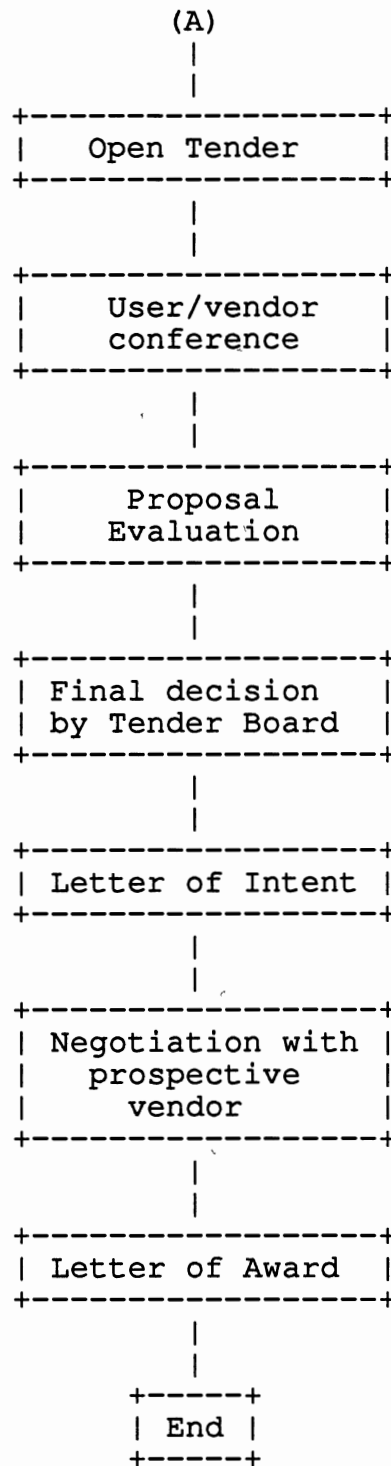


Figure 2 (Continue)

## The Managerial Approach

The flow of the managerial approach is similar to that of the technical approach except that at the proposal evaluation stage, it is more concerned with:

- \* What are the problems that can be solved by the proposed computer system?
- \* To what extent do the vendors understand the organizational problems and the current procedures of handling the problems?
- \* How much does the organization have to pay to bring about the benefits, or the cost of leaving the problems unsolved?

The premise of this managerial approach is that the organization is acquiring a computer as a tool to solve its problems. More interestingly, the success of such an installation will be seen as the right decision taken by the decision makers and it has nothing or little to do with the technical aspect of the selected computer system. In other words, the right management and the right decision are the controlling factors in determining the success of a computerization project, irrespective of the set of computer equipment selected.

Though the managerial approach is of problem-solving oriented, it has its limitations such as:

- \* If only user application systems are evaluated, the organization may end up in buying an obsolete computer



system and will soon run out of technical and maintenance supports;

- \* The organization will incur investment loss in near future if the technical issue of computer upgradeability is overlooked during proposal evaluation;
- \* Since the data professionals are not involved in the acquisition process, the factor of system acquaintance will not be considered. This may result in the requirement of extensive training for the data professionals to handle the selected system;

#### The Integrated Approach

In fact, the technical approach and the managerial approach should not mutually exclude each other. The top management of an organization should oversee that in a computer system acquisition and evaluation process, these two approaches complement each other in forming a more balanced and more acceptable integrated approach to both the data processing professionals and the executives in the organization. It should be clear that the acquired computer system is designated to solve organizational problems and is the asset of the organization; therefore, it should not be classified according to different professionals.

Purportedly, this integrated approach is to fortify greater cooperation between the executives and the technocrats in system procurement. This approach has the following outline:

- (a) Initial System Study (ISS);
- (b) Request For Solution (RFS);
- (c) Pre-qualification Presentation and Preliminary Short-listing;
- (d) Tender Specification Preparation;
- (e) Tender Invitation; and
- (f) Proposal Evaluation.

As can be seen from the outline, one of the major differences is the introduction of the RFS stage, and the pre-qualification presentation and preliminary short-listing stage in the integrated procurement approach. This approach has the process flow as depicted in figure 3.

The following sub-sections describe in great details each of the stages in the integrated approach of computer system acquisition and evaluation. To produce a clear picture, a case study will be used which is mainly based on the computerization project for the Local and Municipal Councils (LMC) in a developing country where a pilot project was carried out using the integrated approach in system acquisition. The great success of this pilot project has a catalytic effect on the other councils in computerizing their main business. By 1990 all the 128 local councils were computerized except a few relatively small ones [8, 9].

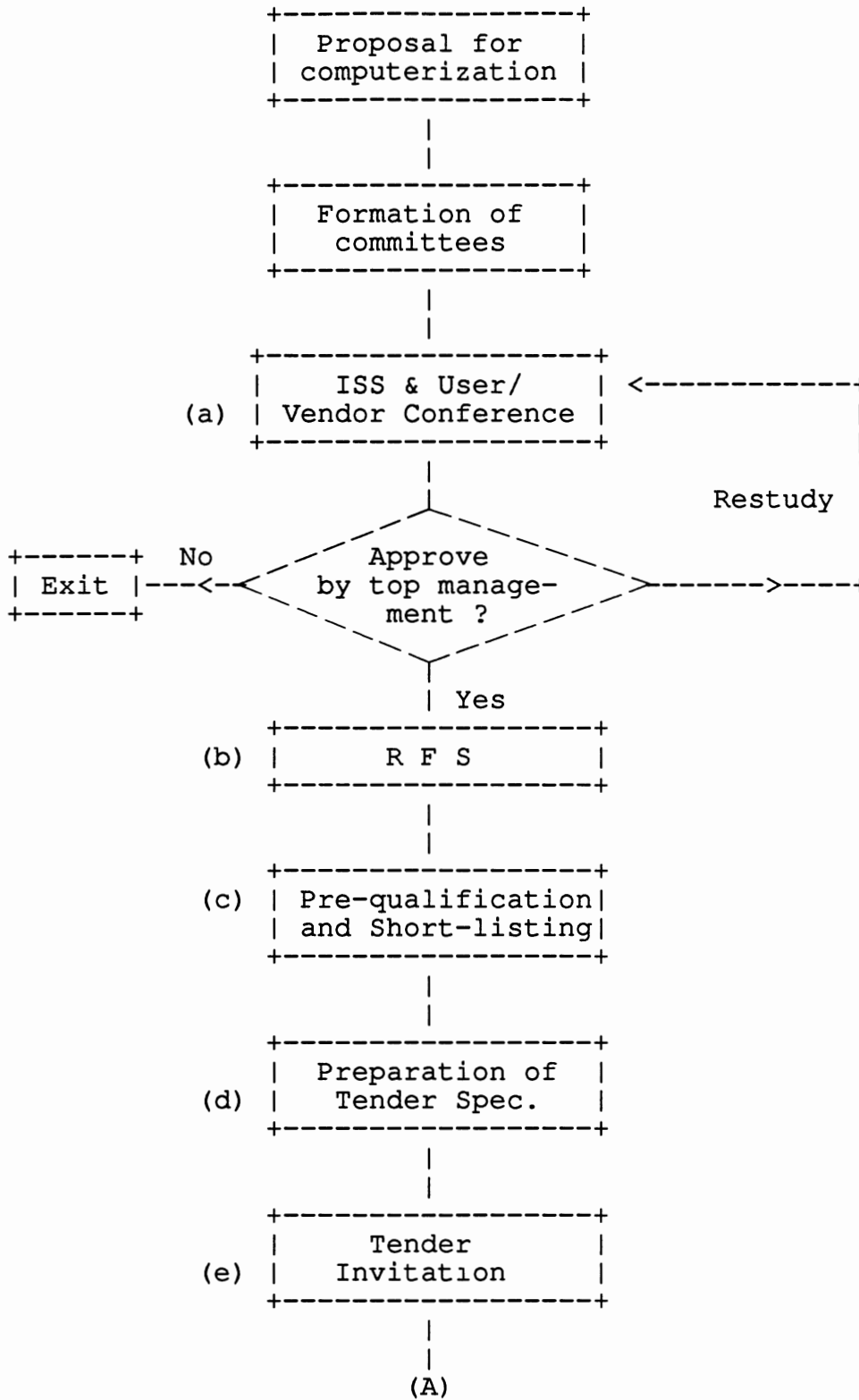


Figure 3. The Integrated Computer Procurement Approach

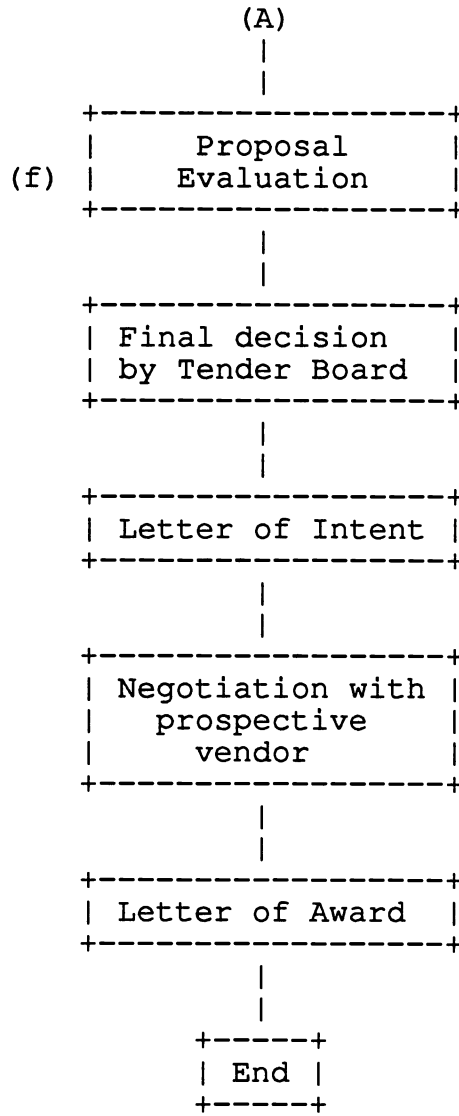


Figure 3 (Continue)

(a) Initial System Study (ISS)

The aim of ISS is for the organization to identify as many of the existing and potential problem areas in the organization as possible. It also provides the justifications and feasibility of the computerization project. It is

important to note that ISS should not be restricted to the managerial problems only; operational problems should also be considered in the study. The project committee should compose of representatives from each level of management. Decisions are made collectively under consensus of all representatives. The output of this stage is a list of problems with stated priority to be considered for computerization. The implementation schedule should be clearly indicated especially if it is to be carried out in phases. A comprehensive description of each problem should be given together with the current way of handling the problem and all the exceptional cases, the present volume of data, and the expected annual growth rate. Corresponding to each problem is the objectives and the minimum expectations of the computerized system intended.

The preciseness of ISS has a great impact on the computer system that is to be acquired. It is better to be comprehensive and exhaustive at this initial stage to avoid the need to turn back at later stages. An example of the ISS is presented below.

In the case of LMC, a resolution to use computer in the effort towards a more efficient, speedy, effective and modern management was adopted in a national seminar in March 1987 [8]. In executing the resolution, the ministry concerned, after considering the cost involved and the risk undertaken to computerize all the 128 councils simultaneously, decided to run a pilot project at four sites in phase

I. Phase II and III were subjected to the success of the pilot phase and were planned for 1988 and 1989. A project team was formed comprising of administrators from the ministry concerned and two other central agencies which provide technical expertise.

A total of five application systems were identified to be computerized:

- (i) Property Information System (PIS),
- (ii) Business Licensing Information System (BLIS),
- (iii) Car Parking System (CPS),
- (iv) Miscellaneous Revenue System (MRS), and
- (v) Receipting System (RS).

In the ISS report, each application system is given a brief description. For instance PIS has the following specification:

A. Problem

- a. Difficulty in retrieving information on property.
- b. Difficulty in obtaining timely information to aid management planning.
- c. Delay in the preparation of bills.
- d. Difficulty in identifying defaulters immediately after the stipulated payment period.
- e. Difficulty in carrying out analysis of defaulters.
- f. Difficulty in preparing timely financial statements.

B. Objective

- a. To maintain centralized records of all

properties within the Council including private properties, government properties and public utilities.

- b. To help management in valuation decision making.
- c. To generate information needed for planning related to property decision making.
- d. To help in improving the efficiency of revenue collection and control system.
- e. To generate management accounting reports in various aspects such as revenue collected, number of defaulters, etc.

C. Activity

- a. Preparation of valuation list.
- b. Analysis of properties in different zones.
- c. Rental/market value of various categories of properties in different zones.
- d. Concentration of different categories of properties (high rise, double storey, single storey, etc) in different zones.
- e. retrieval of information on a particular property.
- f. Information related to revenue collection and defaulters.
- g. Preparation of bills in January and July for all assessees to include conservancy and sewerage fee where applicable.
- h. Payment system on the basis of payments made by assessees as specified by the Council.
- i. Identification of defaulters who have not paid the assessment in the given period.
- j. Preparation of new bills along with the costs to the defaulting assessees.
- k. Preparation of financial statements and management reports.

D. Current System Description

- a. At the end of each year, assessment bills for

all holdings under the council are prepared. Assessment bill contains details of the property like the property address, annual value, assessment rate, and any other payment.

- b. Assessment bills are sent out to the owner and these bills are to be paid up by the end of February for the 1st half year and the end of August for 2nd half year.
- c. All payments made by assessees are credited to the individual accounts and receipts are issued for the amount paid.
- d. At the end of the payment period, accounts of all the assessees are looked into. All assessees with a balance due are identified.
- e. These assessees are then issued notice demanding payment. The notice will contain information like property address, amount due, assessment rate and notice fee (based on the amount due). Cancellation on notice fee is possible with acceptable reasons.
- f. Payment period from the time of issue of notice is 15 days.
- g. All payments made during this period are also credited into the assessees' accounts.
- h. At the end of this 15 days, accounts of all assessees are looked into to identify those with a balance due.
- i. For all those with a balance, a warrant attachment is prepared to include costs of attachment. Cancellation of said warrant of attachment is possible.
- j. At given intervals of time (monthly, half-yearly, yearly) certain reports will be prepared for management and administrative use. Some of the reports are total amount owing to the council, number of properties that have undergone extensions, etc.

E. Operational Requirement

- a. Billing: Under the statutory provisions, assessments shall be payable half-yearly by the owners of holdings in the council in the months of January and July. The system should also cater for monthly bills.



- b. Assessment bills for the 1st half-year must be prepared and be ready for despatch to owners not later than the 15th day of January. The same applies in July for the 2nd half-year bills. The system should cater for preparation of regular installment bills as requested.
- c. The bills must contain at least the following details:
  - Account No.
  - Name of owner
  - Identity Card No.
  - Postal Address
  - Location
  - Annual value of property
  - Percentage rate levied
  - Arrears brought forward
  - Amount of costs due and payable
  - Period for which rates levied
  - Current half-year rates
  - Total due
- d. The amount of current yearly and half yearly rates payable should be calculated by the computer and debit entries should be captured in the Assessment File.
- e. Cash Posting: All payments made to the council must be posted to the accounts. Counter payments will be receipted by receipting machines. This should then be used to update the main system without rekeying in data.
- f. Payments may be made in full, partial, regular installments or of monthly basis.
- g. All payments when posted must produce an update listing. The purpose of this list is to afford some form of check to ensure that difference between debit and amount paid is not due to wrong posting. The system must allow wrong posting to be corrected.
- h. Rebates and total exemption are granted to properties which are used for special purposes e.g. recreational, social, religious, etc.
- i. Refunds are sometimes made at the request of owners in respect of overpayment and postponement of rates.
- j. Write off are made in respect of properties such as those required by government and statutory

bodies.

- k. Issue of Notice of Demand: Under the statutory provisions, if any sum in respect of any rate remains unpaid at the expiration of the prescribed time, e.g. at the end of February or August, a Notice of Demand shall be served on the person requiring him to pay the same together with Notice Fee which vary according to amount due.
- l. The Notice of Demand is a statutory form and the following details must be printed on it:
  - Account No.
  - Name of owner
  - Identity card No.
  - Address of posting
  - Period for which rate is due
  - Date of issue of notice
  - Amount due (arrears)
  - Notice Fee
  - Location and description of property
  - Annual value
  - Assessment for half year
  - Notice No.
  - Indication 1st or 2nd half year
  - Cut off date

Pre-printed stationery must be used.

- m. Warrant of Attachment: Under statutory provisions if the amount of rates remain unpaid after the expiration of 15 days of the service of Notice of Demand, The council may issue a Warrant of Attachment. When a Warrant of Attachment is issued certain costs are payable. These fees must be debited to the accounts concerned.
- n. Rates Master Listing: It is necessary to print all master accounts on request showing the transactions during the year for each account so that a hard copy exists for audit and reference purposes.
- o. All hardware has to be installed by 31 October, 1987, and PIS has to be fully tested and run by 2nd January, 1988 for the 1st half-year assessment of 1988.

F. Number of Accounts

- a. There are 55,000 accounts. The system should at least cater for 80,000 accounts as rateable

holdings increase in the next 5 years.

- b. The number of bills to be issued will be twice the number of accounts plus 10% in respect of cases where owners request separate bills/ instalment bills.
- c. Number of changes in annual value, names of owners and address, etc: It is estimated that these will be about 10% of the number of accounts in a year.
- d. Number of rebates, refunds, write-offs, etc: The number here is fairly small.
- e. Number of cash posting: Approximately twice the number of accounts.

G. Special Considerations

- a. Billing: The critical period is in the months of January and July when all bills have to be printed and despatched to the owners.
- b. Cash receipts: Most of the receipts will be received in the months of January, February, March, July, August and September. These months are the peak period.
- c. Notice of Demand: These will be issued as often as required.
- d. Warrant of Attachment: These will be issued automatically upon the expiring date of Notice of Demand.
- e. sub-divisions: One property may be sub-divided into many pieces of smaller lots for housing development. The problem is to provide new account numbers for these sub-divided properties.
- f. Valuation information: The system should be able to produce valuation reports, such as number of properties used for commercial purposes, industrial purpose, etc.

From the specifications above [12], it is expected that vendors are able to visualize the problems that lead to computerization of the councils, user requirements, system

capacity requirement, software requirements, work load, as well as category and number of personnels required to run and maintain the system. With the completion of ISS and blessing from the top level management, the project takes on to the second stage.

(b) Request For Solution (RFS)

In ISS stage, a functional specification or operational requirement is prepared. This specification forms the basic document in RFS stage to request for solutions from vendors. In practice, RFS is advertised in major newspapers. Interested vendors can pick up the document from the organization. Few days or typically a week later, a bidders' conference will be held between the project committee and the vendors. This is the chance where vendors can clarify whatever doubts they have arising from the RFS document with the project team. The conference is also essential to mark the spirit of cooperation between the organization and the potential suppliers [13].

In principle, at this stage the committee should only stress on the operational requirements without setting down the system configuration. All technical necessity should be left for the supplier to suggest which model in his product line is most suitable to satisfy the user requirements [13]. The committee should also avoid mentioning the budget set aside for the project as this will influence the vendors in proposing their best solutions.

Following the meeting, a supplier should indicate his/her intention whether to continue to pursue with the tender. If so, a date will be set about one month later for a pre-qualification presentation.

In the case of LMC, 17 vendors collected the RFS document. However, only 14 turned up for the briefing, and 11 presented their solutions to the project committee in the pre-qualification stage. Out of the six drop-outs, five are small companies.

(c) Pre-qualification Presentation  
and Preliminary Short-listing

One of the main purposes of introducing pre-qualification presentation in the system acquisition is to short-list a few vendors for further evaluation. Citing from the past experience, each government computer acquisition competition attracts about 15 proposals on the average. The evaluation committees have to spend quite some time vetting through all the proposals. Under such circumstances, it is rather difficult for the evaluation committees to carry out their work effectively and efficiently. Therefore, this stage of pre-qualification scanning is of great help in speeding up the short-listing process.

The executives play a vital role in this stage. Vendors are expected to present an overall system solution to the management. Criteria for short-listing are:

- \* Compliance to the relevant government regulations;

- \* All mandatory operational requirements are adequately addressed;
- \* Understanding of the organizational problems;
- \* Feasibility of the proposed system;
- \* Stability of the company and good track records;
- \* Estimated start-up capital and the recurrent cost;
- \* Commitment on after sale maintenance and technical support.

Vendor should propose a total solution to the problems which includes both software and hardware configuration to support the operational requirements. Similarly, no supplier should be listed for further consideration if its proposed solution is not feasible or the company's financial standing is in question. A vendor can also be denied based on its track record and the past experience the agency has with the vendor. Past vendor's record is a good piece of information in anticipating whether a vendor can perform after sale. However, whenever discretion is used in making judgement, it is necessary to seek consensus within the committee. In any cases, the reasons for rejections have to be formally compiled and submitted to the Tender Board. Normally, a list of four or five proposals is ideal for next stage of system acquisition and evaluation, that is, tender specification preparation.

Referring to the LMC case, a full week was allocated for pre-qualification presentations by 11 interested vendors. Short-listing was done by the project committee

together with the Chairman from the council. Based on the criteria set forth earlier, seven proposals were rejected with reasons shown in Table I.

TABLE I  
LIST OF REJECTED PROPOSED SOLUTIONS  
WITH REASONS IN THE LMC PROJECT

Vendor code	Reason for rejection
1/11	Proposed a network of PC's. Files are not centralized. May pose difficulty in backup, file sharing and system maintenance. Improper record-locking feature.
3/11	Lack of after sale support. Employee turnover rate is high. No regional office near councils. Respond to remedial call may take more than 2 days.
4/11	Extensive amendment on by-laws is needed on the proposed solution which is not feasible now.
5/11	Only supplies hardware. Does not undertake turn-key jobs. Lack of customer support personnel.
7/11	The annual turnover sales deteriorated in the past three years. Cost is 24% more than the budget.
10/11	It is a software house. Still uncertain which hardware model to propose.
11/11	Super-micro computer is proposed. Limited field upgrade capability such as additional terminals. Only PC printers are proposed. System conversion charge is 38% of the total cost.

Although most of the proposed solutions are rejected at the pre-qualification stage, some of the ideas are noble and can be incorporated into the system when preparing for the tender specification document, or as a long term solution for the betterment of the system. One good example is the solution put forward by vendor 11/11. Its ideal is to divide the area covered by a council into three zones with approximately equal number of properties in each zone. Each zone has its assessment bills in different months such as January and July for Zone 1, March and September for Zone 2, May and November for Zone 3. The advantage of this strategy is that the work load will be equally distributed throughout the year and thus improve on system utilization. Another useful ideal recorded during a pre-qualification presentation that can be put into immediate practice is the use of mobile collection centers at the markets and at rural areas. Data is keyed into the diskette by means of PC's as payment is made, and later brought to the council for batch mode posting.

The above example argues well that the pre-qualification stage is a useful tactic in tapping ideals and information from the vendors to improve on business functions and subsequently the application system design and the system configuration. With all the information collected and evaluated in the pre-qualification presentations, the project committee should now gain more confidence in preparing for the tender specification document.



(d) Tender Specification Preparation

A tender specification is a legal document and therefore cannot be omitted in a system procurement exercise. After conducting the pre-qualification presentation, the project committee should have acquired better views and solutions to the problems. The job of the project committee now is to adopt as much of the constructive suggestions put forward by various vendors in the pre-qualification presentations as possible into the tender specification document.

The tender specification document should contain the following materials:

- a. Organization objectives and project background;
- b. Tendering procedures;
- c. Operational requirements;
- d. Technical requirements;
- e. Implementation requirements;
- f. Support requirements;
- g. Schedule of prices;
- h. Contract requirements;
- i. Questionnaire.

In the LMC computerization project, the off-line collection option is added to the list of original operational requirements after the pre-qualification presentations. Meanwhile, the system configuration is finalized as follow:

A. Hardware

- a. One Central Processing Unit with 32-bit wordsize and 4 MB (min.) memory upgradeable to 8 MB.
- b. One or two unit of hard disks with total capacity of 100 MB upgradeable to 200 MB (for data files only).
- c. One unit of cartridge or tape of at least 80 MB per cartridge.
- d. One line printer of at least 400 lpm.
- e. Nine NLQ 132 column printers of about 200 cps.
- f. 19 VDU and one consol.
- g. Five unit of 80286 PC's.
- h. Five unit of receipting machine each with one 5.25" diskette drive, audit and slip printer.

B. System Software

- a. Operating system -- must be applicable in multi-user, multi-tasking environment. Preferably industrial standard with comprehensive security features.
- b. System utilities -- Standard system utilities. System must have file recovery utility and backup facility.
- c. Language compilers -- Basic, COBOL, and a 4th Generation Language.

C. Other

- a. Uninterrupted power supply for three receipting machines for a duration of 30 minutes.

A detailed list of items to be included under each of these topic are shown in Appendix B.

(e) Tender Invitation

At this stage, a tender specification document is sent to each short-listed vendor. The organization expecting each of the short-listed vendor on receiving the tender invitation, will prepare a proposal to be submitted to the organization for further evaluation. All proposals should follow the tender procedure closely to avoid being disqualified.

In the LMC computerization project, four vendors are invited to submit their proposals in October 1987. The vendors are advised to adhere to the tender procedure and remain as close to their original solutions as possible. In November, all the four suppliers submitted their written proposals for further evaluation.

(f) Proposal Evaluation

This is the stage where the organization is deciding which proposal should be given preference in contract awarding. Two committees are formed by the top management to undertake this evaluation job. One committee is to look into the technical aspect of the evaluation while the other will concentrate on the financial evaluation. All committee members have to be aware of the procurement and evaluation regulations that may vary from one organization to another organization. In the public sector, regulations have to be obeyed strictly such as no one should sit in both evaluation committees, and these two committees should work indepen-

dently [19].

Several proposal evaluation methodologies can be applied in carrying out evaluation. Evaluation methodologies will be discussed in more details in chapter III along with the criteria used in choosing a right methodology. The key advice at this stage of proposal evaluation is "never leak out information to any competing vendors."

In the evaluation work of LMC computerization project, it took about two weeks before the letter of intent was sent to the preference bidder requesting for further negotiation.

#### Rationale for the Integrated Procurement Approach

The suggested integrated procurement approach is an extension and modification over that is used traditionally, namely the technical approach as well as the managerial approach. Indeed, the change to the integrated approach is in tandem with the rapid technological advances.

There are several major differences between the integrated procurement approach and the technical as well as the managerial approaches. Firstly, in the traditional approaches the feasibility study is done within the agency without much of the opinions and feedbacks from the vendors. In fact, this is the government restriction that when preparing the tender specification document the committee must not talk with any vendors. As a result, when competition is finally opened for bidding and a bidders' conference

is held, a lot of questions will be raised which require the agency to issue solicitation amendments to change the specifications in the tender document. This seems to be in conflict with the original goals of achieving equity, integrity, and economy in public sector management. On the other hand, the integrated approach encourages more interactions between the organization and the vendors for up-to-date technology information. This is critical because:

- \* It is difficult for the organization to stay abreast of technological changes alone;
- \* Government computer acquisitions tend to be of grand design and thus intricate in nature;
- \* Questions frequently arise that were not thought of previously and need to be answered in order to produce a better tender document [14].

Essentially, the usefulness of tapping knowledge and information from the vendors can be summarized from Kelman's comment [14] that:

**"As computer applications become less obvious and more critical, the need becomes greater for ideas from as many sources as possible. In such an environment, vendors must be allowed to apply their expertise and ingenuity to identifying new approaches for the public sector...vendors can serve more and more as sources of ideas, not merely as instruments to satisfy simple wants that government has determined."**

Secondly, with the introduction of the pre-qualification presentation and preliminary short-listing stage in the integrated procurement approach, the executives are given an important role to play in short-listing potential suppliers

after resolving technical issues with the data processing professionals in the organization. It is designed in such a way with the hope that executives who are involved in this stage will be more committed to the computerization project and are able to work hand in hand and more competently with the technical personnels in the technical evaluation later. Some other important benefits of having pre-qualification presentation in the integrated procurement approach are:

**A. Promote Greater Understanding and Commitment Among Technocrats and Executives:**

- a. That within the organization concerned, the pre-qualification stage serves as the bridge between the technical group of staff and the executives to further strengthen their mutual understanding.
- b. That commitment of the management in the preliminary short-listing process is vital to the success of the entire computerization project.

**B. Save Resources:**

- a. Resource saving especially for those vendors who do not meet the basic user requirements of the organization because they are told to leave the tender at a much early stage.
- b. Time saving for the acquiring organization in proposal evaluation.

**C. Assist in Tender Document Preparation:**

- a. That since the pre-qualification presentation is to short-list some vendors for further consideration, the organization can be sure that the presentations are of quality.
- b. That the project committee can be enlightened by the vendors' presentations on their respective up-to-date products.
- c. That solutions from various vendors regarding application systems, as well as hardware and

software capacity requirements can be used as references by the project committee in drawing up the tender specification document.

- d. That the necessity of making solicitation amendments to change specifications in the tender document in response to vendor questions or comments after its issuance can be avoided.
- e. That tender specification drawn up after going through the pre-qualification and preliminary short-listing stage will be more realistic, feasible and contains less errors.

**D. Increase the Effectiveness in Proposal Evaluation:**

- a. That detailed evaluation can be carried out more effectively and efficiently with fewer and better proposals.
- b. That the acquiring organization has an earlier assessment on the company and its capacity of providing postaward technical support.

Summary

This chapter explains the technical and managerial approaches in computer system procurement which are traditionally employed in government agencies. However, due to their limitations in coping with the present technological advances, a 6-staged integrated computer system procurement approach is recommended which includes:

- (a) Initial system study;
- (b) Request for solution;
- (c) Pre-qualification presentation and preliminary short-listing;
- (d) Tender specification preparation;
- (e) Tender invitation; and
- (f) Proposal evaluation.

In addition to fortifying greater understanding and commitment among technocrats and executives in computer procurement, this integrated procurement approach helps to save resources both for the bidders and the computer acquiring organization. Most importantly, this 6-staged procurement approach is very beneficial to the project committee in preparing the legal tender specification document. Finally, through the strict scanning in the preliminary short-listing, only bidders with good quality proposals will be considered for further consideration. By this way, the detailed proposal evaluation can be done in a more effective and efficient manner.

All in all, the 6-staged computer procurement approach is practical especially in the developing nations where there is a scarcity of computer experts and the use of computer technology is still in the transitional period. The success story of the computerization project in the LMC, which is provided throughout this chapter as a case study, tells it all.

In the next chapter, Chapter III, some of the frequently used proposal evaluation methodologies will be explored, together with some suggestions on the selection of methodology in a computer proposal evaluation.



## CHAPTER III

### PROPOSAL EVALUATION METHODOLOGIES

#### Introduction

Proposal evaluation is the last major step in the integrated computer procurement approach. Proposals submitted by the bidders need to be evaluated for tender award. In this aspect, Sondergaard, the Chief Consultant from Information System Datacentralen, suggested that a team of well-qualified members must be formed to "concentrate on this (evaluation work) as their only and most importance task" [21]. Undeniably, unlike other office equipment procurement, proposal evaluation is very crucial in computer system acquisition. Pope [17] quoted from the Australian Government Computer Acquisition Guidelines that "an evaluation methodology is a documented set of procedures for determining the tendered offer which most effectively meets the (user) requirements for computing capacity". Organization may incur great loss in resources, business, and investment if a wrong choice of computer system or vendor is selected.

This chapter is set to discuss three evaluation methodologies, namely, the Cost-only Methodology, the Weighted-scoring Methodology, and the Cost-effectiveness-

ratio Methodology. However, the Cost-value and the Least-total-cost methodologies will not be discussed due to their less popularity. Discussion also focuses on the peculiar features of each methodology, and the applicability of each methodology under different procurement situations.

#### Cost-only Methodology

Under this methodology, decision is made solely based on tendered cost. Preference is given to the bidder with the lowest cost. Advantages of this methodology are its simplicity and resource saving. However, due to its simplicity, this methodology is suitable only if:

- \* System features required or desired by the users are highly standardized; and
- \* Extensive customer support from supplier is not expected.

In most computer acquisitions, the required technical features are not standard. Therefore, features such as ease of use for operators and programmers, ease of upgrading, reliability, privacy, and security vary among systems. Thus, these features need to be evaluated. Conversely, contracting officers always argue that since the mandatory requirements have been taken care of, Cost-only Methodology can be used as the sole factor in deciding contract awards. This is a very conservative view, and the project committee has to deal with this very carefully.

## Weighted-scoring Methodology

Percentages or weights are allocated separately for both technical and financial evaluations. In evaluating each proposal, scores are assigned according to the strength of the features as stated in the tender document. Then, weights will be used to normalize the respective scores before adding them up. The winning proposal is one with the highest sum of scores from both evaluations. The main characteristics of this methodology are:

- \* Both technical and financial aspects of a proposal are evaluated separately;
- \* Weights for technical and financial can be adjusted according to circumstances;

Taking advantage from the above characteristics, Weighted-scoring Methodology is most applicable if:

- \* Sophisticated system features are desired by the users; and
- \* There is a need to allocate different weights between technical and financial evaluations.

In the case of the LMC computerization project, four vendors are invited to put up their detailed proposals after the pre-qualification stage. Since LMC is acquiring a turnkey system, vendor support and user training are two very important aspects. In addition, since all LMC employees are the first time computer users, there is a lack of technical personnel. Thus, LMC depends heavily on the successful vendor for system backup and technical support.

Under such circumstances, the project committee decided to give more weight on technical evaluation which includes hardware, software, vendor support, maintenance, documentation and training. Theoretically, this leads to the use of Weighted-scoring Methodology. However, it was due to some reasons as explained in Chapter V, page 70 and 71, Cost-effectiveness-ratio Methodology was applied in the LMC case.

#### Cost-effectiveness-ratio Methodology

Cost-effectiveness-ratio Methodology is similar to the Weighted-scoring Methodology in that technical evaluation is done and scores are assigned to each proposal. But, in the Cost-effectiveness-ratio Methodology the ratio of tendered price to technical merits is computed for each proposal. In this context, low ratio is desirable. The key features of this methodology are:

- \* There is no control over emphasis on either technical or financial factor;
- \* Only technical evaluation is assigned with scores;
- \* The ratio of total cost per technical score represents cost-benefit of a proposal;
- \* If there is a tie using Weighted-scoring Methodology, Cost-effectiveness-ratio Methodology resolves it by favouring the proposal with narrower difference between technical and financial scores.

Inherited with the above properties, Cost-effectiveness-ratio Methodology can be applied under the following

circumstances:

- \* A sophisticated and expensive system is acquired;
- \* Technical and financial factors are equally important in the evaluation;
- \* There is difficulty to evaluate cost on item to item basis.

### Sensitivity Study

This section shows a case where a set of data can produce different results in a proposal evaluation when different evaluation methodologies are applied. Referring to Table II, the second, third, and fourth columns are the technical scores and tendered prices of three proposals from vendors A, B, and C. Number in the parenthesis is the ranking of preference for the corresponding methodology. For Weighted-scoring Methodology, assume a 60 % weight is assigned to technical evaluation while financial evaluation takes up the rest. If *Cost-only* is the methodology used in choosing the 'best' proposal, then, vendor A should have won the contract due to its lowest bidding price. On the other hand, if the *Weighted-scoring Methodology* is applied, then, we would prefer vendor B because of its highest score. Certainly, proposal C would be the most cost effective proposal if *Cost-effectiveness-ratio* is the evaluation methodology employed.

From this case study, it can be realized that there is high sensitivity involved in choosing a suitable evaluation

methodology in a proposal evaluation. As a matter of fact, one of the modules in ACPES called *Advice on Evaluation Methodology Selection* is designed to make sure that a desirable methodology is chosen and used in any proposal evaluation. It is also to ensure that there is consistency in choosing evaluation methodology under different tender conditions.

TABLE II  
DIFFERENT EVALUATION METHODOLOGIES ON  
A SAME SET OF FIGURES CAN PRODUCE  
DIFFERENT OUTCOMES

Score / Cost	Vendor A	Vendor B	Vendor C
<u>Technical:</u>			
Before Normalized	195/300	255/300	220/300
After Normalized	39.0/60	51.0/60	44.0/60
5 Year Total Cost	590K	720K	600K
<u>Financial:</u>			
Before Normalized	180/200	148/200	178/200
After Normalized	36.0/40	29.6/40	35.6/40
<u>Methodology:</u>			
Cost-only	590 (1)	720 (3)	600 (2)
Weighted-scoring	75.0 (3)	80.6 (1)	79.6 (2)
Cost-effectiveness -ratio	3.03 (3)	2.82 (2)	2.73 (1)

## Summary

Three different computer system proposal evaluation methodologies are reviewed in this chapter. These methodologies are:

- (a) Cost-only,
- (b) Weighted-scoring, and
- (c) Cost-effectiveness-ratio.

Each of these methodologies has its own unique features. The applicability of each methodology depends on the procurement situations.

It should be aware that applying different methodologies on a same set of scores may produce different results. Therefore, it is of utmost importance that a right methodology is employed. It is also vital to ensure that the selection of evaluation methodology be consistent. The Advice on Evaluation Methodology Selection in ACPES is designed to provide consultancy, to counter check deviation, and to control any unbridled discretion in selecting evaluation methodology.

## CHAPTER IV

### EXPERT SYSTEM AND THE VP-EXPERT SHELL

#### Introduction

This chapter provides the overview of an expert system in relation to the Advisory Computer Procurement Expert System (ACPES). It discusses the ACPES knowledge domain and the general features of VP-Expert Shell that is to be used in developing ACPES. It is divided into two parts; the first part contains the following sub-topics:

- (a) General Structure of an expert system;
- (b) The ACPES knowledge domain;
- (c) Benefits of ACPES;
- (d) Appropriateness of ACPES domain.

The second part of this chapter focuses on the characteristic properties of the VP-Expert Shell.

#### General Structure of an Expert System

Expert system basically comprises of three components, namely, the knowledge domain, the inference engine, and the user interface [14, 16]. The knowledge domain contains facts and rules pertaining to an area of problem domain. The inference engine then applies the knowledge domain to make decisions. User interface provides the means of



communication and interaction between the users and the expert system in problem solving. Figure 4 shows the interconnection of the three components.

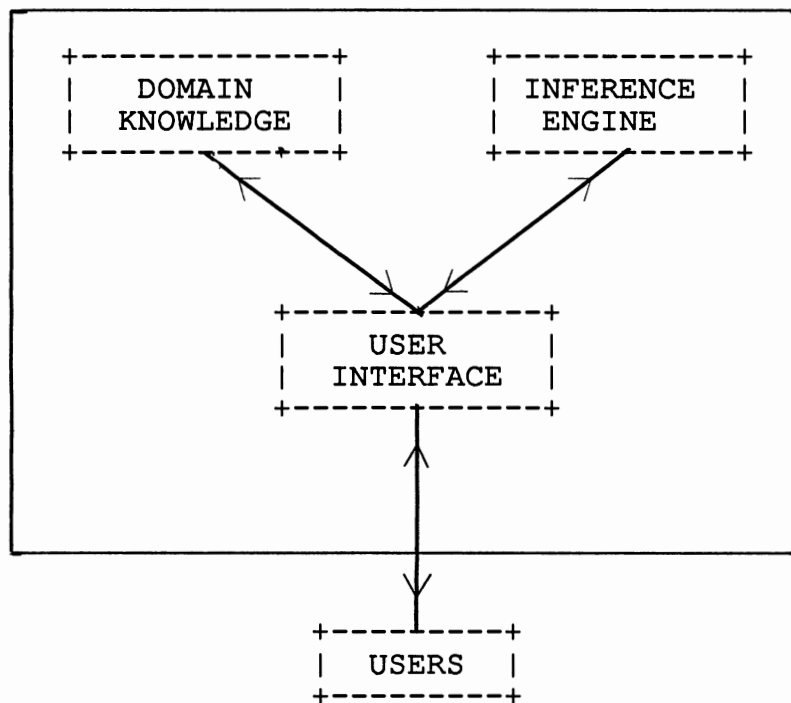


Figure 4. The Basic Structure of an Expert System Consists of Three Logical Components That Interact With the Users

Cleal D.M. and Heaton N.O. [3] in commenting on the term expert systems point out that:

**"Generally the term expert system is a misnomer and the expert system is used to provide guidance rather than expertise. It is important that the expert recognizes this and sees the system as an aid rather than as a threat."**

In a similar context, Simon G.L. defines expert system as a software product that "offers decision support, allows the user to enter into an interactive dialogue during which the system can offer advice, proffer decisions and also explain the reasoning that yields the conclusions [20]".

Though expert systems are now commercially used, today's expert systems are still not capable of generating new rules by themselves. They also do not possess the ability of adaptive learning [16]. Therefore, the design of ACPES inherits the same limitations of unable to self generate new rules and lacking the ability of self learning.

#### The ACPES Knowledge Domain

The knowledge engineer is the person responsible in acquiring and organizing the facts and rules in the knowledge base of an expert system. In the case of ACPES, the knowledge base is created mainly through the working experience of the author himself. This constitutes a dominant portion of the rules in the knowledge domain. Certainly, some rules in the knowledge domain are guided by the government circulars and have to be fully complied. In fact, if the knowledge engineer himself serves as the expert, it is likely to be more effective in eliciting the knowledge domain [3].

Elicited knowledge has to be translated into rules and organized in a form that is understandable by the inference engine. Control structure and interface capabilities will

then be added to the system. Hitherto, there are four commonly used knowledge representation models, namely, the production rules, semantic networks, frames, and predicate calculus or logic. Procedural knowledge is best represented by using production rules. Declarative knowledge can either be represented by semantic networks, frames, or predicate calculus [16]. Since ACPES predominantly consists of actions and procedures, a procedural knowledge data structure is most suitable. VP-Expert System Shell uses production rules in its knowledge representation. This is the main reason for choosing VP-Expert System Shell as the development tool in the implementation of ACPES.

The advantages of using production rules are due to the fact that these rules can easily be created and understood as compared to other form of representations. It is also a good way to represent strategies and recommendations which deal with a lot of experience in problem solving. The most basic production rule in the VP-Expert Shell consists of the IF-THEN relation. Usually, conjunctive AND and logical OR are used together in the formation of more complex rules.

#### Benefits of ACPES

Expert system is the state-of-the-art technology since early 1980s'. Over the last two decades, there has been a tremendous lead forward in the development of this area. Today, there is a widespread use of expert system technology ranging from defence, airline, management, manufacturing, to

retail stores [1]. In general, expert systems deliver many advantages to the users. Among some of the examples are:

- \* They assist in strategic planning and problem solving in many specific areas;
- \* They can be used as training tool for the inexperienced and poorly performing staff;
- \* The use of expert systems shorten the learning curve, reduce training cost and supervision;
- \* They ensure consistency in decision making, planning, and action;
- \* They can be easily deployed in any locations where their services are needed, regardless of the operating environment;
- \* They can be replicated and thus their expertise are more readily available to the users;
- \* They can be used to cope with the loss of skilled staff;
- \* They are not subjected to problems of human nature such as emotion, health, and aging as compared to human experts.

ACPES certainly inherits all the above listed benefits.

In addition, it has several peculiar advantages of its own:

- \* With the use of ACPES, departments will no longer have to rely totally on the government central agency to provide computer procurement experts which are in acute scarcity in the public sector;
- \* Using ACPES, computerization projects can take off

the ground in shorter time;

- \* With ACPES, it can help to prevent any mis-interpretation of government circulars on computer procurement procedures and irregularities;
- \* Computer procurement experts will have more time to work on procurement improvement issues.

At present, most of the computer procurements are under central control. Packaging the expertise and guidelines of computer procurement into ACPES is an attempt to cut sluggishness and strangulation in red tape while streamlining the procurement matters among government agencies. It is expected that by giving the mandate for the managers to manage would bring about quality services to the public. Essentially, this is the ultimate goal of public service. Since rules are fixed in ACPES, it helps in preserving consistency throughout its application and thus eliminating any human manipulations. Moreover, its availability helps to shorten the waiting time in computerization projects.

#### Appropriateness of ACPES Domain

Appropriateness of a problem to be developed into an expert system can be examined from the nature, complexity and scope of the problem [16].

In terms of the nature of the problem, computer procurement process requires the use of heuristics and is cognitive in nature. These make the ACPES domain suitable

for expert system development. Concerning the complexity and scope of the problem, Walters and Norman [24] suggest that the problem should be narrow-scoped and well-defined. Since each module in the ACPES is well-bounded by itself, and within which information relevant to the solution can be found, thus the question of ambiguity does not arise.

Walters and Norman further suggest that the application area should not depend extensively on common-sense reasoning. In contrast, ACPES consists of professional domain in which expertise is attained from formal training, real life experience, seminars, reading, as well as government documents. Finally Hayer-Roth [6] advises that "problems which experts can solve in a 3 minutes to 3 hours timespan are probably the best in terms of problem complexity". All these factors have been taken into consideration so as to decide what modules to be included in ACPES.

#### The VP-Expert Shell

Conventionally, expert systems can be built either by using a high level computer language (e.g. Lisp and Prolog), a shell (e.g. EMYCIN and SAGE), or a toolkit (e.g. KEE and ART). A shell is essentially an expert system without the knowledge domain, and a toolkit is a set of software routines used specifically in building and testing of knowledge-based system [4]. The use of shell as expert systems development tool has been increasingly popular among

system engineers in recent years.

VP-Expert Shell has been chosen as the system development tool for ACPES due to its suitability, simplicity, and ease of use. To execute VP-Expert, an IBM-compatible microcomputer with a minimum of 640 KB of memory and DOS version 2 or higher are required. The VP-Expert system environment provides menu-driven user interface with help facilities. Figure 5 shows the layout of the VP-Expert consultation screen.

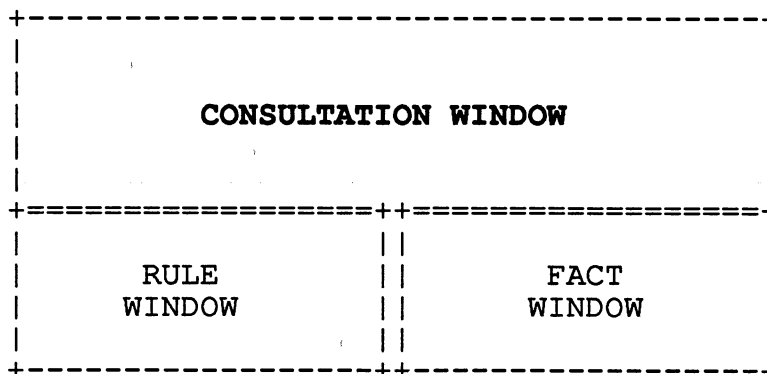


Figure 5. Format of the VP-Expert Consultation Screen

The consultation window is where the user interface occurs. Rule window displays the path of the inference engine, and the fact window displays the values of the variables known by the inference engine during a consultation session. The rule and fact windows are useful in understanding how a conclusion is made and it helps in

program debugging. However, once the system is built, the rule and the fact windows are usually hidden away from the users.

The inference engine of VP-Expert system uses backward chaining strategy. This means that search is conducted from the goal state to the initial state. Forward chaining is also possible using WHENEVER command.

VP-Expert allows the use of confidence factors or CNF to deal with uncertainty. CNF values are numbers between 0 and 100 with 100 as the default value which represents the highest level of confidence. Each variable can be assigned with a CNF during consultation with the knowledge base. But the CNF of the conclusion provided by the expert is programmed into the system. The values will then be used by the inference engine in showing the level of confidence on making an assertion. For multiple conditions in a rule connected by AND, the inference engine first checks for all the conditions. If the rule is found to be true, then the overall CNF of the rule is calculated from:

$$\text{Min [CNF(cond1), CNF(cond2),...]} * \text{CNF(conclusion)} / 100$$

For two conditions connected by OR, the calculation is as follows:

$$[\text{CNF(cond1) + CNF(cond2) - CNF(cond1) * CNF(cond2)} / 100] * \text{CNF(conclusion)} / 100$$

If there are more than two conditions connected by OR, then computation will proceed from left to right.



In the more complicated cases where multiple conditions are connected by a mixture of AND and OR, then the rule will be broken down into several semi-rules in which OR has a higher precedence than AND. Consider the following rule:

```
IF condition1 CNF1 AND condition2 CNF2
   OR condition3 CNF3 THEN conclusion CNF4
```

It will be broken down into two semi-rules:

```
IF condition1 CNF1 AND condition2 CNF2
OR
IF condition1 CNF1 AND condition3 CNF3
THEN conclusion CNF4
```

If this rule fires, then the overall CNF for this rule will be:

$$\left[ \frac{\text{Min}(\text{CNF1}, \text{CNF2}) + \text{Min}(\text{CNF1}, \text{CNF3})}{\text{Min}(\text{CNF1}, \text{CNF2}) * \text{Min}(\text{CNF1}, \text{CNF3}) / 100} \right] * \text{CNF4} / 100$$

### Summary

Application of expert systems has been remarkably effective and prevailing in recent years. One of the reasons is due to the emergence of system development tools. VP-Expert Shell is one of them. A shell is an expert system without the knowledge domain. The other two logical components of an expert system are the inference engine and the user interface.

Since ACPES dominantly consists of procedures, production rule is the most suitable knowledge representation model. VP-Expert Shell uses the IF-THEN production rules which, combined with its simplicity and ease of use, have

obviously made it a suitable choice for ACPES.

The objectives of developing ACPES are discussed in the light of improving the present government procurement procedures. In an effort to decentralize the procurement control, some government mechanism has to be furnished so as to streamline the procurement process in all the government agencies. ACPES strives the first step in this direction by giving expertise and guidelines in government computer system procurements.

On the appropriateness of the ACPES knowledge domain for expert system development, the relevant literature has been reviewed. From the nature, complexity and scope of the problem (which is modularized), ACPES is found to be appropriate for expert system development.

To familiarize with the VP-Expert Shell, some of its crucial properties are discussed under the heading of "The VP-Expert Shell". These include the minimum computer configuration to execute the shell, the consultation screen, the inference engine strategy, and the use of confidence factors in dealing with uncertainties.

## CHAPTER V

### DEVELOPMENT OF ACPES

#### Introduction

Expert system is an application system which assists in solving problems using the encoded knowledge of experts. In designing an application system, the user requirements have to be taken into consideration first. This chapter is divided into several parts. The first part is devoted to review some of the basic user requirements in ACPES. The second part describes the system development methodology used in designing and coding of the program. To validate the system, two cases are put to test. The test results are discussed in part three. The operational features and the updating of ACPES will then be presented in part four. Finally, a chapter summary is given.

#### User Requirements

Besides to streamline the implementation of the integrated computer procurement approach, the other main objective of developing ACPES is to help the public service to overcome the problem of scarcity of computer procurement experts especially if a government decides to decentralize the approval and procurement of computers in all government

departments. Therefore, ACPES must be of a package that can be made readily available and portable for the use of any department. In view of this, ACPES is developed on a platform that requires only a simple system configuration such as an IBM compatible microcomputer to run. This is because most of the government departments acquire microcomputers before they look for medium or large scale computer systems. The selection of VP-Expert Shell also satisfies other user requirements. At the ground level, the requirements are that the expert system must be able to provide guidelines and advice on:

- (a) Whether computerization is a feasible and justifiable solution to the problems faced by the organization;
- (b) How to conduct the Initial System Study (ISS) and produce the report for the purpose of requesting solutions from the interested vendors;
- (c) How to short-list vendors based on their presented solutions during pre-qualification presentations;
- (d) What subject matters are to be included in the Tender Specification Document;
- (e) How to select appropriate evaluation methodology.

The five modules in ACPES satisfy these user requirements.

All questions asked by the expert system are based on the checklists by Price [18], government circulars as well as the Treasury Circular on computer procurement [11], and the experience of the system engineer while working in The

Malaysian Administrative Modernization and Management Planning Unit (MAMPU).

Another important user requirement is the documentation of user input and the advice given by ACPES. To enable an easy way of doing documentation, the PRINTON and DISPLAY commands are included. Basically, the DISPLAY command displays a given text message to the user. The literal text can be up to 1,000 character long, including spaces, and must be surrounded by double quotes. The PRINTON command, when executed, causes all subsequent DISPLAY text to print on a printer as well as on screen. Thus, when these two commands are used together in ACPES, a sequence of displayed messages will be printed which document the consultation.

To enable ACPES to be used as a training package in computer procurement for new government officers, each rule is attached with a brief explanation why such conclusion is drawn, or why such information (input) is important in making decision. Examples may also be given for easy reference. For instance, if Rule 18 in Figure 6 of page 61 is fired during a consultation, the explanatory note in quotes will be displayed and documented. Other user interface features such as how a conclusion is drawn (by setting the trace path), why a question is being asked (if the BECAUSE clause is programmed into the rule) and what-if analysis (by changing the value of one variable while maintaining all the others) are built-in features of the VP-Expert Shell.

```
RULE 18
IF    Q12=Can AND Q13=Can AND Q14=Not_likely
      AND Q15=Not_likely
THEN Iss=is_not_justifiable

DISPLAY
      "In general, the justification for computerization falls
into any of these four categories: That the operational
requirements cannot be met without automation (e.g. high
data volume); cannot find staff to do the low level manual
work (e.g. data aggregation for statistics); able to save
resources in long term (e.g. EDI application); and able to
improve customer service quality and generate higher
profit (e.g. ATM).";
```

Figure 6. An IF-THEN Rule That Uses the DISPLAY Command for the Purpose of Documentation

Since most of the ACPES users are expected to be inexperienced or new officers, user friendliness is another important aspect. The introductory screen is therefore designed in each module to explain the purpose of the module, and how to use CNF. Figure 7 on next page is an example of such screen. Thereafter, the hierarchical type of menu interface (such as those employed in the Lotus 1-2-3 Spreadsheet) makes ACPES very simple to use. At any moment, users can press Function-key 1 to get help from the system.

ACPES must also be able to handle uncertainties as some of the questions may require the users to input judgmental data. By inputting certainty factors, comparisons can be made between proposals based on the levels of confidence in the conclusions. Certainty processing is handled by using Confidence Factor or CNF provided in the expert system shell as explained in Chapter IV. This increases the

usability of the system.

This expert system advises you on matters relating to the formation of the Initial System Study (ISS) team. It assists you in finding out if the solution of computerization of an organization is feasible and justifiable. If you can conclude positively, then you may proceed to the next stage, i.e. Request For Solution (RFS).

To enter the Confidence Factor (CNF), follow these steps:

- \* move lighter to the answer, press the Home key,
- \* enter CNF value between 0 and 100, then
- \* press the Enter key followed by the End key.

The default value of CNF is 100, the highest level of certainty.

Please carefully answer every question asked by the expert system.

Please press the SPACEBAR to start the consultation.~"

1Help    **2Go**    3Whatif    4Rule    7Set    8Edit    9Quit  
 1Help 2How? 3Why? 4Slow 5Fast 6Quit

Figure 7. An Introductory Screen of a Module in ACPES

### Expert System Development

ACPES is divided into five modules. Each module has its logical function satisfying one of the user requirements listed (a) to (e) in the previous section. Practically, they are corresponding to the first five stages in the integrated computer procurement approach as described in Chapter II. By splitting ACPES into modules allows program

development to be done in phases. Virtually, it facilitates program debugging, testing and validation during program development, and modification during system updating. It also increases the readability and understandability of the system. Moreover, modularization is necessary because VP-Expert Shell limits the size of each knowledge base to 16 Kilobytes.

Each module is being treated as a major area in the whole problem space. Each major area is then subdivided into sections. Figure 8 below illustrates the division of the module that gives guidelines on tender specification preparation into 12 sections.

P	O	S	D	-- General Conditions of Tender
R	F	P	O	-- Schedule of Prices
E		E	C	-- Operational Requirements
P	T	C	U	-- Technical Requirements
A	E	I	M	-- Implementation Requirements
R	N	F	E	-- Support Requirements
A	D	I	N	-- Training Requirements
T	E	C	T	-- Documentation Requirements
I	R	A		-- Contract Requirements
O		T		-- System Conversion
N		I		-- Demonstration
		O		-- Miscellanies
		N		

Figure 8. Module of ACPES for Guidelines on Tender Specification Preparation is Subdivided Into 12 Sections



Sections are further broken down into one or more questions or facts that require the users to input values for the variables when prompted by the expert system. In some areas, if the user inputs 'Not sure' in response to a question, some follow-up questions will be asked in order for the inference engine to find the fact for that question. However, due to the limitations of the version of the VP-Expert Shell used in developing ACPES, such tactic cannot be fully expressed in this project. Subsequently, rules are developed based on expertise. There are a total of 178 rules and 105 facts in ACPES. Table III below shows the break down of the number of rules and facts in each ACPES module.

TABLE III  
NUMBER OF RULES AND FACTS IN  
EACH MODULE OF ACPES

No.	Function of Module	No. of Rules	No. of Facts
1	Guidelines on ISS	73	21
2	Guidelines on RFS	26	26
3	Advice on Short-listing	36	16
4	Guidelines on Tender Specification	29	29
5	Advice on Evaluation	14	13
	Methodology Selection		
	TOTAL	178	105

## Consultations

It is relatively easy to consult ACPES. Operations are mainly menu-driven. Figure 9 and Figure 10 on next page show the main menu and the consult menu of the VP-Expert Shell. To load the user file, first set the path (drive) using DOS command, choose the knowledge-based file from a displayed list, load the file by choosing 'consult' option, then choose 'go' option to begin the consultation. From then on, the user merely has to respond to each question by moving the cursor to the most appropriate answer and press the Return key. To use the confidence factor (CNF), move the cursor to the selected answer, press the Home key, key-in the CNF, and press the Return key. To mark the completion of a question, the user has to press the End key if the ENDOFF command is not included in the module. For questions involving plural variable where the user can choose more than one answers, the End key is compulsory to indicate the completion of a question. To delete a selected answer, simply move the cursor to the answer and press the Delete key. The expert system will only prompt the user with questions relevant to the current rule being tested. Consultation terminates whenever a goal is reached. Figure 11 and 12 on page 67 show a consultation screen and a conclusion screen of ACPES.

<p style="text-align: center;"> V P - E X P E R T  Version 2.1  Copyright (c) 1988  By Brian Sawyer  All Rights Reserved  Editor Portion Copyright (c) 1984, 1985, 1987, Idea Ware  Inc.   Educational Version  Published by Paperback Software International </p>	
[ RULES ]	[ FACTS ]
1Help 2Induce 3Edit <b>4Consult</b> 5Tree 6FileName 7Path 8Quit 1Help 2Go 3Whatif 4Rule 7Set 8Edit 9Quit	

Figure 9. The Main Menu of the VP-Expert

1Help <b>2Go</b> 3Whatif 4Rule 7Set 8Edit 9Quit 1Help 2How? 3Why? 4Slow 5Fast 6Quit	

Figure 10. The Consult Menu of the VP-Expert

```
The first step in ISS is formation of a study team. Which
of the following groups of personnel are represented in
your ISS team?
A=Users  B=Data processing  C=Management  D=All the above
(You may choose more than one answers.)
A          B          C          D

Do you have data processing professionals in your
organization?
Yes          No

Enter to select  END to complete  /Q to Quit  ? for
Unknown
```

Figure 11. An Example of a Consultation Screen in One of the ACPES Modules. Options in Bolt Print are the Chosen Answers

```
In general, the justification for computerization falls
into any of these four categories: That the operational
requirements cannot be met without automation (e.g. high
data volume); cannot find staff to do the low level
manual work (e.g. data aggregation for statistics); able
to save resources in long term (e.g. EDI applications);
and able to improve customer service quality and generate
higher profit. (e.g. ATM).

Expert system advises that this computerization
is not justifiable.

H A V E   A   G O O D   D A Y   !!

Please press the SPACEBAR to exit.
```

Figure 12. The Advice From One of the Modules in ACPES

## System Updates

ACPES needs to be updated as computer procurement is a dynamic subject. For instance, changes in government policies or procurement procedures may affect the existing rules in the ACPES knowledge domain. Fortunately, the modularity of ACPES according to logical functions greatly facilitates system updating in terms of time required to testing and recompilation [5].

To update any modules of ACPES, load the module into a familiar word processing package. Update the affected questions, then search for all the rules that contain such questions. Update these rules according to the latest changes. If new questions are added, examine which rules are affected and amend them. Append any additional rules to the RULE section, if any. The module is then ready to be recompiled. Error message will be shown on the screen one at a time during compilation. Correction can be accomplished using the VP-Expert editor. Paths of the affected rules will then be tested using test data before releasing the new version for production work.

## System Testing And Validation

During the system development stage each module is tested exclusively to ensure that it behaves as expected and rules are fired as designated by the system engineer. However, due to the exponential nature of the number of paths with respect to the increase in the number of facts in

the knowledge base, it is next to impossible to test all the combinations of facts in the knowledge base.

To demonstrate the usability and the usefulness of ACPES, and how ACPES can provide guidelines and advice in computer procurement consultations, the LMC computerization project [12] and the computerization of Department S (the name S represents an anonymous department) are put to test. In carrying out the tests, relevant materials for these two projects were reviewed before ACPES consultation sessions began. This is to ensure some accuracy in providing the answers to the questions being asked during consultations. Appendixes C and D document the entire process of consultations for the LMC and Department S projects respectively using ACPES. A portion of the knowledge base in each module can also be seen from these printouts.

#### Test Result Analysis

When the computerization projects of LMC and Department S were put to test using module-1, both were found to be feasible and justifiable to the organizations. For LMC, it was tested twice. In the first test, it was found that there was no data processing professionals in the Initial System Study team. This was then rectified. Perhaps this was because there was no computer staff in LMC. On the other hand, Department S had its in house computer staff way before the computer acquisition.

The Initial System Study Reports and the Tender

Specification Documents produced in both projects are found to be conformed to the standard and the requirements stated in module-2 and module-4 of ACPES respectively. These two modules are designated to serve as the guidelines in the preparations of both documents.

Module-3 of ACPES was consulted to short-list vendors during their pre-qualification presentations. In the LMC project, 11 vendors and their proposals were screened using module-3. Out of 11 vendors, four were short-listed. They are: vendor 2 of 11, 6 of 11, 8 of 11, and 9 of 11. The confidence factors in short-listing these four vendors ranged from 67% to 100%. Most important of all, the outputs from these consultations matched with those that were done without ACPES. (Please refer to Table I on page 30). Similarly, consultations on module-3 resulted in four short-listed proposals in the Department S project, which again matched with the actual situation where IBM, NCR, Data General, and Sperry Univac were short-listed. The confidence factors in this case was between 67% to 79%.

Module-5 of ACPES is designed to give advice on the selection of evaluation methodology. In the case of Department S project, the output from the consultation agreed with the use of Cost-effectiveness-ratio Methodology as in actual course. However, in the LMC project, the advice given by ACPES was Weighted-scoring, but Cost-effectiveness-ratio was applied instead. This discrepancy was due to the Financial Officer's insistence that financial

evaluation should be given equal weight as technical evaluation in the procurement exercise. Eventually, it came to a compromise and Cost-effectiveness-ratio was chosen after a lengthy discussion. The summary of the test results as compared to actual are tabulated in Table IV below.

TABLE IV  
NUMBER OF MATCHES BETWEEN ACTUAL AND  
TEST RESULTS BY MODULE OF ACPES

Module #	Number of Test	Number of Matches
Module-1	2	2
Module-2	2	2
Module-3	19	19
Module-4	2	2
Module-5	2	1

#### Summary

This chapter states the user requirements in ACPES. It provides guidelines and advice to the users according to the integrated computer procurement approach as described in Chapter II. ACPES has to be readily available and easily portable; friendly, and easy to operate because most of the users are expected to be non-experienced.

To a certain extent, the development methodology of ACPES is influenced by the user requirements and the



features of the VP-Expert Shell. Obviously, dividing ACPES into five logical modules has many advantages. Not only that this approach facilitates system development, it makes system maintenance and updating easier and more efficient.

A brief description of ACPES consultation operations is also given in this chapter. Eventually, the computerization projects for LMC and Department S were input into ACPES for illustration as well as system testing and validation. An analysis of the tests is given as conclusions.

In the next chapter, some conclusions of this study will be provided together with some insight on future research directions.

## CHAPTER VI

### CONCLUSION AND FUTURE RESEARCH

In recent years, the widespread use of computers in data processing, transaction processing, record keeping and many other governmental activities, has resulted in computer proliferation in many developing countries. The government, on one hand, is encouraging the use of this high technology, but on the other hand, has to be cautious of all computer procurements to prevent any misuse or waste of public funds. Nevertheless, the scarcity of information technology experts, coupled with the revolutionary advances in information technology industry, have led to a situation where traditional computer procurement procedures become ineffective. In the technical approach, the needs of the agency are translated by a group of internal data processing personnels or the users with their limited up-to-date market information, and the vendors are just asked to comply with what have been specified in the tender document. Whereas in the managerial approach, most technical issues are not properly addressed and evaluated at the time of procurement.

The integrated computer procurement approach was devised from the traditional approaches. However, it has many advantages over the traditional approaches:

- \* It promotes greater understanding and commitment among technocrats and the executives in the agency;
- \* It saves resources for both the agency as well as those vendors who do not meet the basic user requirements;
- \* It assists in tender document preparation;
- \* It increases the effectiveness in proposal evaluation.

This study, therefore, suggests to formalize the use of this integrated approach in all procurement of government computers, especially in the developing countries.

In line with the formalization of this integrated computer procurement approach, and the tendency of a government to decentralize the procurement control, an expert system called ACPES is developed to streamline all departmental procurement process by providing guidelines and advice. Furthermore, it can help to prevent misinterpretation of government regulations and reduce irregularities by giving consistent advice and recommendations.

ACPES was built on VP-Expert Shell. It consists of five modules. The first module gives advice on the Initial System Study (ISS). The second module on the preparation of the ISS Report to be used in requesting for proposals from vendors. The third on the short-listing of vendors. The fourth on the preparation of Tender Specification Document, and the fifth on the selection of evaluation methodology.

Two typical computerization projects were put to test; one was the Local and Municipal Council's computerization project, which had been used throughout this study as an

example, and another was from Department S. Eventually, it was found that:

- \* Both the computerization projects of LMC and Department S were feasible and justifiable;
- \* The ISS Reports and the Tender Specification Documents in both cases were conformed to the advice given by ACPES;
- \* In both cases, the list of short-listed vendors during the pre-qualification presentations was the same as those done previously without using ACPES;
- \* The evaluation methodology used in one of the two cases conformed to the advice given by ACPES, but the other one did not.

In view of the satisfactory use of the integrated computer procurement approach in the LMC project, and the encouraging test results shown in ACPES, this study concludes that:

- (a) The integrated computer procurement approach should be formalized and used in the government computer procurements especially in the developing countries;
- (b) ACPES can be used to assist the implementation of the above-mentioned procurement approach.

There are several areas in this study where future research can concentrate on. One possible area would be the use of a more powerful expert system shell to develop ACPES so that more comprehensive knowledge bases for each ACPES

module can be developed. It also enables the inclusion of the module on detail proposal evaluation. This module requires a fairly large knowledge base. Another area with regard to the use of more powerful development tool would be the use of fuzzy logic in the inference engine. The use of fuzzy logic would improve on the quality of decisions especially those dealing with ambiguous values.

The other area of interest for future research would be the examination of the level of success on integrated computer procurement approach and ACPES after putting them into use. However, this can be conducted only after a number of years of use of the system to ensure a significant analysis.

## REFERENCES

1. Bramer, Max Practical Experience in Building Expert Systems. John Wiley & Sons, England, 1990.
2. Brow, R.B., Wright, R.D.J., Cloke, C.G., Morris, T.B., Trumper, I.F.S. Government Purchasing: A Multi Department Review of Government Contract and Procurement Procedures. Her Majesty's Stationary Office, London, 1984.
3. Cleal, D.M., Heaton, N.O. Knowledge-based Systems: Implications for Human-computer Interfaces. Ellis Horwood, England, 1988.
4. Edwards John. S. Building Knowledge-Based Systems: Towards a Methodology. Halsted Press, New York, 1991.
5. Fett, D.P. An Expert System for Auditing Data Communications. Thesis for Master of Science, Oklahoma State University, Stillwater, 1989.
6. Hayes-Roth, Frederick, Waterman, Donald A., and Lenat, Douglas B., eds. Building Expert Systems. Addison-Wesley, Reading, Massachusetts, 1983.
7. Kelman, S. Procurement and Public Management, The Fear of Discretion and the Quality of Government Performance. The AEI Press, Washington, D.C., 1990.
8. Koh, S.H. Computer and Productivity: A Study of its Usage in the Local and Municipal Councils. Journal of Malaysian Public Service 1, 2 (May 1989), 34-38.
9. The Malaysian Administrative Modernization and Management Planning Unit Computer Utilization in Local and Municipal Councils of Malaysia, 1990.
10. The Malaysian Administrative Modernization and Management Planning Unit System Acquisition and Evaluation, 1987.
11. The Ministry of Finance of Malaysia The Treasury Circular 8 of 1976: Application for Electronic Data Processing Systems, Procedures and Guidelines, Malaysia, Dec. 1976.

12. The Municipal Council of Kota Setar Tender Document for a Turnkey Project to Supply, Deliver, Install, Test, Commission and Develop Application Systems for the Municipal Council of Kota Setar, 1987.
13. Norton, Henry Computing Procurement Guidelines and Procedures. Oxford University Press, Oxford, 1988.
14. O'Brien, J. A. Management Information Systems, A Managerial End User Perspective. Richard D. Irwin, Inc., 1990.
15. Parameswaran Computerization, A Way of Life for Civil Servants. Business Times, (1990, Dec. 8), 13.
16. Pigford, D.V., Baur, G. Expert Systems for Business: Concepts and Applications. Boyd & Fraser, Boston, 1990.
17. Pope, J. Marketing in The Public Sector, Government Procurement. IBM Australia Limited Public Sector Region, 1988.
18. Price, S. Managing Computer Projects. Price Project Services Ltd., Manchester, 1986.
19. Prime Minister's Department of Malaysia The General Circular 1 of 1985: Establishment of National Data Processing Committee, Malaysia, Jan. 1985.
20. Simon, G.L. Expert Systems and Micros. NCC, England, 1985.
21. Sondergaard, A. Selection of Hardware and Software and Acquisition Procedures. Datacentralen af 1959, 1985.
22. Teh, Kelvin Computers for Keeping Government Records Up-to-date. Computimes, (April 1992), 1-2.
23. Vince, P. Vagas A Report on The Phillipine Computer Industry. Japan-Asia Conference for Computerization, CICC Foundation, Japan, 1987.
24. Walters, J.R., Norman, R. N. Crafting Knowledge-based Systems: Expert Systems Made Easy/Realistic. Wiley-Interscience, New York, 1988.
25. Wee, Tew Lim Brief Report on The Computerization Position in Singapore. Japan-Asia Conference for Computerization, CICC Foundation, Japan, 1987.
26. Yan, Zhaoming The Computerization in China. Japan-Asia Conference for Computerization, CICC Foundation, Japan, 1987.

APPENDIX A

SAMPLES OF CONSULTATION SCREEN

The following four screens each corresponds to a rule in the knowledge base of the expert system. The answers to the questions are printed in bold and are underlined.

This expert system advises you on matters related to the short-listing of vendors during the pre-qualification stage in computer system procurement.

Press any key to start the consultation.

Do you think this vendor understands your organization problems?

**Yes**

No

How is the annual turnover sale for the last three years of the company?

**Increasing**

Fluctuating

Decreasing

Engaging a vendor who understands your problems can provide good advice and design better application systems. In addition, less attention is needed while developing the systems. An increasing annual sale generally indicates healthy growth of a company, thus, the downward side is reduced.

The expert advises that this vendor should be short-listed.

Press the SPACEBAR to exit the consultation.



This expert system advises you on matters related to the short-listing of vendors during the pre-qualification stage in computer system procurement.

Press any key to start the consultation.

Do you think this vendor understands your organization problems?

Yes

No

How is the annual turnover sale for the last three years of the company?

Increasing

Fluctuating

Decreasing

Fluctuation in sale is quite common, however, there is usually a reason for it. You may want to verify the reasons and examine the employee turnover rate before you make your decision to short-list this vendor or not.

The expert advises that this vendor can be considered for short-listing.

Press the SPACEBAR to exit the consultation.

This expert system advises you on matters related to the short-listing of vendors during the pre-qualification stage in computer system procurement.

Press any key to start the consultation.

Do you think this vendor understands your organization problems?

Yes

No

How is the annual turnover sale for the last three years of the company?

Increasing

Fluctuating

Decreasing

There is a risk of discontinued support from the vendor as the company may be sold, taken over or wind up if sales continue to decline.

The expert advises that this vendor should not be short-listed.

Press the SPACEBAR to exit the consultation.

This expert system advises you on matters related to the short-listing of vendors during the pre-qualification stage in computer system procurement.

Press any key to start the consultation.

Do you think this vendor understands your organization problems?

Yes

No

It can be extremely difficult and time consuming for a vendor who cannot perceive your problems and the objectives of computerizing your organization.

The expert advises that this vendor should not be short-listed.

Press the SPACEBAR to exit the consultation.

## APPENDIX B

### LIST OF CONTENTS OF TENDER SPECIFICATION DOCUMENT

1. Description of organization:
  - Organization objectives
  - Organization set up
  - Organization chart
2. Project:
  - Title
  - Background
  - Goals
3. Procedure of tender:
  - General rules conform to government regulations
  - Closing date
  - Where to be sent
  - Number of copies
  - Separate packaging for technical and financial proposals
  - Format of tender
  - Contact person and telephone
4. Operational requirements:
  - Terms of reference of operational requirements
  - Functions required
  - Data and process
    - structures, flow and interrelationship
  - Minimum performance expected
    - Response times at normal and maximum loads
  - Expansibility
    - physical
    - functional
  - Reliability requirements
    - Mean Time Between Failures
    - serviceability
  - Security requirements
    - physical
    - logical
    - data level
    - file level
    - communication
    - Documentation standard

5. Technical requirements:
  - Details of existing facilities
  - Details of computer policy, if any
  - Specifications for interfaces with other systems
  - Site details with plan
    - floor space
    - floor loading
    - power supply
    - access
    - potential hazards
  - Details of data files and databases to be set up
  - Computer language prefer
6. Implementation requirements:
  - implementation plan
  - implementation strategy
7. Support requirement:
  - specify operational hours
  - preventive maintenance scheme
  - minimum and maximum response time after receiving notification of a breakdown
8. Schedule of prices
  - format for price quotation
    - direct purchase
    - leasing (3-year period)
    - annual maintenance cost
9. Contract requirements:
  - attached a sample contract for comments
10. Questionnaire
  - attached questionnaire to be answered

## APPENDIX C

### TEST PROCEEDINGS AND RESULTS OF THE LMC PROJECT

MODULE 1: Testing on the Formation of ISS team, Feasibility  
and Justification of the Project

Assignment: TEST 1 of Module 1

Date: 10-23-1992

#### Proceeding of Consultation

The first step in ISS is formation of a study team. Which  
of the following groups of personnel are represented in your  
ISS team?

A=Users B=Data processing C=Management D=All the  
above

(You may choose more than one answers.)";

**A**                    **B**                    **C**                    **D**

Do you have data processing professionals in your  
organization?";

Yes                    **No**

#### Results

It is crucial to include data processing (D.P.)  
professionals in the ISS team because they can provide  
computer expertise in the discussions. Since your  
department does not have D.P. staff, please get assistance  
from either your parent organization, MAMPU, or INTAN.

Expert system advises that this computerization:  
CANNOT BE DETERMINED YET CNF 100.

Assignment: TEST 2 of Module 1

Date: 10-23-1992

Proceeding of Consultation

The first step in ISS is formation of a study team. Which of the following groups of personnel are represented in your ISS team?

A=Users    B=Data processing    C=Management    D=All the above

(You may choose more than one answers.)

**A                    B                    C                    D**

Each representing group in the ISS team should have certain knowledge. Does the user group possess the following knowledge/quality?

A=Operational knowledge                    B=Analytical ability  
C=Some computer knowledge                D=Some organizational knowledge

(You may choose more than one answers.)

**A 89                    B 68                    C 55                    D 60**

Does the group representing the data processing professionals possess the following knowledge/quality?

A=System design analysis    B=Technical writing ability  
C=Application knowledge    D=Communication skill

(You may choose more than one answers.)

**A 95                    B 70                    C 83                    D 60**

Besides management skills, does the group representing the management possess sufficient corporate financial knowledge?

**Yes 89                    No**

Under the Terms of Reference, do you have a clear and specific objective, and a realistic scope of study?

**Yes                    No**

Under the Terms of Reference, have you included the following issues?

A=Constraints                    B=Timescales                    C=Method of Reporting  
D=Progress Control Method for Study

(You may choose more than one answers.)

**A                    B                    C                    D**

The next 4 questions associate with feasibility of computerization. Please give a profound thought before answering each of the questions.

Use CNF to indicate the degree of confidence.

Is the technology needed to perform the tasks commercially available?

**Yes 88                    No                    Not sure**

Does the organization possess or have access to the necessary resources including finance to provide computerization?

Yes                      No                      **Not sure 75**

You have to consult the financial officer if budget for the project has already approved by the Treasury. Is budget confirmed?

**Yes 99**                      No

Will computerization fit in with the organization environment?

Yes                      No                      **Not sure 60**

Environment here means the supporting infrastructure such as fiber optic transmission lines. It also refers to the portability and shareability of information with other agencies. Think along this line and do you feel environment conditions permit this computerization project?

**Yes 79**                      No                      Not sure

Are the staff of the organization prepared to support computerization?

**Yes**                      No                      Not sure

The next 4 questions determine the justification of computerization. Please answer each of the question carefully.

Use CNF to indicate your level of confidence.

Can the requirements be met without a computer?

**Can 66**                      Cannot                      Not sure

Can you find staff who can tolerate manual methods disregard of low skill level and social stigma?

**Can 75**                      Cannot

Can significant financial/staff saving be achieved in long term through computerization?

**Likely 89**                      Not likely

### Results

Congratulation! You have a good ISS team to work with, and the computerization project is feasible and justifiable. Now, you may proceed to the next procurement stage, i.e. Request For Solution. The filename is RFS.KBS.

Expert system advises that this computerization:  
IS FEASIBLE AND JUSTIFIABLE CNF 100.

MODULE 2: Guidelines on ISS Report Preparation.

Assignment: TEST 1 of Module 2

Date: 10-23-1992

Proceeding of Consultation

For each of the items mentioned in the following questions, please check if you have included them in the Initial System Study (ISS) Report which is to be given to the interested vendors at Request For Solution stage.

A precise project title.

**Included**                      Not included

Background of the organization.

**Included**                      Not included

List of applications to be computerized.

**Included**                      Not included

List of existing facilities used in daily operations.

**Included**                      Not included

The organization chart indicating the geographical locations as well as the number of users for each application.

**Included**                      Not included

The maximum and average loadings for the system.

**Included**                      Not included

The expected average response time in normal daily operation.

**Included**                      Not included

The tolerable system availability time in percentage.

**Included**                      Not included

The maximum tolerable recovery time.

**Included**                      Not included

Deadlines for:

(i) Hardware installation

(ii) System software installation.

**Included**                      Not included

The next 7 questions apply to each of the application systems planned to be computerized.

The functional specification.

**Included**                      Not included



Details of current operational procedure.

**Included**                      Not included

The current data volume.

**Included**                      Not included

The expected annual growth rate of the data volume.

**Included**                      Not included

Sample record kept at present.

**Included**                      Not included

The interrelationship between data and process in diagrammatic form.

**Included**                      Not included

The deadline of system hand over.

**Included**                      Not included

What are the other application systems planned to be computerized in the near future and their estimated storage requirements for both data and programs.

**Included**                      Not included

The security requirements for:

- (i) Loss of data
- (ii) Unauthorized access.

**Included**                      Not included

Documentation requirements:

- (i) Type
- (ii) Number of copy
- (iii) Language of instruction.

**Included**                      Not included

Training requirements:

- (i) Topic/area
- (ii) Place.

**Included**                      Not included

Minimum warranty requirements:

- (i) Coverage
- (ii) Duration.

**Included**                      Not included

Minimum support requirements:

- (i) Maintenance
- (ii) Number of years of guaranteed technical support.

**Included**                      Not included

Operational standards to be followed strictly.

**Included**                      Not included                      Not applicable

General computer policy to be strictly adhered to.  
Included                      Not included                      **Not applicable**

Site details.  
**Included**                      Not included

### Results

Expert system advises that ISS REPORT IS COMPLETE CNF 100.

You have successfully completed the ISS Report which will be referred to by the interested vendors before they make their pre-qualification presentations. During their presentations, they will propose total solutions to your organization according to the requirements stated in this ISS Report. Now, you may get the consent from the top management, and then advertise in several news papers to invite the interested vendors to collect the ISS Report from your organization. The next knowledge base in ACPES you may want to consult is LIST.KBS for short-listing of vendors.

MODULE 3: Advices on short-listing of vendors at the Pre-qualification Presentation and Preliminary Short-listing Stage.

Assignment: TEST 1 of Module 3

Vendor Code: 1/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

Yes                      No                      **Not sure 70**

Please refer to the ISS Report for the list of mandatory requirements. Can you confirm you have the list now?

**Can 95**                      Cannot

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

**All**                      Only some

Do you think this vendor understands your organization problems?

70% or more                      **Less than 70% 88**

Results

Awarding a project to a team who cannot see your problems is to invite risk to your project.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 88.

Assignment: TEST 2 of Module 3

Vendor Code: 2/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes** No Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes** No Not sure

Are there any mandatory requirements not being answered?

Yes **No**

Does the solution presented meet all the mandatory requirements?

**All 85** Only some

Do you think this vendor understands your organization problems?

**70% or more 79** Less than 70%

Is the proposed total solution feasible?

**Yes 95** No Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

Increasing **Fluctuating 85** Decreasing

How do you grade the employee turnover of the company?

**Healthy 77** Too high

What percentage of the profit is put into R & D by the manufacturer?

Above 20% **Between 10 & 20%** Below 10%

What is the ratio of technical staff per installation?

(Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)

**A** B C

Is the initial cost higher than the budget?

Yes **No**

Results

You need to check why its sales fluctuated and less than 20% of its profit is channelled back to R & D.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 77.

Assignment: TEST 3 of Module 3

Vendor Code: 3/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

Yes                      No                      **Not sure 85**

You can request for a copy of the registration certificate. Examine the company name, expiring date, and the category of supply. Is the certificate valid?

**Valid 98**                      Not valid

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

**All**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 75**                      Less than 70%

Is the proposed total solution feasible?

**Yes 86**                      No                      Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

Increasing                      **Fluctuating**                      Decreasing

How do you grade the employee turnover of the company?

Healthy                      **Too high**

Results

After sale support may not be provided satisfactorily due to lack of experienced personnel in the company.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 100.

Assignment: TEST 4 of Module 3

Vendor Code: 4/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

**All 85**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 82**                      Less than 70%

Is the proposed total solution feasible?

Yes                      **No 79**                      Not sure

Results

Infeasible solution is good on paper only.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 79.

Assignment: TEST 5 of Module 3

Vendor Code: 5/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

All                      **Only some 95**

Results

ALL mandatory requirements MUST be met for further consideration.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 95.

Assignment: TEST 6 of Module 3

Vendor Code: 6/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

Yes                      No                      **Not sure 68**

You can request for a copy of the registration certificate. Examine the company name, expiring date, and the category of supply. Is the certificate valid?

**Valid 94**                      Not valid

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All 88**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 88**                      Less than 70%

Is the proposed total solution feasible?

**Yes 85**                      No                      Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

**Increasing**                      Fluctuating                      Decreasing

How do you grade the employee turnover of the company?

**Healthy 68**                      Too high

What percentage of the profit is put into R & D by the manufacturer?

**Above 20%**                      Between 10 & 20%                      Below 10%

What is the ratio of technical staff per installation?

(Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)

**A**                      **B**                      **C**

Is the initial cost higher than the budget?

**Yes**                      No

The initial cost is higher than the budget by

**Above 7%**                      **Between 5 & 7%**                      Below 5%

### Results

You need to ensure that the company is taking measures to beef up its staff strength, and the higher cost will not give rise to serious financial problem to the organization.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 68.



Assignment: TEST 7 of Module 3

Vendor Code: 7/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

**All 88**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 79**                      Less than 70%

Is the proposed total solution feasible?

**Yes 79**                      No                      Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

Increasing                      Fluctuating                      **Decreasing 89**

Results

The company may get into financial problem and wind up in no time.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 89.

Assignment: TEST 8 of Module 3

Vendor Code: 8/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes** No Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes** No Not sure

Are there any mandatory requirements not being answered?

**Yes** No

Does the solution presented meet all the mandatory requirements?

**All 96** Only some

Do you think this vendor understands your organization problems?

**70% or more 99** Less than 70%

Is the proposed total solution feasible?

**Yes** No **Not sure 67**

Please consult the computer staff in the evaluation committee in order to assess whether the proposed solution is feasible or not. What is the conclusion?

**Feasible 84** Not feasible

How do you grade the annual turnover sales for the last 3 years of the company?

**Increasing 67** Fluctuating Decreasing

How do you grade the employee turnover of the company?

**Healthy 77** Too high

What percentage of the profit is put into R & D by the manufacturer?

**Above 20%** Between 10 & 20% Below 10%

What is the ratio of technical staff per installation?

(Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)

**A** B C

Is the initial cost higher than the budget?

**Yes** No

The initial cost is higher than the budget by  
 Above 7%                      Between 5 & 7%                      Below 5%

### Results

A higher cost of not more than 5% of the budgeted cost should not give rise to financial problem to the organization. You may request for supplementary from the Treasury or get it from other votes.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 67.

Assignment: TEST 9 of Module 3

Vendor Code: 9/11

Date: 10-23-1992

### Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 67**                      Less than 70%

Is the proposed total solution feasible?

**Yes 90**                      No                      Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

**Increasing 88**                      Fluctuating                      Decreasing

How do you grade the employee turnover of the company?  
**Healthy 55**                      Too high

What percentage of the profit is put into R & D by the manufacturer?  
**Above 20%**                      Between 10 & 20%                      Below 10%

What is the ratio of technical staff per installation?  
 (Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)  
**A**                      B                      C

Is the initial cost higher than the budget?  
**Yes**                      **No**

### Results

This is an excellent solution for further consideration.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 100.

Assignment: TEST 10 of Module 3

Vendor Code: 10/11

Date: 10-23-1992

### Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

**Yes 99**                      No

### Results

You may want to remind the presenter on areas not covered by him/her.

This expert system advises that this vendor CANNOT BE DECIDED YET CNF 99.

Assignment: TEST 11 of Module 3

Vendor Code: 10/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

All                      **Only some 80**

Results

ALL mandatory requirements MUST be met for further consideration.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 100.

Assignment: TEST 12 of Module 3

Vendor Code: 11/11

Date: 10-23-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance  
under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory  
requirements?

All                      **Only some 92**

### Results

ALL mandatory requirements MUST be met for further  
consideration.

This expert system advises that this vendor SHOULD NOT BE  
SHORTLISTED CNF 92.

MODULE 4: Guidelines on Tender Specification Preparation.

Assignment: TEST 1 of Module 4

Date: 10-23-1992

Proceeding of Consultation

For each of the items mentioned in the following questions, please check if they have been documented in the Tender Specification Document which will be used in the Tender Invitation Stage.

A proper document title and a short description of the organization background.

**Yes**                      No                      Not sure

Under the heading of Instructions to Tenderers you have to specify the general conditions of tender conform to government regulations.

**Yes**                      No                      Not sure

Tender closing date.

**Yes**                      No                      Not sure

Where proposals to be sent.

**Yes**                      No                      Not sure

Method of packaging.

**Yes**                      No                      Not sure

Number of copies required with at least one original copy.

**Yes**                      No                      Not sure

Contact points and persons (of the organization).

**Yes**                      No                      Not sure

For financial guarantee requirements, provide the Standard Bank Guarantee Form (Security Deposit).

**Yes**                      No                      Not sure

For company details, vendors are required to provide:

- (a) a copy of the registration certificate issued by The Ministry of Finance;
- (b) Equity structure (foreign / local);
- (c) Turnover, number of employees and ownership in the last 3 years;
- (d) Previous relevant experience;
- (e) Overseas business tie-up;
- (f) For the past 3 years, provide
  - gross sales
  - net earnings
  - debt/equity ratio

- number of employees.  
**Yes**                    No                    Not sure

For Schedule of Prices, provide the formats and specify type of currency to be used in all quotations.  
**Yes**                    No                    Not sure

Under the Schedule of Prices, vendors should be asked to provide itemized hardware and software prices. Price quotations should be given for direct purchase and yearly maintenance.  
**Yes**                    No                    Not sure

As in previous question, price quotations should be given for leasing as well as leasing with option to purchase for 3-year and 5-year periods. For leasing with option to purchase, request also the respective residue values.  
**Yes**                    No                    Not sure

As in previous question, price quotations should be given for system conversion and data preparation, site preparation, ancillary equipment, and training charges.  
**Yes OR Not Applicable**                    No                    Not sure

**Operational Requirements:**

The Tender Specification Document should repeat the operational requirements contained in the Initial System Study Report. However, it should take into consideration of all the comments/suggestions put forward by the vendors during their pre-qualification presentations and make all necessary amendments. These items include:

- (a) The functional requirements of each application system;
- (b) Details (with plan) of the computer site;
- (c) Specification for interface with other systems;
- (d) Details of existing facilities; and
- (e) Minimum expectation of system performance.

**Yes OR Not Applicable**                    No                    Not sure

The technical specifications that have to be included in the Tender Document are:

- (a) Minimum computing capacity to be met for hardware, software, and communication;
- (b) Minimum modular expansibility of the computer system;
- (c) Criteria for acceptance.

**Yes**                    No                    Not sure

Request for benchmark test with its specification.

**Yes**                    No                    Not sure

Request for relevant brochures or any formal publications to support claims.

**Yes**                    No                    Not sure



Request for performance calculations (load and response times) including recovery and fallback.

**Yes**                      No                      Not sure

Request for reliability statements such as Mean Time Between Failures (MTBF) and Mean Time For Repairs (MTFR) of critical items (Disk drives, Tape Drives, CPU, Printer, and Communication Controller).

**Yes**                      No                      Not sure

Minimum security features.

**Yes**                      No                      Not sure

Implementation Requirements:

- (a) State the preference implementation strategy of application systems; and
- (b) Request for the detail implementation

schedule.

**Yes**                      No                      Not sure

The following questions are concerning the Support Requirements for hardware and software. Please check if all the items listed in each question have been included in the Tender Specification Document.

Request to state the minimum number of years of guaranteed support, minimum warranty period and conditions.

**Yes**                      No

Request for a detail maintenance plan and a full list of supporting staff.

**Yes**                      No

The following questions are concerning the Training Requirements. Please check if all the items listed in each question have been included in the Tender Specification Document.

Request for a detail plan of training for:

- (a) Appraisal/General
- (b) Daily operation of hardware and system software
- (c) Application systems.

**Yes**                      No

Request to state where and how training sessions are conducted such as classroom type or using self-learning software packages.

**Yes**                      No                      Not sure

Documentation Requirements for:

- (a) Hardware
- (b) System software
- (c) Software packages
- (d) Operational manual of application systems.

**Yes**                      No

Contract Requirements:

Attach a draft contract containing contractual compliance statements.

**Yes**                      No

System Conversion: Request a plan of system Conversion for:

- (a) Data Conversion or data preparation;
- (b) Program conversion, if applicable
- (c) Testing.

**Yes**                      No

Demonstration: Request for a demonstration on the proposed machine or at least machine of the same production line, and prototypes of application systems.

**Yes**                      No

### Results

Congratulation! You have successfully completed the Tender Specification. Your next action is to produce enough copies of the document and send them to the short-listed vendors.

Expert system advises that: TENDER SPECIFICATION IS COMPLETE  
CNF 100.

MODULE 5: Advices on Selection of Computer Evaluation  
Methodology.

Assignment: TEST 1 of Module 5

Date: 10-23-1992

Proceeding of Consultation

Are the features of the acquiring system hardware conformed to the industrial standard that can be found in most of the systems in the market?

Yes                      Not likely                      **Not sure 86**

Please check if you have any peculiar requirements for:

- \* CPU,
- \* Disk storage sub-system,
- \* Tape storage sub-system,
- \* Printers and/or plotters,
- \* Terminals,
- \* Data entry machines,
- \* Communication system,
- \* Any other peripherals.

**None 92**                      Some

The acquiring system is for....

**General purposes 100**                      Specific functions

Are the features of the acquiring system / application software conformed to the industrial standard that can be found in most of the systems in the market?

Yes                      **Not likely 70**

Is simplicity of operation varies greatly among different computer systems?

**Yes 75**                      No

Is hardware reliability differs substantially among different computer systems?

**Yes 60**                      No

Is system/application software reliability varies widely among computer systems?

**Yes 65**                      No

Do you expect extensive vendor support?

**Yes 95**                      No

Are the required system features sophisticated?

**Yes 83**                      No

Which of the following evaluation should be given more emphasis?

**Technical 88**

Financial

Both

### Results

The acquiring computer system does not seem to conform to the industrial standard in both software and hardware. Thus, technical evaluation is crucial and Cost-only Methodology is eliminated. Weighted-scoring Methodology is recommended because the acquiring computer system is sophisticated. Moreover, Weighted-scoring Methodology allows assignment of different weights to the technical and financial evaluations depend on how critical they are in determining the success of the project.

The expert advises you to use the methodology of WEIGHTED SCORING CNF 99.

APPENDIX D

TEST PROCEEDINGS AND RESULTS OF  
THE DEPARTMENT S PROJECT

MODULE 1: Testing on the Formation of ISS team, Feasibility  
and Justification of the Project

Assignment: TEST 1 of Module 1

Date: 10-23-1992

Proceeding of Consultation

The first step in ISS is formation of a study team. Which  
of the following groups of personnel are represented in your  
ISS team?

A=Users    B=Data processing    C=Management    D=All the  
above

(You may choose more than one answers.)

**A                    B                    C                    D**

Each representing group in the ISS team should have certain  
knowledge. Does the user group possess the following  
knowledge/quality?

A=Operational knowledge    B=Analytical ability  
C=Some computer knowledge    D=Some organizational knowledge

(You may choose more than one answers.)

**A                    B 75                    C 72                    D 64**

Does the group representing the data processing  
professionals possess the following knowledge/quality?

A=System design analysis    B=Technical writing ability  
C=Application knowledge    D=Communication skill

(You may choose more than one answers.)

**A 85                    B 77                    C 75                    D 67**

Besides management skills, does the group representing the  
management possess sufficient corporate financial knowledge?

**Yes 90                    No**

Under the Terms of Reference, do you have a clear and  
specific objective, and a realistic scope of study?

**Yes 88                    No**

Under the Terms of Reference, have you included the following issues?

A=Constraints      B=Timescales      C=Method of Reporting  
D=Progress Control Method for Study

(You may choose more than one answers.)

**A**                      **B**                      **C**                      **D**

The next 4 questions associate with feasibility of computerization. Please give a profound thought before answering each of the questions.

Use CNF to indicate the degree of confidence.

Is the technology needed to perform the tasks commercially available?

Yes                      No                      **Not sure 72**

You may call up 3 or more suppliers to check with them if the technology needed is available. Are you convinced now that the technology is available?

**Yes 84**                      No

Does the organization possess or have access to the necessary resources including finance to provide computerization?

**Yes**                      No                      Not sure

Will computerization fit in with the organization environment?

**Yes 95**                      No                      Not sure

Are the staff of the organization prepared to support computerization?

**Yes 82**                      No                      Not sure

The next 4 questions determine the justification of computerization. Please answer each of the question carefully.

Use CNF to indicate your level of confidence.

Can the requirements be met without a computer?

Can                      **Cannot 85**                      Not sure

### Results

Congratulation! You have a good ISS team to work with, and the computerization project is feasible and justifiable. Now, you may proceed to the next procurement stage, i.e. Request For Solution. The filename is RFS.KBS.

Expert system advises that this computerization:  
IS FEASIBLE AND JUSTIFIABLE CNF 100.

## MODULE 2: Guidelines on ISS Report Preparation.

Assignment: TEST 1 of Module 2

Date: 10-23-1992

Proceeding of Consultation

For each of the items mentioned in the following questions, please check if you have included them in the Initial System Study (ISS) Report which is to be given to the interested vendors at Request For Solution stage.

A precise project title.

**Included**                      Not included

Background of the organization.

**Included**                      Not included

List of applications to be computerized.

**Included**                      Not included

List of existing facilities used in daily operations.

**Included**                      Not included

The organization chart indicating the geographical locations as well as the number of users for each application.

**Included**                      Not included

The maximum and average loadings for the system.

**Included**                      Not included

The expected average response time in normal daily operation.

**Included**                      Not included

The tolerable system availability time in percentage.

**Included**                      Not included

The maximum tolerable recovery time.

**Included**                      Not included

Deadlines for:

(i) Hardware installation

(ii) System software installation.

**Included**                      Not included

The next 7 questions apply to each of the application systems planned to be computerized.

The functional specification.

**Included**                      Not included

Details of current operational procedure.

**Included**                      Not included

The current data volume.

**Included**                      Not included

The expected annual growth rate of the data volume.

**Included**                      Not included

Sample record kept at present.

**Included**                      Not included

The interrelationship between data and process in diagrammatic form.

**Included**                      Not included

The deadline of system hand over.

**Included**                      Not included

What are the other application systems planned to be computerized in the near future and their estimated storage requirements for both data and programs.

**Included**                      Not included

The security requirements for:

- (i) Loss of data
- (ii) Unauthorized access.

**Included**                      Not included

Documentation requirements:

- (i) Type
- (ii) Number of copy
- (iii) Language of instruction.

**Included**                      Not included

Training requirements:

- (i) Topic/area
- (ii) Place.

**Included**                      Not included

Minimum warranty requirements:

- (i) Coverage
- (ii) Duration.

**Included**                      Not included

Minimum support requirements:

- (i) Maintenance
- (ii) Number of years of guaranteed technical support.

**Included**                      Not included

Operational standards to be followed strictly.

**Included**                      Not included                      Not applicable



General computer policy to be strictly adhered to.  
**Included**                      Not included                      Not applicable

Site details.  
**Included**                      Not included

### Results

You have successfully completed the ISS Report which will be referred to by the interested vendors before they make their pre-qualification presentations. During their presentations, they will propose total solutions to your organization according to the requirements stated in this ISS Report. Now, you may get the consent from the top management, and then advertise in several news papers to invite the interested vendors to collect the ISS Report from your organization. The next knowledge base in ACPES you may want to consult is LIST.KBS for short-listing of vendors.

Expert system advises that ISS REPORT IS COMPLETE CNF 100.

MODULE 3: Advices on short-listing of vendors at  
the Pre-qualification Presentation and  
Preliminary Short-listing Stage.

Assignment: TEST 1 of Module 3

Vendor Code: 1/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 73**                      Less than 70%

Is the proposed total solution feasible?

**Yes**                      No                      **Not sure 68**

Please consult the computer staff in the evaluation committee in order to assess whether the proposed solution is feasible or not. What is the conclusion?

**Feasible 86**                      Not feasible

How do you grade the annual turnover sales for the last 3 years of the company?

**Increasing 78**                      Fluctuating                      Decreasing

How do you grade the employee turnover of the company?

**Healthy 67**                      Too high

What percentage of the profit is put into R & D by the manufacturer?

**Above 20%**                      Between 10 & 20%                      Below 10%

What is the ratio of technical staff per installation?  
 (Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)  
**A**                      **B**                      **C**

Is the initial cost higher than the budget?  
**Yes**                      **No**

The initial cost is higher than the budget by  
 Above 7%                      Between 5 & 7%                      **Below 5%**

### Results

A higher cost of not more than 5% of the budgeted cost should not give rise to financial problem to the organization. You may request for supplementary from the Treasury or get it from other votes.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 67.

Assignment: TEST 2 of Module 3

Vendor Code: 2/8

Date: 10-24-1992

### Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      **No**                      **Not sure**

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      **No**                      **Not sure**

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All**                      **Only some 56**

Results

ALL mandatory requirements MUST be met for further consideration.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 56.

Assignment: TEST 3 of Module 3

Vendor Code: 3/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

Yes                      No                      **Not sure 69**

You can request for a copy of the registration certificate. Examine the company name, expiring date, and the category of supply. Is the certificate valid?

Valid                      **Not valid**

Results

All companies need to have a valid registration certificate issued by the Ministry of Finance in order to participate in any government tenders.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 69.

Assignment: TEST 4 of Module 3

Vendor Code: 4/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All 78**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 81**                      Less than 70%

Is the proposed total solution feasible?

**Yes**                      **No 80**                      Not sure

Results

Infeasible solution is good on paper only.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 88.

Assignment: TEST 5 of Module 3

Vendor Code: 5/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All 83**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 88**                      Less than 70%

Is the proposed total solution feasible?

**Yes 76**                      No                      Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

Increasing                      **Fluctuating 79**                      Decreasing

How do you grade the employee turnover of the company?

**Healthy 86**                      Too high

What percentage of the profit is put into R & D by the manufacturer?

**Above 20%**                      Between 10 & 20%                      Below 10%

What is the ratio of technical staff per installation?

(Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)

**A**                      **B**                      **C**

Is the initial cost higher than the budget?

**Yes**                      No

The initial cost is higher than the budget by

Above 7%                      Between 5 & 7%                      **Below 5%**

### Results

You need to check why its sales fluctuated. However, a higher cost of not more than 5% of the budgeted cost should not give rise to financial problem to the organization. You may request for supplementary from the Treasury or get it from other votes.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 79.

Assignment: TEST 6 of Module 3

Vendor Code: 6/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

Yes                      **No**

Does the solution presented meet all the mandatory requirements?

**All 87**                      Only some

Do you think this vendor understands your organization problems?

**70% or more 85**                      Less than 70%

Is the proposed total solution feasible?

Yes                      No                      **Not sure 79**

Please consult the computer staff in the evaluation committee in order to assess whether the proposed solution is feasible or not. What is the conclusion?

**Feasible 88**                      Not feasible

How do you grade the annual turnover sales for the last 3 years of the company?

Increasing                      **Fluctuating 74**                      Decreasing

How do you grade the employee turnover of the company?

**Healthy 76**                      Too high

What percentage of the profit is put into R & D by the manufacturer?

Above 20%                      **Between 10 & 20%**                      Below 10%

What is the ratio of technical staff per installation?

(Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)

A                      B                      C

Is the initial cost higher than the budget?

Yes                      **No**

Results

You need to check why its sales fluctuated and less than 20% of its profit is spent on R & D, and make sure that it is taking stteps to beeb up its staff strength.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 74.

Assignment: TEST 7 of Module 3

Vendor Code: 7/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes**                      No                      Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes**                      No                      Not sure

Are there any mandatory requirements not being answered?

**Yes**                      **No**

Does the solution presented meet all the mandatory requirements?

**All 57**                      Only some

Do you think this vendor understands your organization problems?

70% or more                      **Less than 70% 79**

Results

Awarding a project to a team who cannot see your problems is to invite risk to your project.

This expert system advises that this vendor SHOULD NOT BE SHORTLISTED CNF 79.



Assignment: TEST 8 of Module 3

Vendor Code: 8/8

Date: 10-24-1992

Proceeding of Consultation

Do you have a complete list of mandatory operational requirements?

**Yes** No Not sure

Has the company registered with the Ministry of Finance under the category of Computer System Supply?

**Yes** No Not sure

Are there any mandatory requirements not being answered?

**Yes** No

Does the solution presented meet all the mandatory requirements?

**All 90** Only some

Do you think this vendor understands your organization problems?

**70% or more 88** Less than 70%

Is the proposed total solution feasible?

**Yes 84** No Not sure

How do you grade the annual turnover sales for the last 3 years of the company?

**Increasing 76** Fluctuating Decreasing

How do you grade the employee turnover of the company?

**Healthy 85** Too high

What percentage of the profit is put into R & D by the manufacturer?

**Above 20%** Between 10 & 20% Below 10%

What is the ratio of technical staff per installation?

(Select A=above 1/8 B=between 1/8 and 1/12 C= below 1/12)

A B C

Is the initial cost higher than the budget?

**Yes** No

Results

You need to make sure that the company is taking measures to beef up its staff strength.

This expert system advises that this vendor SHOULD BE SHORTLISTED CNF 76.

MODULE 4: Guidelines on Tender Specification Preparation.

Assignment: TEST 1 of Module 4

Date: 10-25-1992

Proceeding of Consultation

For each of the items mentioned in the following questions, please check if they have been documented in the Tender Specification Document which will be used in the Tender Invitation Stage.

A proper document title and a short description of the organization background.

**Yes**                      No                      Not sure

Under the heading of Instructions to Tenderers you have to specify the general conditions of tender conform to government regulations.

**Yes**                      No                      Not sure

Tender closing date.

**Yes**                      No                      Not sure

Where proposals to be sent.

**Yes**                      No                      Not sure

Method of packaging.

**Yes**                      No                      Not sure

Number of copies required with at least one original copy.

**Yes**                      No                      Not sure

Contact points and persons (of the organization).

**Yes**                      No                      Not sure

For financial guarantee requirements, provide the Standard Bank Guarantee Form (Security Deposit).

**Yes**                      No                      Not sure

For company details, vendors are required to provide:

- (a) a copy of the registration certificate issued by The Ministry of Finance;
- (b) Equity structure (foreign / local);
- (c) Turnover, number of employees and ownership in the last 3 years;
- (d) Previous relevant experience;
- (e) Overseas business tie-up;
- (f) For the past 3 years, provide
  - gross sales
  - net earnings
  - debt/equity ratio

- number of employees.  
**Yes**                      No                      Not sure

For Schedule of Prices, provide the formats and specify type of currency to be used in all quotations.

**Yes**                      No                      Not sure

Under the Schedule of Prices, vendors should be asked to provide itemized hardware and software prices. Price quotations should be given for direct purchase and yearly maintenance.

**Yes**                      No                      Not sure

As in previous question, price quotations should be given for leasing as well as leasing with option to purchase for 3-year and 5-year periods. For leasing with option to purchase, request also the respective residue values.

**Yes**                      No                      Not sure

As in previous question, price quotations should be given for system conversion and data preparation, site preparation, ancillary equipment, and training charges.

**Yes OR Not Applicable**                      No                      Not sure

Operational Requirements:

The Tender Specification Document should repeat the operational requirements contained in the Initial System Study Report. However, it should take into consideration of all the comments/suggestions put forward by the vendors during their pre-qualification presentations and make all necessary amendments. These items include:

- (a) The functional requirements of each application system;
- (b) Details (with plan) of the computer site;
- (c) Specification for interface with other systems;
- (d) Details of existing facilities; and
- (e) Minimum expectation of system performance.

**Yes OR Not Applicable**                      No                      Not sure

The technical specifications that have to be included in the Tender Document are:

- (a) Minimum computing capacity to be met for hardware, software, and communication;
- (b) Minimum modular expansibility of the computer system;
- (c) Criteria for acceptance.

**Yes**                      No                      Not sure

Request for benchmark test with its specification.

**Yes**                      No                      Not sure

Request for relevant brochures or any formal publications to support claims.

**Yes**                      No                      Not sure

Request for performance calculations (load and response times) including recovery and fallback.

**Yes**                      No                      Not sure

Request for reliability statements such as Mean Time Between Failures (MTBF) and Mean Time For Repairs (MTFR) of critical items (Disk drives, Tape Drives, CPU, Printer, and Communication Controller).

**Yes**                      No                      Not sure

Minimum security features.

**Yes**                      No                      Not sure

Implementation Requirements:

(a) State the preference implementation strategy of application systems; and  
 (b) Request for the detail implementation schedule.

**Yes**                      No                      Not sure

The following questions are concerning the Support Requirements for hardware and software. Please check if all the items listed in each question have been included in the Tender Specification Document.

Request to state the minimum number of years of guaranteed support, minimum warranty period and conditions.

**Yes**                      No

Request for a detail maintenance plan and a full list of supporting staff.

**Yes**                      No

The following questions are concerning the Training Requirements. Please check if all the items listed in each question have been included in the Tender Specification Document.

Request for a detail plan of training for:

- (a) Appraisal/General
- (b) Daily operation of hardware and system software
- (c) Application systems.

**Yes**                      No

Request to state where and how training sessions are conducted such as classroom type or using self-learning software packages.

**Yes**                      No                      Not sure

Documentation Requirements for:

- (a) Hardware
- (b) System software
- (c) Software packages
- (d) Operational manual of application systems.

**Yes**                      No

Contract Requirements:

Attach a draft contract containing contractual compliance statements.

**Yes**                      No

System Conversion: Request a plan of system Conversion for:

- (a) Data Conversion or data preparation;
- (b) Program conversion, if applicable
- (c) Testing.

**Yes**                      No

Demonstration: Request for a demonstration on the proposed machine or at least machine of the same production line, and prototypes of application systems.

**Yes**                      No

### Results

Congratulation! You have successfully completed the Tender Specification. Your next action is to produce enough copies of the document and send them to the short-listed vendors.

Expert system advises that: TENDER SPECIFICATION IS COMPLETE  
CNF 100.

MODULE 5: Advices on Selection of Computer Evaluation Methodology.

Assignment: TEST 1 of Module 5

Date: 10-25-1992

Proceeding of Consultation

Are the features of the acquiring system hardware conformed to the industrial standard that can be found in most of the systems in the market?

**Yes 75**                      Not likely                      Not sure

Are the features of the acquiring system / application software conformed to the industrial standard that can be found in most of the systems in the market?

**Yes**                      **Not likely 67**

Is simplicity of operation varies greatly among different computer systems?

**Yes 73**                      No

Is hardware reliability differs substantially among different computer systems?

**Yes 59**                      No

Is system/application software reliability varies widely among computer systems?

**Yes 65**                      No

Do you expect extensive vendor support?

**Yes 70**                      No

Are the required system features sophisticated?

**Yes 74**                      No

Which of the following evaluation should be given more emphasis?

Technical                      Financial                      **Both**

Results

The acquiring computer system does not seem to conform to the industrial standard in both software and hardware. Thus, technical evaluation is crucial and Cost-only Methodology is eliminated. Cost-effectiveness-ratio Methodology is recommended because the acquiring computer system is sophisticated and there is no need to control the weights of technical and financial evaluations.

The expert advises you to use the methodology of COST EFFECTIVENESS RATIO NF 99.

VITA

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