NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

PROTOTYPE: AN EXPERT DATABASE SYSTEM OF ABRI (EDSA) TO ASSIST PERSONNEL SELECTION IN THE ARMED FORCES OF THE REPUBLIC OF INDONESIA

by

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September 1994

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1994	Master's Thesis

4. TITLE AND SUBTITLE PROTOTYPE: AN EXPERT DATABASE SYSTEM OF ABRI (EDSA) TO ASSIST PERSONNEL SELECTION IN THE ARMED FORCES OF THE REPUBLIC OF INDONESIA

5. FUNDING NUMBERS

6. AUTHOR(S) Nidjo Sandjojo

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

An assignment of an officer of the Armed Forces of the Republic of Indonesia (ABRI) to a non-Department of Defense and Security (DEPHANKAM) position is considered just a tour of duty like any other assignment. One type of such assignment is appointment to become a member of a legislative body, especially the House of People's Representative (DPR). There are three type of DPRs, each requiring certain qualifications in order for an officer to be selected. The process of assigning the officers outside of DEPHANKAM is currently done manually and takes a great deal of time. This paper describes the design and implementation of a prototype expert database system that will substitute the laborious manual work in selecting the right officers to be assigned to a DPR position. The prototype design is based on a rule-based expert system and a personnel database of officers of ABRI. It produces a list of officer that match certain qualifications, along with the reasoning used by the system.

14. SUBJECT TERMS Expert Database System, personnel selection, ABRI			15. NUMBER OF PAGES * 96
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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TO ASSIST PERSONNEL SELECTION IN
THE ARMED FORCES OF THE REPUBLIC OF INDONESIA

by

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1994

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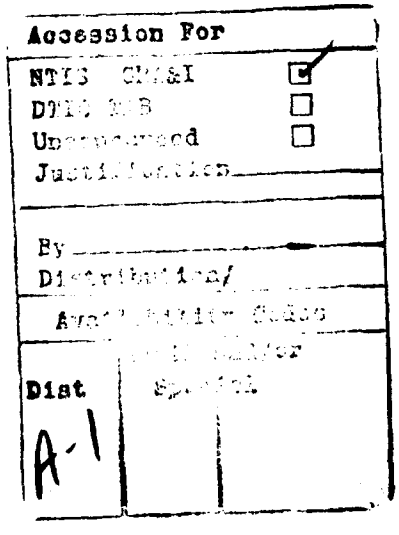
ABSTRACT

An assignment of an officer of the Armed Forces of the Republic of Indonesia (ABRI) to a non-Department of Defense and Security (DEPHANKAM) position is considered just a tour of duty like any other assignment. One type of such assignment is appointment to become a member of a legislative body, especially the House of People's Representative (DPR). There are three type of DPRs, each requiring certain qualifications in order for an officer to be selected. The process of assigning the officers outside of DEPHANKAM is currently done manually and takes a great deal of time. This paper describes the design and implementation of a prototype expert database system that will substitute the laborious manual work in selecting the right officers to be assigned to a DPR position. The prototype design is based on a rule-based expert system and a personnel database of officers of ABRI. It produces a list of officer that match certain qualifications, along with the reasoning used by the system.



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I. INTRODUCTION

A. BACKGROUND

On 1 April 1994, Indonesia entered the first Five-Year Development Plan (REPELITA) of its Second Long-Term Development Period (PJP) of 25 years, which should pave the way and prepare Indonesia for the take-off phase of its national development. One of its goals in the defense and security sector is the development of the Armed Forces of the Republic of Indonesia (ABRI)[1] into a more effective and efficient defense and security force, as well as socio-political force, in accordance with the development of science and technology. As General Feisal Tanjung, Commander in Chief of ABRI, explained at a hearing in the House of People's Representatives (DPR), under the military's fifth strategic (five-year) plan, which began on 1 April 1994, ABRI's capability will be geared toward acquiring a professional, effective, efficient, and modern force [Ref. 1].

Modernization of ABRI is also an objective of the PJP, which directs that ABRI keep up with advances in information technology by maximizing the use of state-of-the-art software and hardware. In the information technology era, managers attempt to make their decisions based on facts, data collection, and a decision aid, rather than only on intuition and experiences. As Shumaker and Franklin assert, in the military, as in any

[1]See List of Indonesian Acronym in Appendix A.

technologically sophisticated and complex organization, people must be able to communicate with computers [Ref. 2].

The need for decision making support is being increasingly recognized in a variety of disciplines: military, public policy making, land management, medicine, and oil exploration [Ref. 3]. Decision aids are currently under widespread development to help managers do their jobs. Expert systems are among the most exciting new developments in information technology, which enable programs to reach a level of decision making performance comparable to (or even exceeding) that of top human experts [Ref. 4]. Sophisticated software has been developed that will assist managers in their decision-making processes, essentially to enable computers to think like human experts.

There is no doubt that ABRI is in need of decision aids to simplify laborious work for which computer technology can be substituted. One of them is in the personnel selection process, which is currently done manually by personnel staff officers of ABRI.

ABRI has created a new office named Office of Command and Control Center (PUSKODAL) which since 1984 has set forth the information system architecture concept for ABRI that supports its dual function [Ref. 5]. Ideally, this office can be used as a backbone information system for ABRI. All services of ABRI should conceivably be able to access the data or program applications from it or provide data into it, and especially utilize the personnel data using the computer network.

B. OBJECTIVE

The main objective of this thesis is to describe the design and development of a prototype Expert Database System that can be used as a decision aid in selecting officers who will do assignments outside the Department of Defense and Security (DEPHANKAM), as a member of the House People's Representatives (DPR). The prototype will provide the personnel staff officers with solutions based upon officer data, a rules base needed to support it, and expert system rules extracted from a knowledge base. Theoretically, this prototype can be applied in various applications with certain modifications.

C. RESEARCH QUESTIONS

To accomplish the objective, three primary questions need to be researched and answered. These will be addresses in this thesis as follows:

1. Can an expert system be applied to the task of selecting officers for assignments to a non-Department of Defense and Security assignment?

2. Can an expert system prototype be developed and implemented to assist personnel staff officers of ABRI?

3. Can the required domain expert be captured into a knowledge base?

D. SCOPE, LIMITATION, AND ASSUMPTION

The selection process for the entire ABRI is very broad and beyond the scope of this thesis. This thesis mainly focuses on selecting officers who are going to be appointed to a non-Department of Defense and Security (DEPHANKAM) assignment and, specifically, the non-department position as a member of the House of the People's Representatives (DPR). The domain expert is limited to the author himself, since he has worked in similar job as Chief Career Officers Section. The author makes assumption that the database management system (DBMS) in the PUSKODAL ABRI is able to support the expert systems.

E. METHODOLOGY

The research methodology employed in this thesis will be mainly an observational approach coupled with extensive literature review of articles, books, journals, and periodicals on the subject, as well as ABRI's directives and policies. This method is (in my opinion) sufficient to support the development of an expert database system of ABRI.

II. PROBLEM AND THEORETICAL BASIS FOR SOLUTION

A. THE DUAL FUNCTIONS OF ABRI

1. History

Unlike the Armed Forces of other countries, ABRI is unique in that it has a dual function which is called ***Dwi Fungsi***. This *Dwi Fungsi* consists not only of a defense and security role, but a social-political role as well. The motivation for the Dual Function of ABRI goes back to the country's struggle for independence, when people voluntarily took up arms in defending the state and nation. During the war for independence, Indonesian people fought side by side with military people to defend the country. The interaction with the village people, which was essential to this successful independence effort, is a central theme in ABRI's tradition of social involvement [Ref. 6]. As a component of the people, Indonesia's Armed Forces help guide the Republic during its early years and developed into a social force that became closely involved with the ntinuing growth of the young Republic.

Its original concept was known as the "*middle way*", developed by General Abdul H. Nasution, Army Chief of Staff, in 1958. General Nasution defined the position of the National Army of Indonesia (TNI), now ABRI, as serving not merely an instrument of civilian government as found in western nations, nor a military regime ruling the country, but filling the role as a social force or people's "power", similar to other social

forces in Indonesian society [Ref. 7]. Nasution originally called this concept "wide front", referring to ABRI's broad responsibility for not only defense and security force, but social and political matters also. In 1965/1966, the doctrine of dual function was formulated to provide a rationale, a direction, and, to some extent, limitations, to that expanded role [Ref. 8]. Based on the doctrine, ABRI officially became both a military and a social political force. Former Army General and political observer T. B. Simatupang asserted that the doctrine of dual function of the Armed Forces did not create that situation, but that the situation already existed and the doctrine made the policy official.

Dual Function can be defined through its sub-elements, which are defending and securing the nation from its enemies, and assisting in developing the nation's welfare [Ref. 9]. It should be pointed out that, for ABRI, although the military function appears to be primary, the social-political function remains of equal importance.

2. Implementation

Group-Captain John Busshell of the Australian Air Force, an ex-Australian Defense Attache to Indonesia [Ref. 6], asserted that the place of ABRI in the State is difficult to reconcile with the Western concept of the armed forces as an instrument of the government of the day. Busshell's point of view on ABRI's dual function is understandable, and maybe many western people share his views because of different culture, historical background, and lack of correct information.

In Indonesia active duty military personnel are not enfranchised (although retired members are), nor they are allowed to choose or even participate in any political

party. This is because of ABRI's task of protecting the nation as a whole and the need to stand neutral from any political party. If military personnel were allowed to participate in politics, then the potential exists for ABRI to be divided into different groups, with internal conflicts of the sort that happened prior to 1965.

To express the concerns of military personnel regarding the life of the nation, representatives are appointed to the Legislative Bodies, which consist of the People's Consultative Assembly (MPR) and the House of the People's Representatives (DPR). ABRI was allotted blocs of appointed seats in both the MPR and DPR. There are three type of DPRs: the House of the People's Representatives of the Republic of Indonesia (DPR-RI), the Provincial Representatives Assembly (DPRD Tingkat-I), and the District/Municipal Representatives Assembly (DPRD Tingkat-II). Of the 500 members of the national DPR-RI, 75 are military appointees [Ref. 10, 11].

In reference to the second of the two functions of ABRI, military people may sit in the Legislative, Executive, and Judicial Branches of Government. They are not restricted to governmental sectors only, but may also assists in development at the village level, such as in constructing roads, bridges, irrigation works, and public schools, and in promoting the village and the welfare of the rural community.

The essence of the dual function of ABRI remains important to Indonesia today, as President Soeharto of Indonesia asserted in his speech:

> The Armed Forces of the Republic of Indonesia (ABRI) have been an inseparable part of our democracy based on ***Pancasila***. History has ushered in ABRI as the force of the national struggle that gave birth to, defended and upheld national independence. For this reason, therefor, ABRI is responsible for the safe journey of our nation and country in the pursuit of realizing the ideals of our

> national independence. This is the essence of ABRI's role as a socio-political force. As a defense-security force, ABRI has succeeded in defending our national sovereignty, preserving our national territorial integrity, and creating peace and order. By consistently applying the doctrine of overall people's security and defense, by continuing to develop a small but effective force, the dual functions of ABRI contributes immensely to the creation of dynamic national stability.[Ref. 12]

Based on the Guidelines of State Policy [Ref. 13], ABRI must be able to act as a stabilizer, dynamist, and unifying forces (element) of national life, actively participate in the development process, and enhance the strength of democratic, constitutional life, and uphold the law in the framework of strengthening the national defense.

B. PROBLEM DISCUSSION

Prananto [Ref. 5] has explained the problems and issues in data processing of ABRI information systems. In general, phase-by-phase plans in terms of both hardware and software requirements were laid out. In short, the problems in ABRI information systems are lack of trained and professional people in the information systems (IS) area, managerial passiveness in designing IS, lack of resources, computer illiteracy among managers, and budget constraint in computer hardware and software procurement. All of these matters limit computer applications in ABRI. Computer thought is not in every manager's mind, especially among those who have never worked with computer applications, or who have very little knowledge about computers and information systems.

A few attempts have been made to overcome, or at least minimize, the problem in the ABRI management information systems (MIS).

Sutedjo [Ref. 14] has created a stepping stone for database management systems (DBMS) implementation for the Indonesian Army. His primarily objective was the

implementation of a DBMS in the Indonesian Army, more specifically in the Data Gathering and Processing Service (Pullahta).

Ariyadi [Ref. 15] wrote the design and implementation of the personnel database system for the Indonesian Navy. His objective was to provide a software application on DBMS to support the decision making process in the Indonesian Navy regarding personnel management activities. He proposed a database design including the logical and physical phases and an implementation of a personnel database prototype on microcomputer using Dbase II.

Subekti and Prawiraatmadja [Ref. 16] wrote a prototype database management for a budgeting system for DEPHANKAM. Their main discussion was on the DBMS, the general structure of data, the impact of the database development to the DEPHANKAM management, and also a cost analysis concept.

Prananto [Ref. 5] wrote an end-user computing development strategy in the 90's. His main objective was to examine the alternatives available to the ABRI for developing end-user computing to match the organization's goals, objectives, and strategies.

All of those attempts have been well written, but the real implementation - putting theory into practice - still leaves very much in question whether they will provide a means to overcome the deficiencies management information systems. DBMS were not in excellent condition, and major effort must be made soon in order to achieve dependable and accurate information systems.

The problems in the information systems have not been fully acknowledged by top ranking officers. One of the reasons why such problems have not been revealed is that

ABRI adopts a mission priority that places complete focus on the mission, and very little on other aspects. There are many issues to be handled by ABRI before information systems development. The training of personnel and military units, structural re-organization, personnel welfare, etc., may rank above information system development.

Computer-based decision aids do not yet exist. Personnel selection, for instance, is still done manually, and can be laborious and tedious. Its process takes a long time in order to reach the final decision. In the information technology era, that is unacceptable.

C. PERSONNEL SELECTION

1. Introduction

Selection is the process of choosing from among available applicants the individuals who are most likely to successfully perform a job [Ref. 17]. The personnel selection process in ABRI usually takes a long time and, as mentioned, is done manually. The selection of officers who will be assigned outside of DEPHANKAM is not an exception to this process. Military personnel who will be going to fill that second function must go through several selection procedures. It is not easy to select the right person for the right job. The officer assignment decision making environment is filled with complex criteria, some of which have not been well defined. For instance, personal evaluation is very much subjective, and this is one of the criteria in promotion and other personnel selections. This evaluation is only done by one person, his or her supervisor or direct superior officer.

Only very selective people can be assigned to a function outside DEPHANKAM. In this section will be discussed the personnel selection procedure in general, which is composed of two processes: the candidacy and final selection processes.

2. Steps in the candidacy process

Several steps must be taken to spread the word across the chain of commands. The following is the general methodology that has been used to get candidates from all three services (Army, Navy, and Air Force) and the Police.

- ABRI Headquarters issue a telegram to all three services (Army, Navy, Air Force) and the Police Headquarters asking for candidates with certain qualifications who meet various selection criteria.
- Upon receiving the telegram, the Chief of Staff of each of the three services and the Police take action necessary to comply with this telegram. Most of the time they issue another telegram directed to their subordinate organizations or major commands asking the same thing ABRI HQ has asked.
- The subordinate organizations will comply with the telegram by choosing their candidates who meet or nearly meet the requirements and criteria, and send the information on their candidates via telegram back to their headquarters.
- Upon receiving the candidates from their subordinate organizations, usually the three services and the Police do a minor selection process for their level, such as security clearance and general checkup or physical checkup if needed. If the number of candidates exceeds the quota, then the extra ones will be kept as backup candidates.
- Finally the three services send a reply telegram to ABRI Headquarters as a response to the telegram issued by ABRI Headquarters.

3. Steps in the selection process

The selection process starts when the candidates are received by ABRI. These steps are follows:

- Upon receiving the response telegram from the three services and the Police Headquarters, ABRI Hq. makes a list of qualified candidates. This list of officer is usually put in order from most to least qualified.

- Next is a preliminary interview, administrative checking including references and application forms if applicable, and the collection of detailed information related to the requirements needed.

- At this point, a Security Clearance test at ABRI level is conducted. Everybody must pass the test in order to maintain eligibility as a candidate for further processing.

- A final interview is usually then conducted, especially when the candidates exceed the quotas available.

- The last step is the final decision by authority personnel.

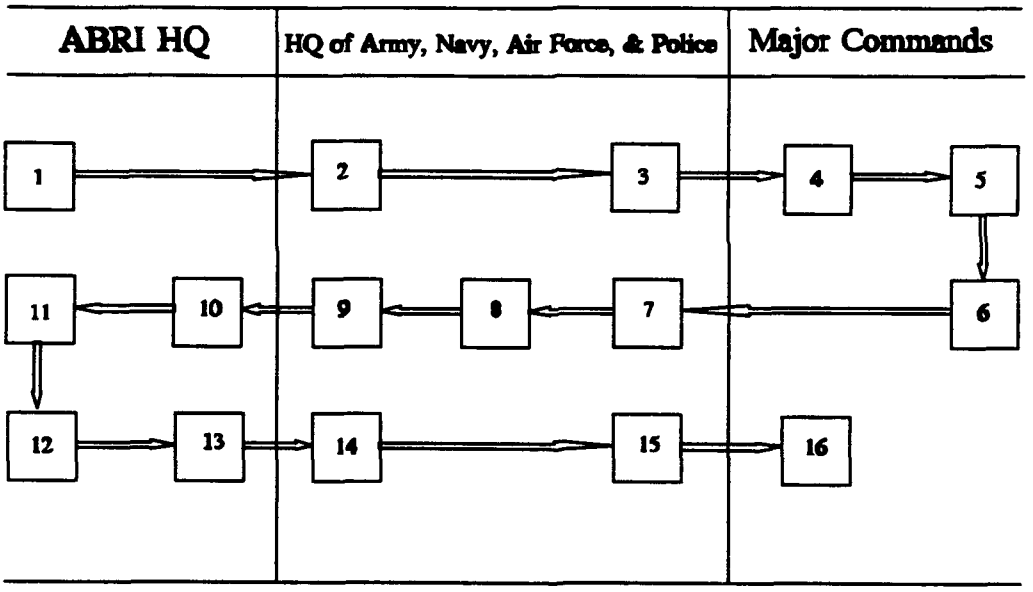

Figure 2-1: Personnel Selection Cycle Conducted by ABRI

In summary, the procedure of these two processes, illustrated in Figure 2-1, is as follows:

1. A telegram is issued by ABRI.

2. All three services and the Police received the telegram.

3. All three services and the Police issue a telegram and/or choose its candidate from Hq.

4. Major Commands received a telegram sent by their superior organization.

5. Major Commands select their candidate(s).

6. Major Commands reply by telegram with the list of candidate(s).

7. All three services and the Police receive candidate(s), make a list of candidates including candidates from Hq., if any.

8. Each of the three services and the Police do preliminary selection for its own level.

9. All three services and the Police reply by telegram with a list of the candidates.

10. ABRI receive candidates from all of the services and the Police, listing them in order.

11. ABRI goes through a selection process.

12. The final decision is made by ABRI.

13. Issue implementation orders to all candidates with copies to their organization or units and a telegram to their respective headquarters.

14. All three services and the Police receive implementation orders.

15. All three services and the Police issue another implementation order to their subordinate organizations or units if necessary.

16. The subordinate organizations or units receive an implementation order and issue the final implementation order to individual person(s) selected.

The prototype of the Expert Database System of ABRI (EDSA) can be implemented in node number 1, number 3, and number 5, or simultaneously in node numbers 1, 3, and 5 of Figure 2-1.

If EDSA is implemented in node number 1, it will shorten the network line by 10 nodes, or from node 1 directly to node 11. This will significantly reduce laborious work, and in this case substantially centralize the process. Then later on ABRI can notify its subordinate organizations involved that their officer is qualified for certain positions and for further processing. If the system is implemented in node number 3, it will shorten three nodes. This will make the selection process more simple and efficient. And if the system is implemented in node number 5, at least it will reduce the manual work. This system can also be implemented simultaneously in nodes 1, 3, and 5. By doing this, the selection process will be faster than before.

The manual selection process as shown in Figure 2-2 has at least three inputs and one output. The first and second inputs are internal inputs, but the third input may be an internal or external input.

The first input is a personnel database, which is usually kept in Data Gathering and Processing Service (PULLAHTA) or computer section, and is not always accurate. The second input is the personal file, which is kept in the personnel section. This file consists of an individual's documents from the beginning of his or her career in the service until retirement. The last input is mostly an external input, which is like an invisible hand. This form of input might be in the form of a letter of recommendation from the candidate's superior or previous commandant.

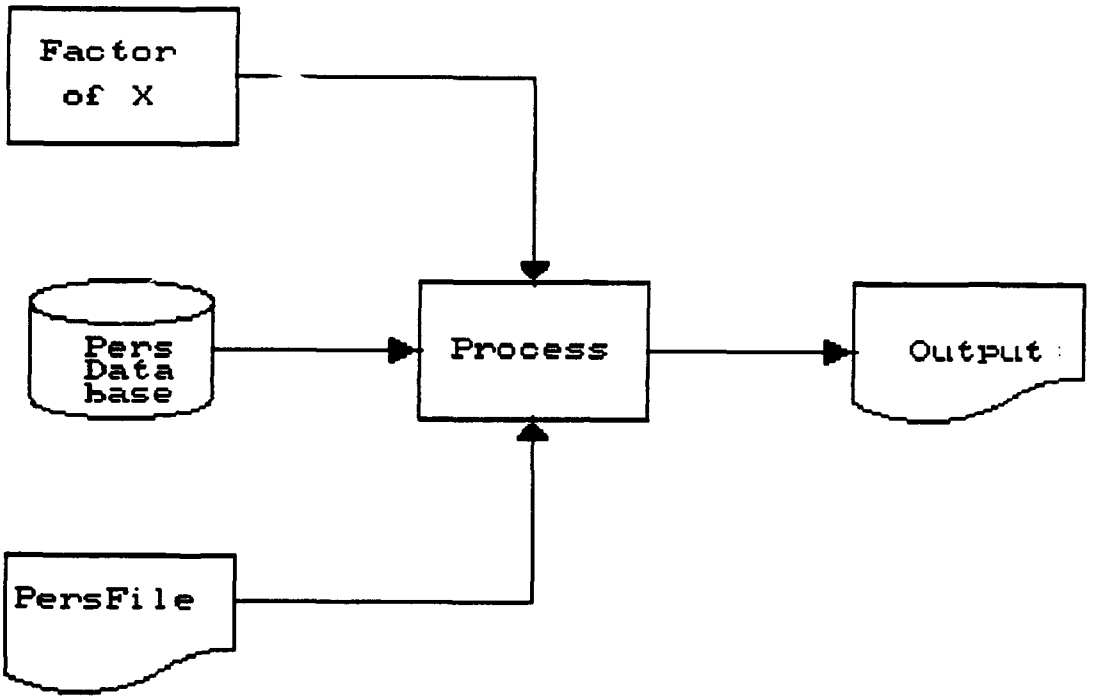

Figure 2-2: Typical Personnel Selection

D. DATABASE MANAGEMENT SYSTEM

1. Introduction

A Database Management System (DBMS) is generally defined as a collection of computer programs used to create, maintain, access, update, and protect one or more databases. DBMS is a topic that is relevant to most applications of computers. However, lack of data and inadequate DBMS are often cited as reasons for failure of management information system.[Ref. 18]

This chapter will discuss how a DBMS can be utilized to provide a better solution for managerial needs in the personnel selection conducted by ABRI Headquarter. A DBMS is basically a software product that allows the creation, use, and maintenance

of databases. A database application is generally an independent application, which can also be used to make data available to several other application programs. DBMS provides multiple users access to the same information for purposes of update and retrieval. As Pfleeger [Ref. 19] explains, these systems are partially responsible for the secrecy, integrity, and availability of the shared data. To share the data provided by the ABRI information systems, users must have their own authentication or password to login.

2. Database

A database is a collection of integrated files. Senn [Ref. 20] defines a database as an integrated collection of stored data in different record types. Personnel databases of ABRI are stored separately by each service (Army, Navy, Air Force) and the Police. There is not yet a unified or integrated database available for all ABRI personnel. Therefore, a great deal of effort is underway to analyze and enhance the process of providing standard data interface between diverse systems [Ref. 5].

The personnel database that is used in this thesis has more than 30 fields. To speed up the retrieval process, only a few of them are taken. DBase III Plus and FoxBase 1.0 are the common database software products used in ABRI database management system.

3. Database Management

To begin the discussion of database management, two examples will be used to illustrate the use of a database in the ABRI's information systems; they are both examples of DBMS mismanagement.

a. Case 1

The personnel officer was asked to find personnel data for an officer who had been assigned outside of the DEPHANKAM for quite a long time. This particular officer was going to be assigned back to the Army from his duty outside of the DEPHANKAM. The first thing done was go to the computer section and look at his data by punching in his serial number. Eventually his data came out, which mentioned that his current position was still outside of DEPHANKAM. Then, by making a long distance telephone call, the author found out that he was no longer working in that Department. He had been moved to his new DEPHANKAM position.

b. Case 2

This time the personnel officer was told to find another file for an officer who was to be assigned to position outside DEPHANKAM. As usual, the first step taken was visiting the computer section and looking at his data. By punching in his serial number, his biography came out. It said his rank was a First Lieutenant, but at that time he was a Captain.

A database is always actively changing. The data administrator or the person who is responsible for it must be able to keep track and update database all the time.

Planning, organizing, and controlling of the databases is the activity of database management. When the database is not updated properly and regularly, then examples like the one presented above will likely occur again and again.

In fact, a computer is an information processing machine in which the information produced becomes a key to decision making in an organization, including ABRI. Logically this information should be available to management, but sometimes it is not. The two examples cited above illustrate that accurate information is not always available to the decision maker.

From these two cases, the conclusion can be drawn that the database management systems of the ABRI in general are not very dependable and not upgraded regularly. According to the author's observations, these problems might be caused by several factors, such as:

- Lack of professional computer information system personnel.
- Poor planning of the development of information systems.
- A copy of upgrading data was not sent to the computer section.
- Proper methods were not implemented.
- A "don't care" attitude on the part of the staff.

4. Database Structure

The database used in this prototype is an active database file used by ABRI. It has more than 30 fields. Several fields are needed for EDSA purposes. The name of the database file is MILPERS.DBF, which is created by using DBase III Plus.

The structure of its database is:

Field	Field Name	Type	Width	Dec
1	NAMA (Name)	C	18	
2	PANGKAT (Rank)	C	15	
3	NPR (Serial Number)	C	6	
4	KODEPKT (Code of Rank)	C	3	
5	JABATAN (Occupation)	C	24	
6	DIKMIL (Military Education)	C	20	
7	DIKUM (Public Education)	C	21	
8	DIKSUS (Special Education)	C	15	
9	TMTABRI (Date of Joining ABRI)	D	8	
10	TMTPA (Date of Commission)	D	8	
11	TGLHR (Date of Birth)	D	8	

E. FEASIBILITY OF USING DSS/ES

1. Decision Support Systems (DSS)

DSS is one of the decision aids that might be applicable in the ABRI personnel selection process. There are some characteristics to be taken into account in the DSS development and problems and limitations too.

a. Characteristics of DSS

These are some of the important characteristics of a DSS:

- Tend to be aimed at the less well-structured, under-specified problems that upper-level managers typically face.
- Attempt to combine the use of models or analytical techniques with traditional data access and retrieval functions.
- Focus on features that make them easy to use in an interactive mode.
- Emphasize flexibility and adaptability to accommodate changes in the environment and decision making approach of the user.
- Support decision makers by providing the user with a collection of supporting tools that allow interactive access to data, models, and procedures.

b. Problems and Limitations of DSS

A DSS typically has some problems and limitations:

- A DSS is useful when dealing with only a subset of all possible semi-structured problems.
- The DSS's contribution to the problem-solving process is limited to the evaluation of alternatives.
- The models must generally be in mathematical or quantitative form.
- A DSS does not relieve the managers from making the actual decisions.

- Problems suitable for a DSS must generally have quantifiable dimensions.
- The structure of a problem and criteria involved in evaluating the problem must be defined by the decision maker.
- Users are frequently unable to effectively communicate their needs to the computer.

2. Expert Systems

An expert system (ES) is another decision aid under the general field of artificial intelligent (AI) that might be useful in assisting personnel selection in ABRI. Like a DSS, an ES has some general characteristics, problems, and limitations.

a. Characteristics of an ES

These are some general characteristics of an ES:

- Ability to capture critical expertise.
- The expertise is captured by emulating one or more expert's thought process.
- Design to capture, transfer, and make available expertise to the decision maker.
- Faster application development.
- Ability to distribute knowledge.
- Desire to gain competitive advantage.
- Flexibility to free experts from making repetitive decisions.
- Ability to combine knowledge from several experts.
- Use qualitative inferences procedures and heuristic.
- The effectiveness of an ES should improve as data and rules are added just like the human experts do.

b. Problems and Limitations of ES

These are some problems and limitations of DSS:

- Knowledge is not always readily available.
- Expertise is difficult to extract from human experts.
- The approach of each expert to a particular problem may be very different although all may be correct.
- ES has not been able to capture common sense knowledge.

3. Comparison between DSS and ES

The fundamentals goal of a DSS and an ES are basically the same: they seek to improve the quality of decisions. Both a DSS and ES are generally designed using an iterative or prototype approach. The objective of a DSS is to support the user in the decision making process by providing access to data and models. In contrast, the objective of an ES is to provide the user with a conclusion or decision significantly better, or more often correct, than the user could reach.[Ref. 21] A DSS allows the user to confront a problem in a flexible, personal way in manipulating the data and models; in contrast, the user of an ES has little or no flexibility.

According to Keen, there is no final DSS. An initial version is built and new facilities are added in response to user's experience and learning. Because of this, the cost of the DSS is not easy to identify. Keen asserts further that the evolutionary nature of a DSS development follows from the reliance on prototypes and fast development. There is no final system. In most instances, the system evolves in response to the user

learning. A major difficulty in designing DSS is that many of the most effective uses are unanticipated and even unpredictable.[Ref. 22]

This thesis will examine the feasibility of applying and developing an expert system to be used in officer selection for assignments outside the DEPHANKAM. Because databases provide such information needed for a knowledge base, the selection process is ideal for a computer-based system or expert system that combines an expert system coupled with a database.

The combination of a database and ES is known as Expert Database System (EDS). In one simple view, the expert system performs intelligent processing on data stored in the DBMS. But in a more complicated view, the DBMS and expert system are united so that large amounts of knowledge and data are stored and processed in an intelligent way.[Ref. 23]

The Indonesian military services and the Police have many tasks, large number of people, vast quantities of materials, and far-flung geographic locations, stretching as far as from Los Angeles to New York in more than 13,000 separate islands. These must be dealt with on a continuing basis, and very often within a very short period of time. In a situation like this, an expert database system, which is an expert system coupled with database that provides information for the knowledge base, is a good system to be implemented.

The major differences between DSS and ES are shown in Table 2-1.[Ref. 4]

TABLE 2-1: THE DIFFERENCES BETWEEN DSS AND ES

	DSS	ES
Objective	Assist human	Replicate (mimic) human and replace him/her
Who makes decision?	The human	The system
Major orientation	Decision making	Transfer of expertise (human-machine-human)
Query direction	Human queries the machine	Machine queries the human
Clients	Individual and/or group users	Individual user
Manipulation	Numerical	Symbolic
Problem area	Complex, integrated	Narrow domain
Data-Base	Factual knowledge	Procedural and factual knowledge

An expert system was chosen because it fits the type of decision process used in personnel selection. Fortunately, an expert system shell is available, and is able to run on a Personal Computer (PC). It is capable of accessing data from a database created by DBase II, DBase III Plus, and FoxBase without being indexed, and also is able to access data created using the spreadsheet Lotus 123. The author has prior knowledge of programming and experience in database management.

In ABRI, an expert system, especially in personnel selection, coupled with database, has never been attempted. The author chose this topic as his thesis because he feels that decision makers need it.

III. THE FUNDAMENTAL OF AN EXPERT SYSTEM

A. EXPERT SYSTEM OVERVIEW

1. Introduction

Expert systems are no different than any other new technology. Thorough analysis and probing in the beginning are essential for deciding the extent of its employment [Ref. 24]. These systems embody knowledge of a specific application area combined with an inference capability that enables the systems to reach a decision. The decision made is an imitation of a human expert's decision.

These systems are only models from a complex situation in one specific domain (e.g., officer selection) and provide consultations based on a set of rules. These rules have been reduced from the knowledge and experience of domain experts, in a manner discussed in Section B. The first expert system was the Logic Theorist, developed in 1956 by Allen Newell and Herbert Simon, of Carnegie-Mellon University, with J.C. Shaw of the Rand Corporation [Ref. 25].

An expert system is usually applied to a very narrow problem area. Because the problem area is narrow, the result or output is expected to be as refined as possible. The output will be a major factor in the decision by the decision maker.

2. Definitions

Some definitions of an expert system are given to provide a better understanding of expert systems. Though these definitions are neither exactly similar nor completely different, they have some major similarities.

- An expert system is a computer program using expert knowledge to attain high levels of performance in a narrow problem area [Ref. 27].

- Expert systems are computer programs that duplicate to some degree the kind of results achieved by human experts, and are able to solve problems, to predict, to provide a rationale and to give advice in a narrow area of consideration [Ref. 2].

- An expert system is a problem solving program that achieves good performance in a specialized problem domain that generally requires specialized knowledge and skill and the systems process the knowledge of experts and attempt to mimic their thinking, skill, and intuition [Ref. 21].

- Expert systems are computer advisory programs that attempt to imitate the reasoning processes and knowledge of experts in solving specific types of problems [Ref. 28].

- Expert system is a type of information system intended to replicate the decisions of a human expert; relies on manipulation of data and use of heuristic; includes knowledge base, inference engine, knowledge acquisition subsystem, and an explanation facility [Ref. 20].

- An expert system is a system of software or combined software and hardware capable of competently executing a specific task usually performed by a human expert [Ref. 29].

- An expert system or a Rule-Based System is a kind of computer program in which the problem domain (the facts and knowledge relating to the problem to be solved) is described not as a sequence of steps, as in conventional programming languages, but rather as a set of rules [Ref. 30].

- Expert system is a type of analysis or problem-solving model, almost always implemented on a computer, that deals with a problem the way an "expert" does, and the solution process involves consulting a base of knowledge or expertise to reason out an answer based on characteristics of the problem [Ref. 25].

- An expert system is an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution [Ref. 31].

As seen above, there is not a single definition universally adopted by information systems experts. Apparently every expert has his or her own definition of an expert system. However, most of the authors mention similar points, such as the human expert as the key person in solving problems and the use of computer process rules.

3. Requirements

The requirements for expert system development, as described by Turban 1993 [Ref. 28], include:

- The task does not require "common sense."
- The task requires only cognitive, not physical, skills.
- At least one genuine expert exists, who is willing to cooperate.
- Experts involved can articulate their methods of problem solving.
- Experts involved can agree on the knowledge and the solution approach to the problem.
- The task is not too difficult.
- The task is well understood and is defined clearly.
- The task definition is fairly stable.
- Conventional (algorithmic) computer solution techniques are not satisfactory.
- Incorrect or non-optimal results can be tolerated.
- Data and test cases are available.

- The task's vocabulary has no more than a couple of hundred concepts.

As Sprague and McNurlin [Ref. 25] explain, there are three components in an expert system: a user interface, an inference engine, and a knowledge base. These will be discussed in the following sections.

From all the definitions given above, it can be summarized that the basic parts of an expert system consist of the components shown in Figure 3-1.

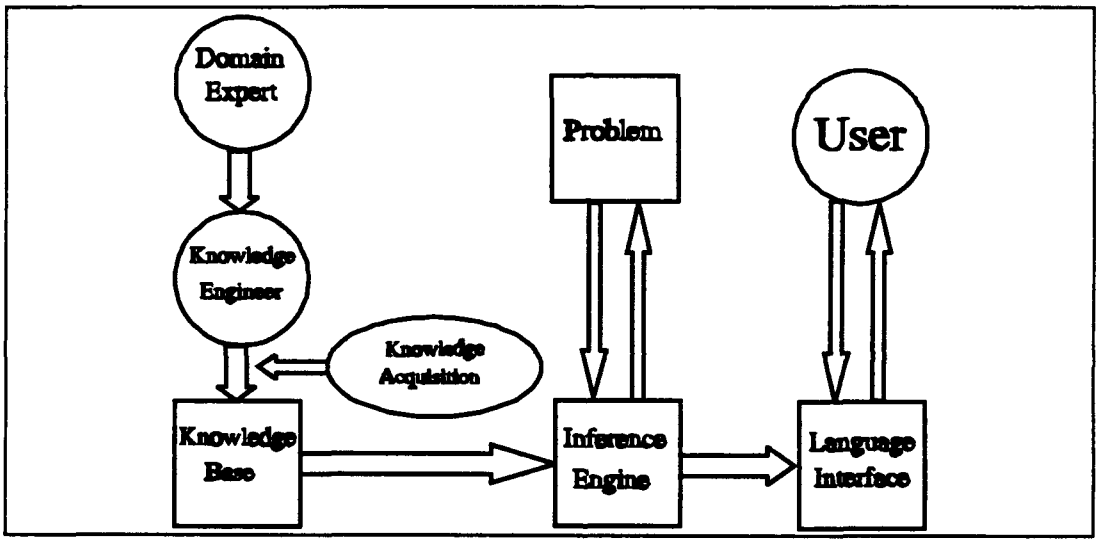

Figure 3-1: The Main Components of Expert System.

As indicated in Figure 3-1, the common objective of an expert system is to transfer expertise from a domain expert to the computer and then make expertise available to the expert as well as to other users.

To achieve this objective, ES requires two critical steps in its development process: knowledge acquisition and knowledge representation. Knowledge acquisition

involves getting knowledge from a knowledge source, e.g., one or more domain experts and other supporting sources. Knowledge representation entails determining the process by which experts solve a problem and then converting the process to a language that the computer can understand and interpret.

These two processes are performed by a professional known as a knowledge engineer. The knowledge is stored in the knowledge base. An ES then explains and justifies its reasoning in part of the explanation subsystem or in a the language interface to interact with users.

B. DOMAIN EXPERT

In developing a rule-based expert system, basically there are three principal roles: the domain expert, the knowledge engineer, and the end user. A domain expert is a person who through years of training and experience has become extremely proficient at problem solving in a particular domain, or the person who has detailed knowledge of the problem domain and understand its nuances [Ref. 29, 30]. The domain expert possesses expertise, which is a set of capabilities that underlie the high performance of human experts, including extensive domain knowledge, heuristic rules that amplify and improve approaches to problem-solving, meta-knowledge and metacognition, and compiled forms of behavior that afford great economy in skilled performance [Ref. 26].

C. KNOWLEDGE ENGINEER

As shown in Figure 3-1, a knowledge engineer captures a domain expert's knowledge and builds the knowledge base, which then is used by the inference engine to make decisions and to present solutions to the user. The knowledge engineer is a specialist in extracting and encoding the knowledge required to implement an expert system.

The knowledge engineer and domain expert work very closely together to define the problem, and must use various sources to obtain knowledge relevant to building the expert system. The most important goal for an expert system is to attain the high level of performance that a human expert achieves in some tasks.

Gathering the knowledge from the domain expert is the most important phase in developing an expert system. This is the main task of the expert system developer. The knowledge engineer interprets and integrates human answers to questions, drawing analogies, posing counter examples, bringing to light conceptual difficulties, and finally encoding it so it can be understood by the computer.

The shortage of experienced knowledge engineers is a major bottleneck in ES construction. To overcome this bottleneck, ES designers are using productivity tools (e.g., special editors), and research is being conducted on building systems that will bypass the need for a knowledge engineers. [Ref. 28]

The author has been working as Chief of Officer Career Section. The Officer Career Section administers personnel and officer careers. The author is a programmer and

has performed various staff duties in the Army and Armed Forces for almost 18 years, so he can be considered both a domain expert and knowledge engineer.

D. KNOWLEDGE BASE

Expert systems use both documented sources and human experts as sources of knowledge. Knowledge mostly comes from scanning the range of observable facts to identify inevitabilities, strong probabilities, and likelihoods. The most common method of representing knowledge is using rules about a specific domain. In most expert systems, this is the crux of an expert system solution.

These rules may consist of facts and rules of thumb (heuristic rules). A heuristic is a rule of thumb that applies in most cases but is not guaranteed to lead to an optimal or even feasible solution. Such information usually is supplied by an expert based on experience in solving particular problems.[Ref. 2]

A knowledge base contains facts and data relevant to a specific application. The rules used in this thesis are in the form of "IF A then B", where A is a fact either from a database, from the result of previous inferencing, or some logical statements concerning the facts. B is the conclusion derived from condition A. An example, if SC = Yes and KODEPKT >07 then CANDIDATE = Not.

A procedure of developing a knowledge base from an expert and encoding it to a programming language is known as knowledge acquisition. This process can be the crux of every expert system solution. When the problems are well defined but the knowledge base is incorrect then the solution means nothing. The flowchart of the developing

knowledge base used in Expert Database System of ABRI (EDSA) is as shown in Figure 3-2.

E. INFERENCE ENGINE

Shumaker defines the inference engine as a computer program that is capable of examining the factual database and finding rules that can be applied to deduce new facts. Sprague and McNurlin define it as a portion of the software that contains the reasoning methods used to search the knowledge base and solve the problem. Hicks and Lee describe it as the component built into the rule interpreter that directs the rule base search.[Ref. 2, 25, 30]

According to Sawyer and Foster, the tasks of the inference engine are the following:

- It compares information supplied in the user's query with information in the knowledge base.
- It seeks specific event-related goals or causal relationships.
- It evaluates the certainty of facts, based on the representative confidence values associated with each fact.[Ref. 31]

The inference engine uses the knowledge base to reason out the problem. A common control method is to chain through the IF-THEN rules to form the conclusion. There are three methods in reaching the conclusion: forward chaining (top-down or data driven), backward chaining (bottom-up or goal driven), or a combination of the two.

Forward chaining is when the chaining of the IF-THEN rules starts from a set of conditions and moves toward some conclusion to generate new facts. The process will continue either until the desired result is achieved or until no more inferences can be

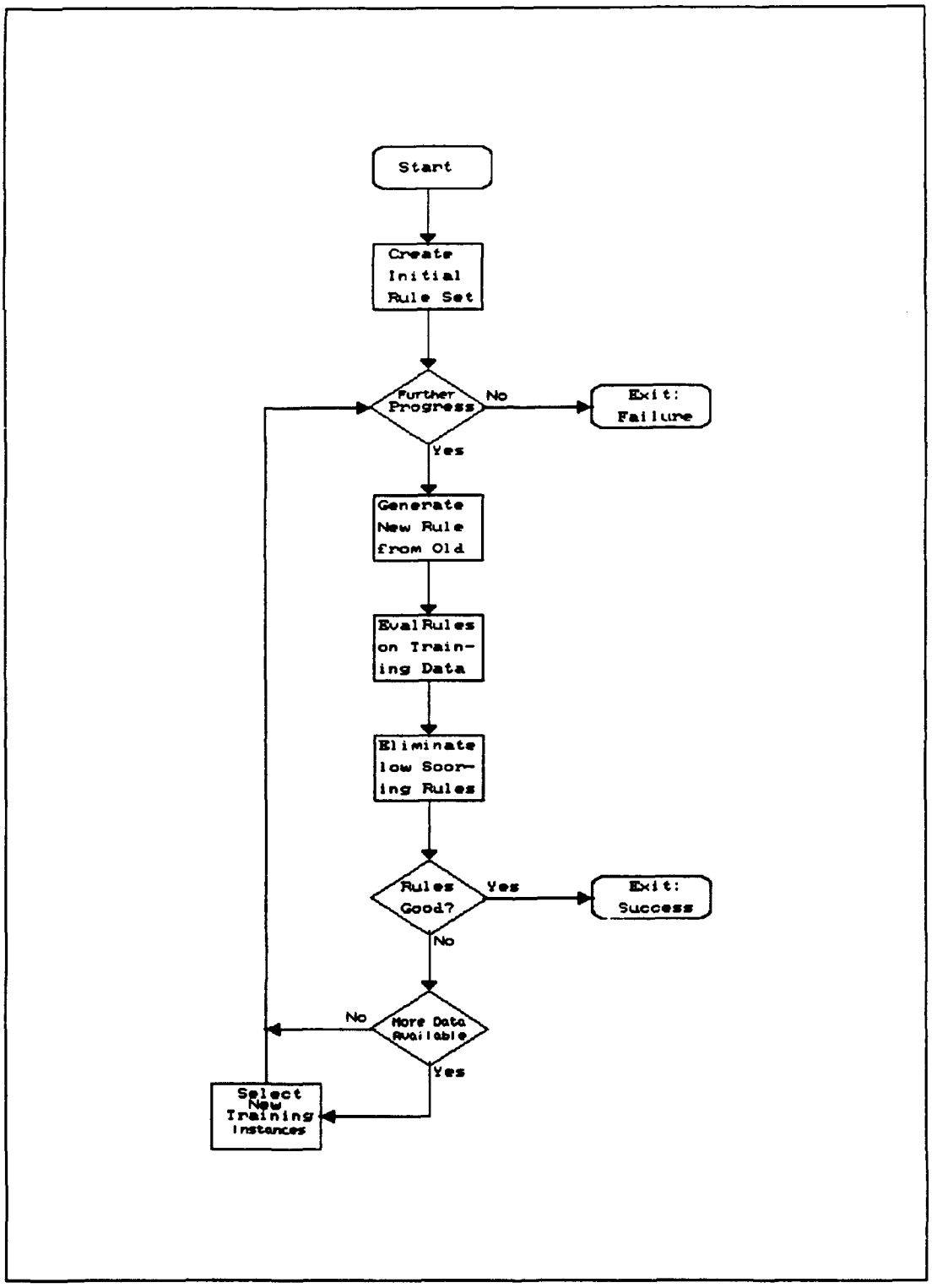

Figure 3-2: Flowchart of Rule Base Process of EDSA.

made. In VP-Expert, the WHENEVER statement is used for the forward chaining method. An example of using WHENEVER is as follows:

```
WHENEVER
        temperature_too_high
IF  temperature >=150
THEN GLOCATE 8,13
        GDISPLAY "The temperature of {temperature}
        indicates a problem in the cooling system.";
```

GLOCATE is a clause to set the current X and Y coordinates used by GDISPLAY text format.

In contrast, backward chaining is when the conclusion is known but the path to that conclusion is not known and the inference engine works backward to determine the supporting rules for the conclusion.

The mixed method uses elements of both forward and backward chaining methods to attempt to speed the process of convergence to a conclusion. This method takes advantage of the best features of both backward and forward chaining.

VP-Expert uses as its default the backward chaining method in reaching the conclusion (i.e., except when the WHENEVER statement is used). By using the trace mode of VP-Expert, the user can trace how VP-Expert came to a decision. This can be viewed either in text or in a graph.

The following are a few examples of the backward chaining method used in EDSA, as shown in Table 3-3 through Table 3-6.

TABLE 3-3: TRACING FOR SC = NO

```
! Serial_Number
! ! (= 262626 CNF 100)

! SC
! ! (= No CNF 100 )

! CANDIDATE
! ! Testing 0
! ! Testing 1
! ! Testing 2
! ! Testing 3
! ! (= Not CNF 100 )
! ! (= Not_Qualify CNF 100)

! Switch
! ! (= k CNF 100)
```

In the example as shown in Table 3-3, the system has traced rule 3 (not having a security clearance). This particular example started from entering the serial number (e.g., 262626). After typing the serial number, the inference engine of EDSA will, by default, reply with a CNF (Confidence Factor) 100. The next step is answering SC (Security Clearance) question either "Yes" or "No." In this case, the answer given by the user is "No". Having "No" as the answer for SC, the inference engine will look for the rule that matches for SC equals "No". The inference engine will start searching by testing from rule 0, rule 1, rule 2, and finally rule 3. Rule 3 is the matching rule for SC = No. Having "No" as the condition for SC, then based on rule 3, CANDIDATE = Not and DPR = Not_Qualify. Therefore, this particular officer is not qualified for any DPR, because he does not have SC. After finding the solution, the inference engine looks for

a switch for looping either out of the loop by typing ? or looking for another candidate by typing any character (A-Z).

TABLE 3-4: TRACING FOR DPRD_TKII

```
! Serial_Number
! ! (= 282828 CNF 100)

! SC
! ! (= Yes CNF 100 )

! CANDIDATE
! ! Testing 0
! ! (= Yes CNF 100 )

! DPR
! ! Testing 3
! ! Testing 4
! ! Testing DPR_A0
! ! (= DPRD_TKII CNF 100 )

! Switch
! ! (= k CNF 100)
```

Another example is shown in Table 3-4. The inference engine will be tracing for rule DPR_A0. After the user typing a serial number (e.g., 282828) and answering the security clearance question by "Yes", then the inference engine will check his or her KODEPKT and Diksus. Finding that KODEPKT <= 07 and Diksus = Suscaleg (i.e., Legislator Candidate Course), then the inference engine responses by writing CANDIDATE = Yes. It is written under Testing 0 which is the result from Rule 0. The inference engine will not stop at this point, but will go through several more rules until it finds the matching condition. As shown in Table 3-4, the inference engine skips rule 1 and rule 2 because the conditions given by the user and the database were satisfied by rule 0 which is basically the opposite of rule 1 and rule 2. The inference engine still tests

rule 3 and rule 4 before getting to the matching rule, i.e. "Rule DPR_A0." This rule specifies that the candidate is best suited for DPRD_TK II.

TABLE 3-5: TRACING FOR SPECIAL CANDIDATE

```
! Serial_Number
! ! (= 202020 CNF 100)

! SC
! ! (= Yes CNF 100 )

! CANDIDATE
! ! Testing 0
! ! ! DIKSUS
! ! Testing 1
! ! Testing 2
! ! (= Not CNF 100 )

! DPR
! ! Testing 3
! ! Testing 4
! ! Testing DPR_A0
! ! Testing DPR_A1
! ! Testing DPR_A2
! ! Testing DPR_A3
! ! Testing DPR_A4
! ! Testing DPR_A5
! ! Testing DPR_B0
! ! Testing DPR_B1
! ! Testing DPR_C0
! ! Testing DPR_C1
! ! Testing DPR_D
! ! Testing DPR_E
! ! Testing DPR_F
! ! Testing DPR_G
! ! Testing SPECIAL0
! ! Testing SPECIAL1
! ! Testing SPECIAL2
! ! (= DPR_RI CNF 100 )

! Switch
! ! (= k CNF 100)
```

An example as shown in Table 3-5 shows a special case which requires almost all rules to be tested. The user enters the Serial Number = 202020 and SC = Yes. Based on these two inputs, the inference engine traces the matching rules. The inference engine tests Rule 0, and finds out that the officer with serial number 202020 does not have the required DIKSUS, and it is reported under Rule 0. Then the inference engine proceeds to test Rule 1 and Rule 2. The condition of not having the required DIKSUS conformed to Rule 2 and the result is Not CNF 100, which means CANDIDATE = Not. However, the inference engine traces more rules to satisfy that there are no enabling rules in the officer's database. It tests the remaining rules starting from Rule 3, and when it gets to Rule Special2 it finds the matching condition. Rule Special2 says that CANDIDATE = Not, and Dikmil = Lemhanas (i.e., National Defense Institute), the rank is Colonel or above then he/she is eligible to become a member of DPR-RI because he/she is a senior officer.

An example of tracing the rule for rejecting the candidate is shown in Table 3-6. Having the serial number in the database, and security clearance = yes, then the inference engine tests the rules. First, it tests rule 0. In this case the officer does not have DIKSUS as required for the system, so DIKSUS appears under Testing 0. Then it tests rule 1 and rule 2. Rule 2 says that if DIKSUS is not equal to SUSCALEG then the officer is not a candidate, and this result is shown under Testing 2, written as (= Not CNF 100). This statement result in CANDIDATE = Not. Finally, the inference engine tests rule 3 and rule 4 until it finds the matching condition for not having the required DIKSUS. The filter in rule 4 is rank. If someone is not a CANDIDATE and his or her rank is below

TABLE 3-6: TRACING FOR NOT_QUALIFY

```
!  Serial_Number
!  !  (= 252525 CNF 100)

!  SC
!  !  (= Yes CNF 100 )

!  CANDIDATE
!  !  Testing 0
!  !  !  DIKSUS
!  !  Testing 1
!  !  Testing 2
!  !  (= Not CNF 100 )

!  DPR
!  !  Testing 3
!  !  Testing 4
!  !  (= Not_Qualify CNF 100 )

!  Switch
!  !  (= g CNF 100)
```

Colonel then he or she is not qualified to be a DPR member, as shown under Testing 4 and stated as (= Not_Qualify CNF 100). This statement means that this particular officer is not qualified to be a DPR member.

F. USER INTERFACE

The user interface is the interface between the expert system and the real world or problem. Usually it is a simple menu on a screen, but some new systems may use multimedia. The user interface's main task is to exchange information between the user and the inference engine. Everyday expressions in grammatically and structurally correct sentences are used here to communicate between human and machine.

The user interface plays what is often considered the preeminent measure of expert system performance. No matter how efficient the system's inference engine or extensive

its knowledge base, the program is only as valuable as its ability to communicate lucidly with those who require access to its output. [Ref. 31]

The more natural the languages being used, the easier for the end user to understand the system. However, this leads to greater demands for permanent storage and memory. Because of the hardware's limited storage and memory capacity, EDSA uses a simple language between the user and the machine, without putting aside the main objective, i.e., solving the problem for the end user or the managers.

G. END USER

Users may or may not be familiar with computers and may lack the in-depth knowledge base used in the problem domain. Many, however, have an interest in making better and possibly cheaper and faster decisions by using expert systems.[Ref. 27]

A user is a person who uses an expert system, such as an end-user, a domain expert, a knowledge engineer, a tool builder, or a clerical staff member. An end-user is the person who uses the finished expert system or for whom the system was developed.

This system is designed for the middle to upper level managers of the rank of Colonel and above of the ABRI. It is rather difficult to get them to set long enough in front of the computer monitor to learn something new. So, EDSA is designed to be as simple as possible in terms of communication between the human and the machine, while still fulfilling the manager's needs. The interaction between the end-user and the computer was made more user-friendly to better insure that the system would be used.

IV. THE EXPERT DATABASE SYSTEM OF ABRI (EDSA)

A. EXPERT SYSTEM SHELLS

Building an expert system from scratch is not easy, but it is often possible to borrow extensively from a previously built expert system. This strategy is a prudent move in ES development and has resulted in the production of products called shell systems. These shell systems are integrated packages in which the major components are programmed, except for the knowledge base. Instead of building the entire system, the programmers or knowledge engineers needs only to insert the knowledge base into a shell that is already provided.

Expert systems are generally composed of six basic components: knowledge acquisition subsystems, inference engine, explanation facility, interface subsystem (for conducting consultation), knowledge base management facility, and knowledge base.[Ref. 28]

The first five subsystems constitute an expert system shell. Figure 4-1 is an example of a shell for a small application, which consists of an inference engine and other control mechanisms. The user supplies the knowledge base to VP-Expert.

The use of VP-Expert shell in EDSA is illustrated in Figure 4-2. By feeding an officer serial number to the system, EDSA will process it by referring to its knowledge base and database file, and then come up with a solution that either the officer is eligible

for a specific DPR candidate or is not a qualified candidate. The solution may be printed out on the screen, or saved to another database file.

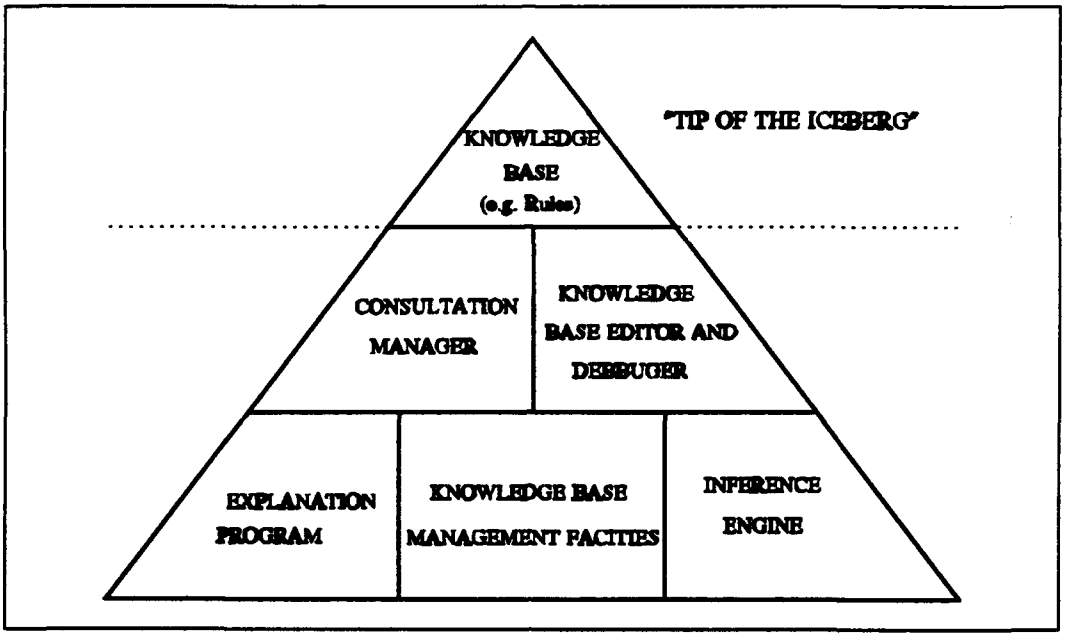

Figure 4-1: Concept of shell (Source: Ref. 27).

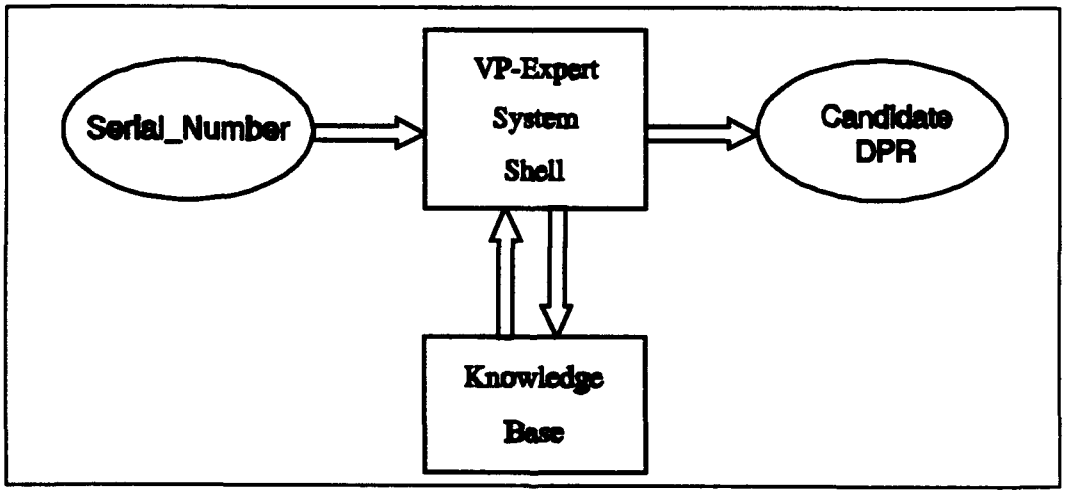

Figure 4-2: The Use of VP-Expert Shell in EDSA

B. EXPERT SYSTEM DEVELOPMENT PROCESS

1. Knowledge Engineering Process

The process of building an expert system is often called knowledge engineering, which typically involves a special form of interaction between the expert system builder, called the knowledge engineer, and one or more human experts in some problem area [Ref. 27]. As Hicks and Lee asserted that there are three principal roles in the development of a rule-based expert system as follows:

- The domain expert, the person (or persons) who has detailed knowledge of the problem domain and understands its nuances.
- The system developer, or knowledge engineer, whose function is to convert the knowledge of the domain into an operating computer program.
- The end user who will use the system when it is completed. [Ref. 30]

2. Knowledge Acquisition Process

The knowledge acquisition process starts when the domain expert provides the knowledge engineer with concepts, knowledge, and solutions, and the knowledge engineer formalizes or structures them to a knowledge base that can be understood by computer. The primary source of knowledge in current expert systems is the domain expert, even though knowledge may originate from many sources such as textbooks, reports, personal experiences, etc. Knowledge engineers must work closely with domain experts in developing the knowledge base. The typical knowledge acquisition process is shown in Figure 4-3.

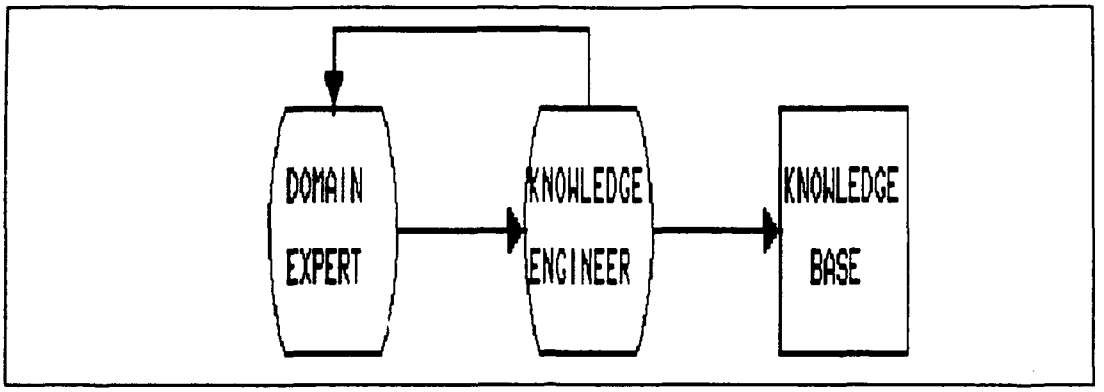

Figure 4-3: Knowledge Acquisition Process

An advantage of VP-Expert in the knowledge acquisition process is the "induce command," which makes the acquisition process much simpler. First we create a decision table in ASCII text of the problem which will be solved. Once a problem has been modeled using decision tables, then it can be converted into a VP-Expert rule base. The induce command is somewhat mis-named. Its function is not really induction, but rather syntactic transformation from the decision table format [Ref. 29].

The first thing done is to create a file with the name extension .TBL. This file consists of a decision table created using any type of text editor, such as Q editor, Norton editor, or the one VP-Expert provides, VP-Expert Editor. This table will be converted to a knowledge base with file extension .KBS.

For instance, Table 4-1 is a table used to find an officer's eligibility to become a candidate. This table is used as the initial knowledge acquisition in building EDSA.

TABLE 4-1: DECISION TABLE FOR CANDIDATE

SC	SPEC_EDU	RANK	CANDIDATE
Yes	Suscaleg	Higher_or_Major	Yes
Yes	Non_Suscaleg	Lower_than_Major	No
Yes	Suscaleg	Lower_than_Major	No

By using induce mode, VP-Expert will create a knowledge base, as shown in Table 4-2. In fact, it will create a complete set of modules, including action blocks, rule blocks, and statement blocks.

TABLE 4-2: KNOWLEDGE BASE FOR CANDIDATE

```
RULE 0
 IF  SC       = Yes   AND
     SPEC_EDU = Suscaleg AND
     RANK     = Higher_or_Major
 THEN CANDIDATE = Yes;

RULE 1
 IF  SC       = Yes   AND
     SPEC_EDU = Non_Suscaleg AND
     RANK     = Lower_than_Major
 THEN CANDIDATE = No;

RULE 2
 IF  SC       = YES   AND
     SPEC_EDU = Suscaleg AND
     RANK     = Lower_than_Major
 THEN CANDIDATE = No
     BECAUSE "Required Rank for Suscaleg = Major";
```

C. KNOWLEDGE REPRESENTATION

Knowledge representation techniques in this thesis use rules that are commonly found in expert systems. Rules provide a formal way of representing recommendations, deductions, or strategies. Some of the terms used in the rules are in the Indonesian language because they are extracted from real database fields. This database is in use by ABRI. (See Appendix A for Indonesian acronyms and their meaning in English). These rules are expressed in IF-THEN statements. The rules used in EDSA are as follows:

RULE 0

IF SC = yes AND
KODEPKT <= 07 AND
DIKSUS = Suscaleg

THEN CANDIDATE = Yes

In this example, in order to be selected as a candidate, one must meet three criteria: these are a Security Clearance (SC), Suscaleg as a special course (DIKSUS), and rank must be Major or above (KODEPKT <= 07). If these three criteria are met by an officer then he or she is a good candidate for a member of DPR.

In contrast, if one of the conditions is not met then he or she will not be chosen as a candidate. The rule for that is follows:

RULE 1

IF SC = Yes AND
KODEPKT > 07

THEN CANDIDATE = Not

BECAUSE "Rank is lower than Major"

The rule above explains that if anyone with the rank lower than Major even has Security Clearance = Yes, he or she will be rejected as a candidate. The most likely reason is because officers below the rank of Major are still needed in the field, and most of them are usually considered too young to be assigned to DPR.

The next rule is about the same as the first one.

RULE 2

IF SC = Yes AND

DIKSUS <> Suscaleg

THEN CANDIDATE = Not

Because "special education is not Suscaleg"

This officer is rejected because he or she does not have special education namely "Suscaleg (Legislator Candidate Course)" needed for legislation candidates.

Rule 3 is concerned with security matters. In the Indonesian government, everybody has to pass the security clearance test at least once during his or her career. This requirement is needed to become a government employee and then may also be required to be taken for other purposes at other times. In this case, if a military officer wants to have a political career, then he or she must take this test and pass it. The rule for this purpose is as follow:

RULE 3

IF SC = No

THEN CANDIDATE = Not

DPR = Not_Qualify

Display "!! Security Clearance is above all !!"

It is clear if an officer does not have the security clearance, regardless of rank he or she is rejected as a candidate as well as DPR member. This rule will display a message saying: "!! Security Clearance is above all !!". This rule reflects the critical importance of security clearances in the selection process.

Another rejection rule is as follow:

RULE 4

IF CANDIDATE = Not and

KODEPKT > 05

THEN DPR = Not_Qualify

This rule explains that if an officer is not a CANDIDATE and his or her rank is below Colonel, (e.g., 06 = Lieutenant Colonel, 07 = Major), then he or she is not qualified to become a member of DPR. But if his or her rank is Colonel or above then he or she could possibly become a member even though not possessing other qualifications. This will be discussed in special rules.

The following rules are needed to determine for which type of DPR a candidate is best suited. Special rules are included for senior officers and flag officers who have a strategic military education background or national defense college background.

Each candidate will be tested against these rules until a match is found. There are three types of DPRs: DPRD_TK II, DPRD_TKI, and DPR_RI.

DPRD_TKII is an Indonesian acronym for Dewan Perwakilan Rakyat Daerah Tingkat II. In English this means District/Municipal Representative Assembly. There are eight rules to satisfy this category.

The first rule is:

RULE DPR_A0

IF CANDIDATE = Yes

DIKMIL = Suslapa AND

DIKUM = SMA AND

KODEPKT = 07

THEN DPR = DPRD_TKII

In rule DPR_A0, there are specific criteria. These criteria are that CANDIDATE = Yes, military education is equal to Suslapa (Officer Advanced Course), public education is SMA (Senior High School), and KODEPKT = 07 (Major). If the officer meets these criteria, he or she is suited for DPR_TKII (District/Municipal Representatives Assembly).

The second rule is:

RULE DPR_A1

IF CANDIDATE = Yes

DIKMIL = Suslapa AND

DIKUM = SMA AND

KODEPKT = 06

THEN DPR = DPRD_TKII

In rule DPR_A1, the criteria are that CANDIDATE = Yes, military education is equal to Suslapa (Officer Advanced Course), public education is SMA (Senior High School), and KODEPKT = 06 (Lieutenant Colonel). If the criteria are met, the candidate is suited for DPR_TKII.

The third rule is:

RULE DPR_A2

IF CANDIDATE = Yes

DIKMIL = Suslapa AND

DIKUM = S1 AND

KODEPKT = 07

THEN DPR = DPRD_TKII

In rule DPR_A2, the criteria are that CANDIDATE = Yes, military education is equal to Suslapa (Officer Advanced Course), public education is S-1 (Strata 1 in Indonesian educations system), and KODEPKT = 07 (Major).

The fourth rule is:

RULE DPR_A3

IF CANDIDATE = Yes

DIKMIL = Suslapa AND

DIKUM = S1 AND

KODEPKT = 06

THEN DPR = DPRD_TKII

In rule DPR_A3, the criteria are that CANDIDATE = Yes, military education is equal to Suslapa (Officer Advanced Course), public education is S-1 (Strata 1 in Indonesian educations system), and KODEPKT = 06 (Lieutenant Colonel).

The fifth rule is:

RULE DPR_A4

IF CANDIDATE = Yes

DIKMIL = Suslapa AND

DIKUM = S2 AND

KODEPKT = 07

THEN DPR = DPRD_TKII

In rule DPR_A4, the criteria that CANDIDATE = Yes, military education is equal to Suslapa (Officer Advanced Course), public education is S-1 (Strata 1 in Indonesian educations system), and KODEPKT = 07 (Major).

The sixth rule is:

RULE DPR_A5

IF CANDIDATE = Yes

DIKMIL = Suslapa AND

DIKUM = S2 AND

KODEPKT = 06

THEN DPR = DPRD_TKII

In rule DPR_A5, the criteria that CANDIDATE = Yes, military education is equal to Suslapa (Officer Advanced Course), public education is S-2 (Strata 2 in Indonesian educations system), and KODEPKT = 06 (Lieutenant Colonel).

The seventh rule is:

RULE DPR_B0

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = SMA AND

KODEPKT = 07

THEN DPR = DPRD_TKII

Notice the differences between the Rule DPR_A series and the Rule DPR_B series, even though both are used to satisfy DPRD_TKII. The DPR_A's rule only requires Suslapa as his or her DIKMIL, and there are three DIKUM accepted (SMA, S-1, and S-2), which is also applicable to the ranks of Major and Lieutenant Colonel. The DPR_B's rule, in contrast, requires Sesko in his or her DIKMIL, only SMA as the DIKUM, and the rank of Major or Lieutenant Colonel. In Rule DPR_B0, the KODEPKT = 07 (Major). The candidate is suited for DPR_TKII.

The eighth rule is:

RULE DPR_B1

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = SMA AND

KODEPKT = 06

THEN DPR = DPRD_TKII

In Rule DPR_B1, the requirements are that the CANDIDATE must be equal to Yes, military education is Sesko, public education is SMA or Senior High School, and Rank is Lieutenant Colonel. This rule is used to satisfy the candidate for DPR_TKII.

DPRD_TKI is an Indonesian acronym for Dewan Perwakilan Rakyat Daerah Tingkat I or Provincial Representative Assembly. This category employs four rules to satisfy DPRD_TKI.

The first rule is:

RULE DPR_C0

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = S-1 AND

KODEPKT = 07

THEN DPR = DPRD_TKI

In this rule, the key criteria are DIKMIL is equal to Sesko and DIKUM is S-1. Rule DPR_C0's KODEPKT is 07. Any candidates fall in this category is best suited for DPRD_TKI.

The second rule is:

RULE DPR_C1

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = S-1 AND

KODEPKT = 06

THEN DPR = DPRD_TKI

This rule is only slightly different from the above rule. The only difference is that Rule DPR_C1's KODEPKT is 06, and any candidates falling in this category is best suited for DPR_DTKI.

The third rule is:

RULE DPR_D

IF CANDIDATE = Yes AND

DIKMIL = Suslapa AND

DIKUM = S2 AND

KODEPKT = 05

THEN DPR = DPRD_TKI

This rule only requires Suslapa in its DIKMIL but S2 as its DIKUM and KODEPKT = 05 or Colonel. This is a rule for senior officer who has only Suslapa as his military education but has S-2 as his public education. The candidates falling in this category are best suited for DPRD-TKI.

The fourth rule is:

RULE DPR_E

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = SMA AND

KODEPKT = 05

THEN DPR = DPRD_TKI

This rule is required for a senior officer or Colonel who has Sesko as his or her DIKMIL, but only SMA as his or her DIKUM. Any candidates falling in this category are best suited for DPR_TKI.

DPR_RI is an Indonesian acronym standing for Dewan Perwakilan Rakyat Republik Indonesia or in English meaning the House of People's Representative of the Republic of Indonesia. There are two plus four special rules used in this category to satisfy the DPR_RI requirements.

The first rule is:

RULE DPR_F

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = S-1 AND

KODEPKT <= 05

THEN DPR = DPR_RI

This rule is for a CANDIDATE with Sesko as his or her DIKMIL and S-1 as his or her DIKUM and the rank is colonel or above i.e 04 is Brigadier General, 03 is Major General, etc., then he or she eligible to be a member of DPR_RI.

The second rule in this category is:

RULE DPR_G

IF CANDIDATE = Yes AND

DIKMIL = Sesko AND

DIKUM = S-2 AND

KODEPKT <= 07

THEN DPR = DPR_RI

This rule specifies that if a CANDIDATE has a Sesko as DIKMIL and S-2 as a DIKUM with rank in the range of Major and above, then he or she is eligible to be a member of DPR_RI.

The last four special rules are required for a senior or flag officer who has strategic military education background. In all special rules there is a displayed message saying: "Because he/she is a senior officer." This message is a reminder to the user that the officer is Colonel or above in rank.

The first rule is written as follow:

RULE SPECIAL0

IF CANDIDATE = Yes AND

DIKMIL = Lemhanas AND

KODEPKT <= 05

THEN DPR = DPR_RI

DISPLAY "Because he/she is a senior officer."

In this rule, the officer's DIKMIL is Lemhanas, the rank is Colonel or above. Lemhanas is the highest military education in ABRI's military education system and not many officers can attain this educational level. Any candidate falling in this category is best suited for DPR-RI.

The second rule is as follow:

```
RULE SPECIAL1
IF      CANDIDATE  = Yes  AND
        DIKMIL     = Seskogab  AND
        KODEPKT    <= 05
THEN    DPR        = DPR_RI
        DISPLAY "Because he/she is a senior officer."
```

In this rule, its DIKMIL requirement is Seskogab or one level below Lemhanas. Officers who attend this course must have Sesko as his military education. The rank is also Colonel or above. Any candidate falling in this category is eligible for DPR-RI.

The third rule is as follow:

```
RULE SPECIAL2
IF      CANDIDATE  = Not  AND
        DIKMIL     = Lemhanas AND
        KODEPKT    <= 05
THEN    DPR        = DPR_RI
        DISPLAY "Because he/she is a senior officer."
```

In this special rule says that CANDIDATE is equal to Not, but since the officer has the highest military education and a rank Colonel or above then he or she might be appointed as a member of DPR-RI. This is not an unusual procedure for appointing officers to the outside of DEPHANKAM because the officer has a high military education and also is a senior officer with a strategic background.

The forth rule is as follow:

```
RULE SPECIAL3
IF      CANDIDATE  = Not  AND
        DIKMIL     = Seskogab AND
        KODEPKT    <= 05
THEN    DPR        = DPR_RI
        DISPLAY "Because he/she is a senior officer."
```

Similar in reasoning to the above rule, this rule tests that the officer has military education Seskogab and rank equal to Colonel or above. The officer might be appointed as a member of DPR-RI.

D. SYSTEM DESIGN AND DEVELOPMENT

1. System Architecture

The use of databases in expert systems can be coupled either tightly or loosely. A tightly coupled architecture is one where the expert system controls the database or database controls the expert system. When the expert system controls the database, the database can only be accessed through the use of the interface generated by the expert system. In contrast, when the database controls the expert system, the expert system is used to optimize database access.

A loosely coupled architecture means that both database and expert system remain in their original structure. The database can be accessed indiscriminately by the expert system to create queries and reports. This architecture is best suited for EDSA.

The EDSA uses rule-based access to the active database used by the ABRI information systems.

The system architecture of EDSA is shown in Figure 4-4. It shows the interaction between the human and the machine. On the human side is the user. The machine side consists of user interface, inference engine, knowledge base, and database.

An expert system shell such as VP-Expert requires very little coding from the programmer. It has a built-in interface engine and user interface. What the programmer or expert system developer needs to do is just write the rule base or knowledge base.

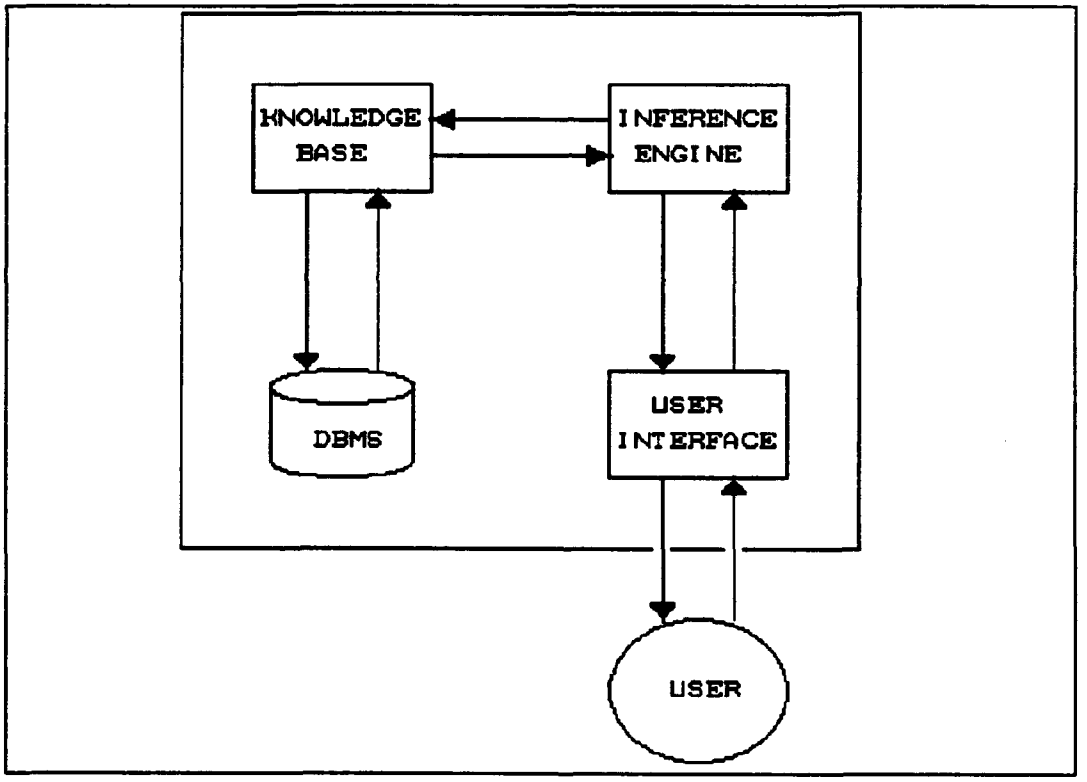

Figure 4-4: The EDSA Systems Architecture

2. User Interface

EDSA uses a simple user interface because it is designed for higher level managers or senior officer in the ABRI. Sometime it is quite difficult to keep senior officers in front of a computer monitor to learn something new. Consequently, the designer of EDSA must keep the human interface as simple as possible to permit use by managers and senior officers.

The first menu displayed on the screen is shown below:

WELCOME TO EXPERT DATABASE SYSTEM OF ABRI (EDSA)

by

MAJOR NIDJO SANDJOJO

Press ENTER to proceed !!!

There are two things the user needs to do. First, to retrieve the officer's data from the database (MILPERS.DBF), the user enters the officer's serial number as shown below:

- **Enter his/her Serial Number:**

Only one officer's data will be retrieved at a time, i.e., for the officer whose serial number is entered. The next question asked is security clearance, as shown below:

- **Does the officer have Security Clearance OK?**
- **Yes No**

Answer this question by highlighting "Yes" or "No" using the left or the right key arrows and then press <ENTER>.

This is all the user needs to do. The inference engine will do the rest to find the solution. Based on these two entries and the data on the individual officer, the solution will be presented to the user as shown below:

- **Name :**
- **Rank :**
- **Serial Number :**
- **Current Occupation :**
- **Military Education :**
- **Public Education :**
- **Special Education :**
- **The officer you choose is: [Yes or No] a candidate for DPR**
- **however, he/she is best suit for: [Specific DPR or Not Qualify].**
- **For further consideration, provide the following information (Year/Month/Date)**
- **Date of Birth :**
- **Date of Commission :**
- **Date of Join the Service :**

- **Press Enter to Continue !!!**

After the ENTER key is pressed, another question will be asked whether to exit the loop or continue with another candidate as shown below:

- **Enter ? to exit the loop or any other character to continue.**

By pressing the ? key, the computer will exit the loop. If the user presses any other character (A-Z), the computer goes back to the beginning of the program to enable the user to perform the same procedure, starting with entering the serial number.

E. PROTOTYPING

The term prototype refers to a working model of an information system application. The prototype built by the author does not contain all the features or perform all the necessary functions of a final system. Rather, it includes sufficient elements of a final system to enable individuals to determine what they like and do not like and to identify features to be added or changed. A prototype system is used in this thesis because it is flexible and allows changes for the future development. As Emery asserted:

> A prototype system is an interim system used in the process of developing a more permanent version. At various stages of its development, or in different types of applications, a prototype system may offer capabilities ranging from a mere facade to an almost fully functional system that lacks only polishing and fine tuning.[Ref. 32]

According to Senn 1989, the process of developing and using the prototype has five characteristics:

- The prototype is a live, working application
- The purpose of prototyping is to test out assumptions made by analysts and users about required system features.
- Prototypes are created quickly.
- Prototypes evolve through an iterative process.
- Prototypes are relatively inexpensive to build.[Ref. 33]

The development of EDSA can best be illustrated in the flowchart shown in Figure 4-5: Prototyping Cycle of EDSA. It begins with designing a prototype. The author designed the program from scratch and determined what the program would do, and what the program's input and output should be.

The next step is knowledge acquisition and its representation. This is the most important stage because EDSA will run using the rules-based system developed at this stage. Precise syntax and logic are very important in writing the rule base. Incorrect syntax will prevent the program from running at all and incorrect logic will result in an incorrect output.

Testing and case study are the next stage. Using hypothetical data, the program is tested. Syntax errors can be detected in this stage, and when encountered must be corrected in the previous stage using a text editor, because the program cannot run if there are syntax errors. Logic errors cannot be detected in this stage.

User feedback is expected in this stage. The program is primarily designed for the senior officers of ABRI. Since only international telephone communication can be used to contact the target end-users, only very limited feedback was obtained by the author. The author plans to make a presentation to the senior officers of ABRI when he returns to Indonesia. He expects that with more feedback, changes to the program are possible.

The next stage is analysis of the results of the output. In this stage incorrect output caused by incorrect logic is detected by comparing the hypothetical database, the input given by the user, and the outcome. Based on the correctness of the output, then we continue to the next stage.

Even if the output is correct, there may still be reasons to make improvements. In author's opinion, writing a program is not only dependent on the correct result itself, but also from many things such as clean code, style of the output, and the satisfaction of the programmer himself in his work. If he feels that he is not satisfied with the program then he may decide to make improvements. The end user's satisfaction will also play an important role in improvements made to the program. If improvements are required, we return to the knowledge acquisition and representation stage; otherwise the development is finished.

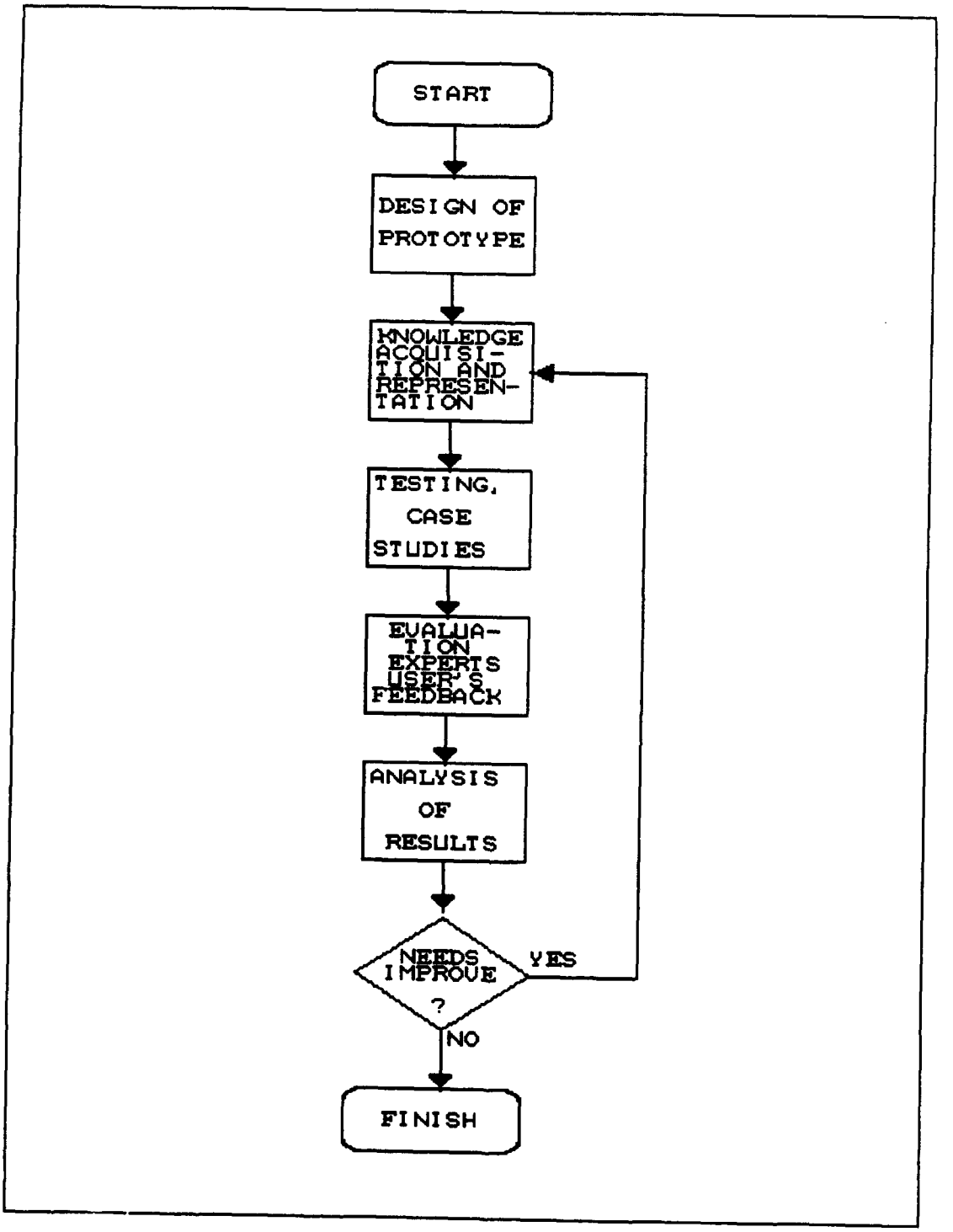

Figure 4-5: Prototyping Cycle of EDSA

V. CONCLUSION

A. BENEFIT OF EXPERT DATABASE SYSTEM

This thesis has discussed the feasibility of developing an expert database system for assigning Indonesian officers tours of duty to a non DEPHANKAM assignment in this case, assignments to the House of People's Representatives (DPR). By modifying the knowledge base, it can be used in other applications as well. It also addresses the ability to capture the domain expertise required by the system in its knowledge base.

The use of an expert system shell has proved to be very effective in developing expert database system. Only a little encoding is required by using IF-THEN rules, compared to using an artificial intelligence (AI) programming language such as PROLOG. It is very much easier, and requires less encoding.

Computer decision aids are more and more commonly used by managers. In personnel selection, it seems to be very useful since the managers deal with a large number of people. ABRI has a large number of officers and staff personnel and has to choose some of them who are qualified for certain positions. In choosing officers who will be appointed to the DRP positions, EDSA can be usefully applied.

By using EDSA, the ABRI can save time and reduce laborious work which is done manually. Also decisions can be reached more quickly. Faster decision making is absolutely important in modern information technology in globalization era.

B. RECOMMENDATION

Information technology (IT) grows very quickly. It does not recognize any boundary in its development. One advance follows another is very short order. Today's technology becomes almost obsolete tomorrow. If we do not keep up with the advances in IT, we will be left behind.

Time has come for ABRI to speed up its development in the IT sector. Look around what has happened to the neighboring countries. They are racing in chasing IT and no one want to be left behind. IT plays a very significant role in running the country.

Most decisions must be made in a very fast situation. Sometimes decisions taken in a minute have a different impact compared with a decision taken later. To help in making the right decision, decision aids are needed. One of them is EDSA.

APPENDIX A

INDONESIAN ACRONYMS AND TERMS

ABRI	Angkatan Bersenjata Republik Indonesia (The Armed Forces of the Republic of Indonesia)
AD	Angkatan Darat (Army)
AL	Angkatan Laut (Navy)
AU	Angkatan Udara (Air Force)
DEPHANKAM	Departemen Pertahanan dan Keamanan (Department of Defense and Security)
DIKMIL	Pendidikan Militer (Military Education)
DIKSUS	Pendidikan Khusus (Special Education)
DIKUM	Pendidikan Umum (Public Education)
DPR	Dewan Perwakilan Rakyat (The House of People's Representatives)
DPR_RI	Dewan Perwakilan Rakyat Republik Indonesia (The House of People's Representatives of the Republic of Indonesia)
DPRD_TKI	Dewan Perwakilan Rakyat Daerah Tingkat I (The Provincial Representatives Assembly)
DPRD_TKII	Dewan Perwakilan Rakyat Daerah Tingkat II (The District/Municipal Representatives Assembly)
Dwi Fungsi	Dual Functions
Jabatan	Occupation
KODEPKT	Kode Pangkat (Code of Rank)

LEMHANAS	Lembaga Pertahanan Nasional (National Defense Institute)
MPR	Majelis Permusyawarakat Rakyat (The People's Consultative Assembly)
Nama	Name
NRP	Nomor Register Pokok (Serial Number)
Pancasila	Five Fundamental Principles; the belief of one supreme God, justice and civility among the people, the unity of Indonesia, democracy through deliberation and consensus among representatives, and social justice for all.
Pangkat	Rank
Pullahta	Pengumpulan dan Pengolahan Data (Data Gathering and Processing Service)
PJP	Pembangunan Jangka Panjang (Long Term Development = 25 year term)
POLRI	Polisi Republik Indonesia (the Police of the Republic of Indonesia)
PUSKODAL	Pusat Komando dan Pengendalian (Command and Control Center)
REPELITA	Rencana Pembangunan Lima Tahun (Five-Year Development Plan)
Sesko	Sekolah Staf dan Komando (Command and General Staff College)
Seskogab	Sekolah Staf dan Komando Gabungan (Combined Command and General Staff College)
SMA	Sekolah Menengah Tingkat Atas (Senior High School)
Suslapa	Kursus Lanjutan Perwira (Advanced Officer Course)

Suscaleg	Kursus Calon Legislatif (Legislator Candidate Course)
TNI	Tentara Nasional Indonesia (Indonesian National Military)
TNI-AD	Indonesian National Army
TNI-AL	Indonesian National Navy
TNI-AU	Indonesian National Air Force
TGLHR	Tanggal Lahir (Date of Birth)
TMTABRI	Terhitung Mulai Tanggal ABRI (Date of Joining the ABRI)
TMTPA	Terhitung Mulai Tanggal Perwira (Date of Commission)

APPENDIX B

CODE OF ABRI'S OFFICERS RANK USED IN EDSA

CODE	Indonesian	American
01	Jederal (Army) Laksamana (Navy) Marsekal (Air Force) Jenderal (Police)	General (Army) Admiral (Navy) General (Air Force)
02	Letnan Jenderal Laksamana Madya Marsekal Madya Letnan Jenderal	Lieutenant General Vice Admiral Lieutenant General
03	Mayor Jenderal Laksamana Muda Marsekal Muda Mayor Jenderal	Major General Rear Admiral Major General
04	Brigadir Jenderal Laksamana Pertama Marsekal Pertama Brigadir Jenderal	Brigadier General Rear Admiral Brigadier General
05	Kolonel	Colonel
06	Letnan Kolonel	Lieutenant Colonel
07	Mayor	Major
08	Kapten	Captain
09	Letnan Satu	First Lieutenant
10	Letnan Dua	Second Lieutenant

Note: The ranks of Colonel down to Second Lieutenant in Indonesian Armed Forces are all the same.

APPENDIX C

TECHNICAL MANUAL OF EDSA

A. Hardware and software requirements, and installation

EDSA is designed to run on an IBM PC/AT computer or compatible. It can be run from a floppy disk or from a hard disk. It is much faster if it is run from a hard disk. No mouse is needed; the keyboard is the main equipment to communicate with the system.

EDSA requires VP-Expert on the machine. A database file is also required, and database software is recommended to update the database. MS-DOS 3.0 or later is needed to run the system.

To run from a hard disk, VP-Expert needs to be installed on the machine first. To install VP-Expert on the hard disk:

- Make a directory C:\VP_EXPERT
- Change directory to C:\VP_EXPERT
- Place original VP-Expert in drive A (or B)
- Type A: xcopy *.* C: and press <ENTER>

B. Starting the EDSA

After installing VP-Expert on the hard disk, start the program by changing the directory to C:\VP_EXPERT. From this directory type: VPX then press <ENTER>.

This will load the VP-Expert program, and the screen will look like Figure C-1. To load the EDSA program press F6 to choose the file.

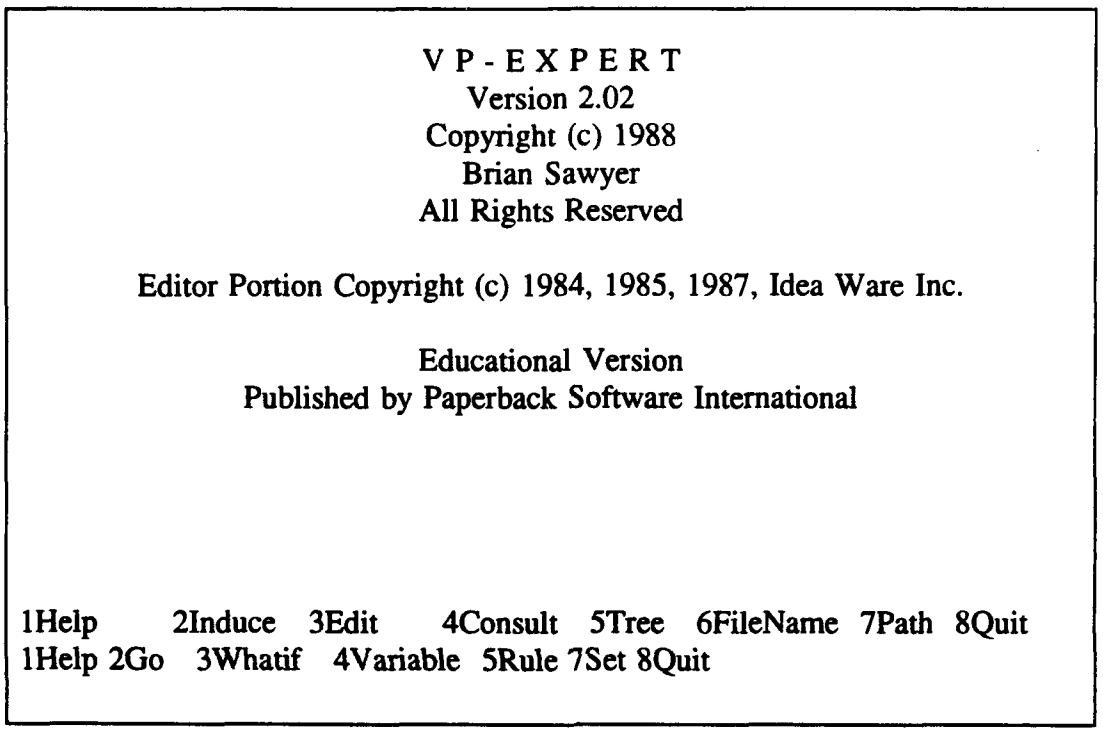

Figure C-1

To run EDSA, choose the file name PERSON by using left/right arrow (if there are more than one file). The screen will then look like in Figure C-2.

A database file is required by EDSA in order to run properly. A DBMS is recommended to update or modify the data. In this prototype, filename MILPERS.DBF is used, consisting of personnel data needed to test the program. It was created using DBaseIIIPlus without being indexed.

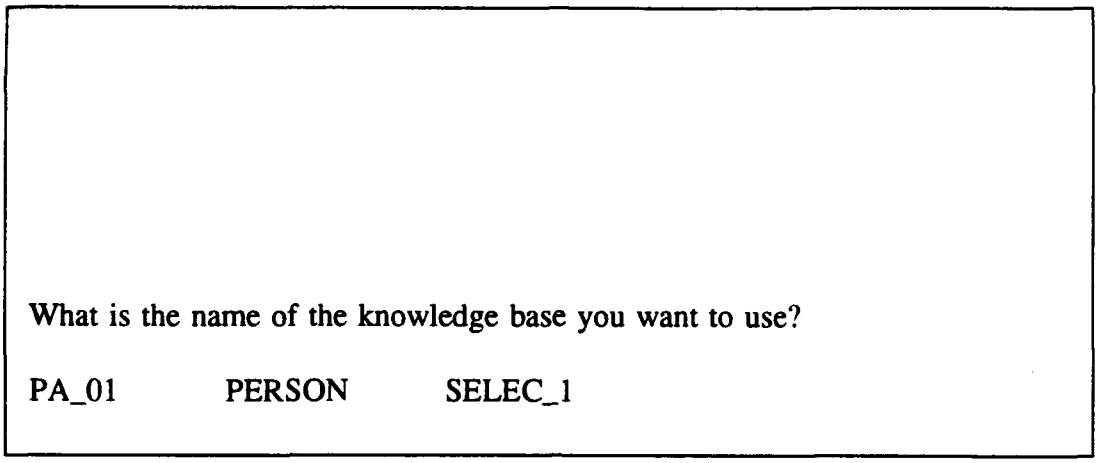
What is the name of the knowledge base you want to use?
PA_01 PERSON SELEC_1

Figure C-2

C. List of Code of the Program

```
! ************************************!
! Program        : Person.Kbs
! Author         : Nidjo Sandjojo
! Date completed : 07 March 1994
! Date revised   : 04 July 1994
! Purpose        : Personnel selection
! Software       : VP-EXPERT
! ************************************

EXECUTE;
ENDOFF;
RUNTIME;

! Actions Block
ACTIONS
  CLS
  COLOR=0
  DISPLAY "          WELCOME TO EXPERT DATABASE SYSTEM OF ABRI (EDSA)"
  DISPLAY " "
  DISPLAY "                          by"
  DISPLAY " "
  DISPLAY "                    MAJOR NIDJO SANDJOJO"
  DISPLAY " "
```

```
DISPLAY " "
DISPLAY " "
DISPLAY " "
DISPLAY "                    Press ENTER to proceed !!!~ "
CLS
WHILEKNOWN Switch
  RESET  SC
  RESET  Serial_Number
  RESET  CANDIDATE
  RESET  DPR
  MENU   Serial_Number, SerNum = Nrp, MILPERS,NRP
  FIND   Serial_Number
  FIND   SC
  MRESET Serial_Number
  GET    Serial_Number = NRP,MILPERS,ALL
  CLS
!  PRINTON
  DISPLAY "Name              = {Nama}"
  DISPLAY "Rank              = {Pangkat}"
  DISPLAY "Serial Number     = {Nrp}"
  DISPLAY "Current Occupation  = {Jabatan}"
  DISPLAY "Military Education  = {DikMil}"
  DISPLAY "Public Education    = {DikUm}"
  DISPLAY "Special Course      = {DikSus}"
  DISPLAY " "
```

```
    FIND CANDIDATE
    DISPLAY "The officer you choose is: [{CANDIDATE}] a candidate for DPR."
    FIND DPR
    DISPLAY "however, he/she is best suit for: [{DPR}]"
    DISPLAY " "
    COLOR = 4
    DISPLAY "For further consideration, we provide the"
    DISPLAY "following information:  (year/month/date)"
    DISPLAY "Date of Birth          = {Tglhr}"
    DISPLAY "Date of Commission     = {Tmtpa}"
    DISPLAY "Date of Join the Service = {Tmtabri}"
!   PRINTOFF
!   EJECT
    DISPLAY " "
    COLOR = 0
    Display "Press ENTER to continue !!!~"
    RESET Switch
    FIND Switch
    CLOSE MILPERS
    CLS
  END;

! Rules Block
RULE 0
IF    SC      = Yes     AND
```

KODEPKT <= 07 AND

DIKSUS = *Suscaleg*

THEN CANDIDATE = Yes;

RULE 1

IF SC = Yes AND

KODEPKT > 07

THEN CANDIDATE = Not

BECAUSE "Rank is lower than Major";

RULE 2

IF SC = Yes AND

DIKSUS <> Suscaleg

THEN CANDIDATE = Not

BECAUSE "Special Education is not Suscaleg";

RULE 3

IF SC = No

THEN CANDIDATE = Not

DPR = Not_Qualify

DISPLAY " !!! Security Clearance is above all !!!";

RULE 4

IF CANDIDATE = Not AND

KODEPKT > 05

```
THEN   DPR      = Not_Qualify;

RULE DPR_A0
IF     CANDIDATE = Yes      AND
       DIKMIL    = Suslapa  AND
       DIKUM     = SMA      AND
       KODEPKT   = 07
THEN   DPR      = DPRD_TKII;

RULE DPR_A1
IF     CANDIDATE = Yes      AND
       DIKMIL    = Suslapa  AND
       DIKUM     = SMA      AND
       KODEPKT   = 06
THEN   DPR      = DPRD_TKII;

RULE DPR_A2
IF     CANDIDATE = Yes      AND
       DIKMIL    = Suslapa  AND
       DIKUM     = S1       AND
       KODEPKT   = 07
THEN   DPR      = DPRD_TKII;

RULE DPR_A3
IF     CANDIDATE = Yes      AND
```

```
        DIKMIL    = Suslapa   AND
        DIKUM     = S1        AND
        KODEPKT   = 06
    THEN  DPR     = DPRD_TKII;

    RULE DPR_A4
    IF    CANDIDATE = Yes     AND
        DIKMIL    = Suslapa   AND
        DIKUM     = S2        AND
        KODEPKT   = 07
    THEN  DPR     = DPRD_TKII;

    RULE DPR_A5
    IF    CANDIDATE = Yes     AND
        DIKMIL    = Suslapa   AND
        DIKUM     = S2        AND
        KODEPKT   = 06
    THEN  DPR     = DPRD_TKII;

    RULE DPR_B0
    IF    CANDIDATE = Yes     AND
        DIKMIL    = Sesko     AND
        DIKUM     = SMA       AND
        KODEPKT   = 07
    THEN  DPR     = DPRD_TKII;
```

```
RULE DPR_B1
IF    CANDIDATE = Yes      AND
      DIKMIL    = Sesko    AND
      DIKUM     = SMA      AND
      KODEPKT   = 06
THEN  DPR       = DPRD_TKII;

RULE DPR_C0
IF    CANDIDATE = Yes      AND
      DIKMIL    = Sesko    AND
      DIKUM     = S1       AND
      KODEPKT   = 07
THEN  DPR       = DPRD_TKI;

RULE DPR_C1
IF    CANDIDATE = Yes      AND
      DIKMIL    = Sesko    AND
      DIKUM     = S1       AND
      KODEPKT   = 06
THEN  DPR       = DPRD_TKI;

RULE DPR_D
IF    CANDIDATE = Yes      AND
      DIKMIL    = Sesko    AND
      DIKUM     = SMA      AND
```

```
        KODEPKT    = 05
THEN    DPR        = DPRD_TKI;

RULE DPR_E
IF      CANDIDATE  = Yes      AND
        DIKMIL     = Suslapa  AND
        DIKUM      = S2       AND
        KODEPKT    = 05
THEN    DPR        = DPRD_TKI;

RULE DPR_F
IF      CANDIDATE  = Yes      AND
        DIKMIL     = Sesko    AND
        DIKUM      = S1       AND
        KODEPKT    <= 05
THEN    DPR        = DPR_RI;

RULE DPR_G
IF      CANDIDATE  = Yes      AND
        DIKMIL     = Sesko    AND
        DIKUM      = S2       AND
        KODEPKT    <= 07
THEN    DPR        = DPR_RI;

RULE SPECIAL0
```

```
IF     CANDIDATE  = Yes    AND
       DIKMIL     = Lemhanas  AND
       KODEPKT    <= 05
THEN   DPR        = DPR_RI
       DISPLAY "Because he/she is a senior officer";

RULE SPECIAL1
IF     CANDIDATE  = Yes    AND
       DIKMIL     = Seskogab  AND
       KODEPKT    <= 05
THEN   DPR        = DPR_RI
       DISPLAY "Because he/she is a senior officer";

RULE SPECIAL2
IF     CANDIDATE  = No     AND
       DIKMIL     = Lemhanas  AND
       KODEPKT    <= 05
THEN   DPR        = DPR_RI
       DISPLAY "Because he/she is a senior officer";

RULE SPECIAL3
IF     CANDIDATE  = No     AND
       DIKMIL     = Seskogab  AND
       KODEPKT    <= 05
THEN   DPR        = DPR_RI
```

```
        DISPLAY "Because he/she is a senior officer";


! Statements Block

ASK Serial_Number: "Enter his/her Serial Number?";


ASK SC: "Does the officer have Security Clearance OK?";

CHOICES SC: Yes,No;


ASK Switch: "Enter ? to Exit the loop, or any other character to continue.";
```

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