Chapter 14

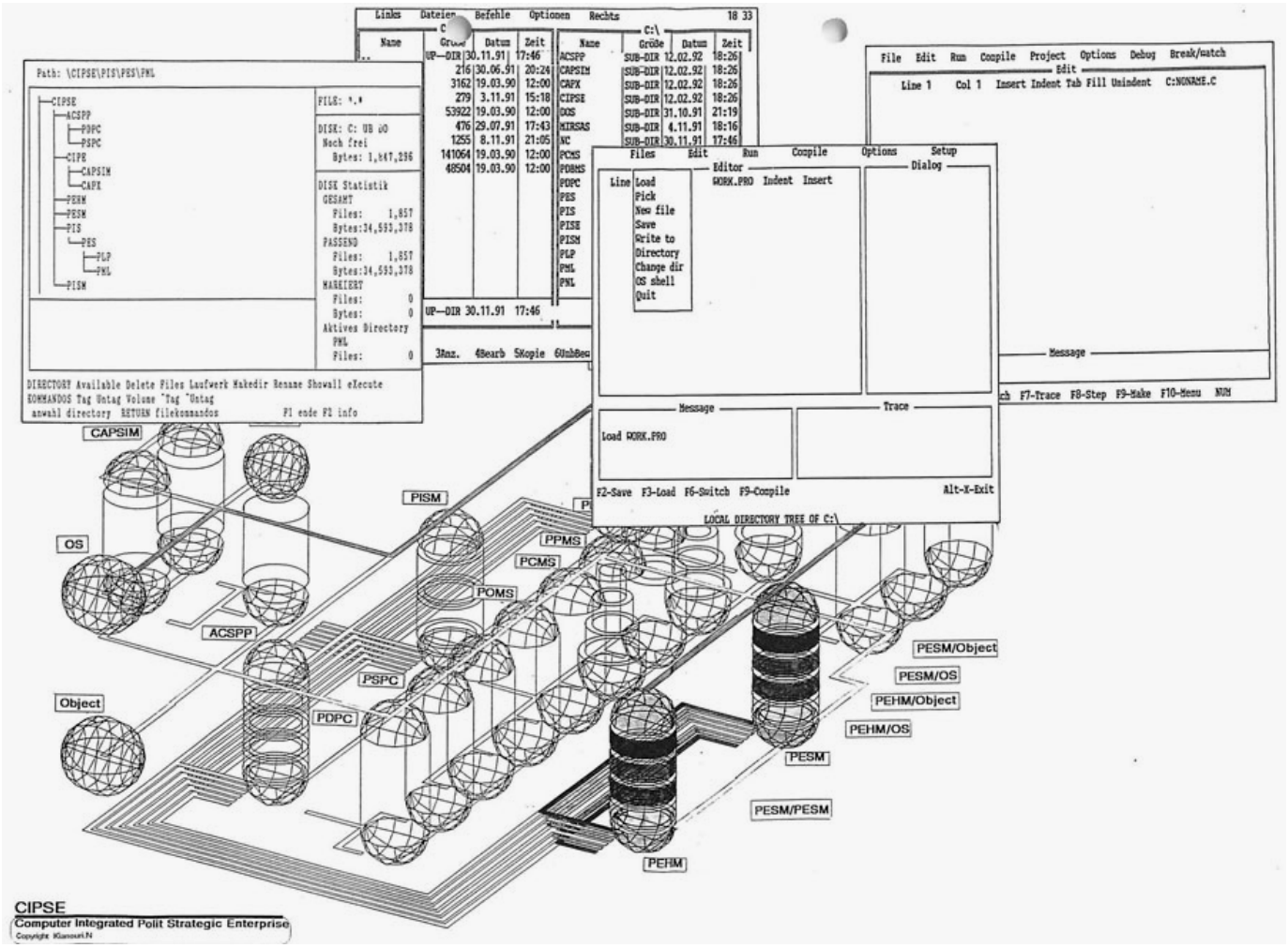
Politic Expert Systems (PES)

14- Politic-Expert Systems (PES)

14.1- Prologue - An expert system is a program that behave like an expert in some, usually narrow, domain of application include tasks. Polit-expert systems have to be capable of solving problems that require po1it-expert knowledge in a particular domain. They should possess that knowledge in some form. Therefore they are also called knowledge-based system. An expert system also has to be capable, in some way, of explaining its behaviour and its decisions to the polit-user, as human experts do. These systems have represented the most extensive and practical use of artificial intelligent to date. Expert systems require the creation of a knowledge base of facts and rules. Users can query the data base, presenting their own questions and facts in response to promptings from the system. An expert system is a computer-based system that uses knowledge, facts, and reasoning techniques to solve problem that normally require the expertise, abilities, and experiences of human expert. To build an expert system we have, in general, to develop the following functions:

- **Political-Problem-** solving function capable of using domain specific knowledge, this may require dealing with uncertainty
- **Polit-user-** interaction function, which includes explanation of the system's intentions and decision during and after the problem-solving process.

Shortly a polit-expert system is a computer program that performs a task normally done by an expert or consultant and which, in so doing, uses captured, heuristic knowledge. If we think of a computer program as being a collection of rules that describe actions to be taken, then the familiar algorithmic program may be viewed as one where the sequence or firing, or testing and applying, the rules is determined in advance and where each rule premise or condition leads to one - and only one - action. That is, progress in such a program is controlled by a tightly knit algorithm. Further, in a conventional algorithmic program, the processing is done using symbols to represent numbers, arithmetic properties, and mathematical operations.



14.2- list of Polit-Expert System (PES) and Polit-Knowledgebase:

- First define of expert system tools

- Design po1it-expert system
- Building large knowledge based system
- Define expert procedures such as plan, prognoses, control plan, situation, etc.
- Objectives of the system
- Task the system will perform
- System's intended users
- System's operating environment
- Define source of expertise.

14.3- Basic Definitions in Polit-Expert System (PES):

Polit-Expertise - This characteristic combines large amount of polit-information with high-level decision making using high-level inference patterns. The experiences of the polit-experts are included in the data base as additional parameters for the polit-declsl0n process.

Manipulation - A manipulation representation is one that facilities computation. In manipulable representations, the information is accessible to other entities, which use the representation as part of a computation.

Polit-Rules - Customary guides for conduct of action' the implications derived from the descriptions of these guides.

Polit-Meta rules - Rules about rules. A special class of polit-rules that represent control knowledge and prescribe the manner in which rules are to be applied. Also help to break down a knowledge base into segment that applies to classes of polit-situations.

Rule Based Systems - A rule-based system is any system that represents knowledge as a set of rules that can be interpreted in a uniform way by applying them to practical facts to infer new facts. The objective of a rule-based system is to encode practical human knowledge in such a way that it can mimic the problem-solving abilities of a human expert.

Polit-Knowledge Base - A data repository that contains both polit-information and polit-knowledge about applying this polit-information within a particular context. The latter is usually expressed in the form of rules. The idea is to store and utilize effectively large amount of polit-knowledge in pragmatically oriented applications and to develop polit-intelligent assistant for politicians and technologists.

Polit-Expert Systems Goals - A goal is an objective to be achieved. In the course of attempting to achieve a goal, various other goals may be set up whose solution will contribute towards achieving this goal. These are referred to as sub goals.

Polit-Knowledge Coordinator - The portion of the polit-information engineering toolkit responsible for applying the rules of information engineering to ensure the consistency and correctness of any polit-information that will be saved in the polit-encyclopaedia. A good design tool has a knowledge coordinator which crosschecks all aspect of the design.
An integral part of encyclopaedia based systems is a polit-knowledge coordinator. The polit-knowledge coordinator is software which ensures consistency among the different pieces of polit-knowledge that reside in the polit-encyclopaedia.

Polit-Expert Consulting Systems - AI methods also been employed in the development of automatic consulting systems. These systems provide human users with expert conclusions about specialized subject areas.
A key problem in the development of expert consulting systems is how to represent and use the knowledge that human experts in these subjects obviously possess and use.

14.4- Polit-Expert System (PES) - polit-expert systems are firmly at the applications end of polit-intelligence system. Expert system theoreticians have debated for years about whether machines will be able to think like people; however, no one doubts that artificial intelligence (simulated human decision making) in the form of expert systems is beginning to play an important role in running companies. Polit-expert systems consist of a database and software that simulated the polit-knowledge and analytical ability of an expert in a political field.

A polit-expert system has four basic components: a polit-knowledge base, -subsystems, a -user interface, and an inference engine:

1- At the heart of a polit-expert system is a large database of polit-knowledge, customarily known as the polit-knowledge base. In a well-designed system, this is interpreted by a separated algorithm often know as the inference engine. The importance of the separation of program and knowledge base is that the program should remain unchanged if the knowledge base is modified and updated, or even a new base plugged in.

2- An inference engine is that part of a polit-expert system that interprets rules and facts in order to make inferences. Depending upon the system, it may be driven by a specific question (backward chaining) or attempt to make inferences from a set of data (forward chaining). Often a combination of both methods is employed. A mentioned, an inference engine is a computer program. This program interprets the facts and rules stored in the knowledge base and applies this information to the particular problem at hand. It guides the computer reasoning process. The user of the expert system interacts with the program, seeking a solution to a specific problem considered to be within the expert system's domain. The inference engine helps the user by:

- Determining what questions need to be asked
- Identifying what facts and rules should be extracted from the knowledge base
- Determining how the evidence obtained from the user's responses should be used to reach the most likely conclusions.

3- The user interface is software that provides for the communication exchange between the system user and the system. Through the user interface, the user can enter facts about a specific situation that are reverent to the system's subject domain and can ask the expert system questions within the system's subject area. Many expert systems also accept new knowledge through the user interface. The user interface also provides the expert system with the requisite facilities to proffer responses.

14.5- Polit-Knowledge - The factor condition of knowing something with familiarity gained through experience or association; the fact or condition of being aware of something; the range of one's information or understanding; the fact or condition of having information; the sum of what is known, an accumulation of the body of truth, information, and principles acquired by an individual or by humanity. The ability to form a mental model that accurately describes the object and represents the action that can be performed by and on that polit-object, -facts, beliefs, and heuristic rules. The integration of a collection of polit-facts and -relationship.

Polit-information associated with rules which allow inferences to be drawn automatically so that polit-information can be employed for purposes. The data, for example, may be facts about components; knowledge may be these facts combined with rules to ensure that systems are correctly configured from those components.

Created by a computer professional called a polit-knowledge engineer, the knowledge base is the heart of the system. The polit-knowledge translates the knowledge from human experts into rules and strategies. Unlike a database, which consists of static relationships between fields, records, and files, a polit-knowledge base is always changing, reflecting the advice of human experts.

14.5.1- Polit-Knowledge-based Systems (PKBS) - Computer programs using knowledge and inference procedures for solving problems that are difficult enough normally to require a significant amount of human expertise to arrive at their solution. They structure data and reasoning rules that link the evidence about a problem to derived conclusions.

14.5.2- Knowledge-based Decision Support Systems (KDSS) - Expert systems are only one major type of knowledge-based information system. They are related to knowledge-based decision support systems (KDSS), which add a knowledge base to the database and model base of traditional decision support systems.

14.6- Knowledge Engineering - A subfield of artificial intelligence addressing the design and development of knowledge systems; concerned with the acquisition, representation, and application of knowledge.

An individual who designs and builds knowledge-based systems like expert systems by helping problem experts map information into a form suitable form which to build a system that other individuals may later use to get advice. The knowledge engineer's speciality is to access problems, acquire knowledge relating to the problems, and build knowledge systems using the information gathered. He or she is concerned with identifying the specific knowledge that is used by an expert in solving a given problem, determining the inference strategy that the expert would use, and developing a system that uses similar knowledge to simulate the expert's behaviour and solutions. The knowledge engineer concentrates on the meaning of the data gathered, the logical interferences between the facts, and the schemas and inference rules that apply to the data. To fulfil this function, the knowledge engineer must interview experts to extract knowledge, abstract the main characteristics of the problem, and then undertake the building of a computer system that represents the knowledge garnered, thereby serving as an intermediary between the knowledge-base and its author.

14.7- Polit-Knowledge Representation - Analysis of the knowledge of an expert, including facts and rules of thumb he uses, the determination of how this knowledge should be delineated in the software that comprises a knowledge-based system, and the method used to encode and store facts and relationship in a knowledge-base.

Knowledge representation is a substantial subfield in its own right, on the borderline between AI and cognitive science. It is concerned with the way in which information might be stored in the human brain, and the ways in which large bodies of knowledge can be formally described for the purposes of symbolic computation.

A (knowledge) representation is a scheme or device used to capture the essential elements of a problem domain.

PIS seek to achieve polit-intelligence through computation. Any computation requires a representation of some entity as well as a procedure for manipulation. Representation and manipulation are key elements of PIS. Obviously, we cannot manipulate knowledge unless it is adequately represented.

The use of graphical constructs to specify both numerical and symbolic relations among sets of entities is fundamental to many knowledge representation approaches. In fact, the careful structuring of this construct is fundamental to many efficient schemes for knowledge manipulation.

Semantic Nets Representation - A semantic network, or simply semantic net, is a labelled digraph used to describe relations (including properties) of objects, concepts, situations, or actions.

Semantic nets are ideal visualization tools, widely used in AI to provide a mechanism to "get started" in the development of a knowledge representation. Knowledge in a semantic net may be naturally organized to reflect hierarchies and enable inheritance a semantic net may be naturally organized to reflect hierarchies and enable inheritance. Because a semantic net representation denotes relations as labelled arcs, an algorithm for reasoning using semantic nets may make relevant associations simply by matching observed (or stored) evidence with the graphical structure.

A semantic net is a formal graphic language for representing facts about entities in some world about which we wish to correspond to physical or abstract objects and their properties, while labels on arrow (directed arcs) that connect the nodes represent relationships between the objects or concepts.

Semantic nets can be used to represent virtually any relationship that among the concepts or objects in some domain of interest. One of the most important uses of nodes and arcs in semantic nets is to represent taxonomic or classification knowledge about a series of entities either physical objects or more abstract concepts - in some domain. When used in this way labelled nodes represent:

- Types or classes of entities,
- Levels of subtypes or subclasses of the entity types, and
- Instance or examples of the entity types or subtypes.

Labelled arrows represent:

- The relationship that one node is the subclass or super class of another, or
- The relationship that one is an instance of the other's class.

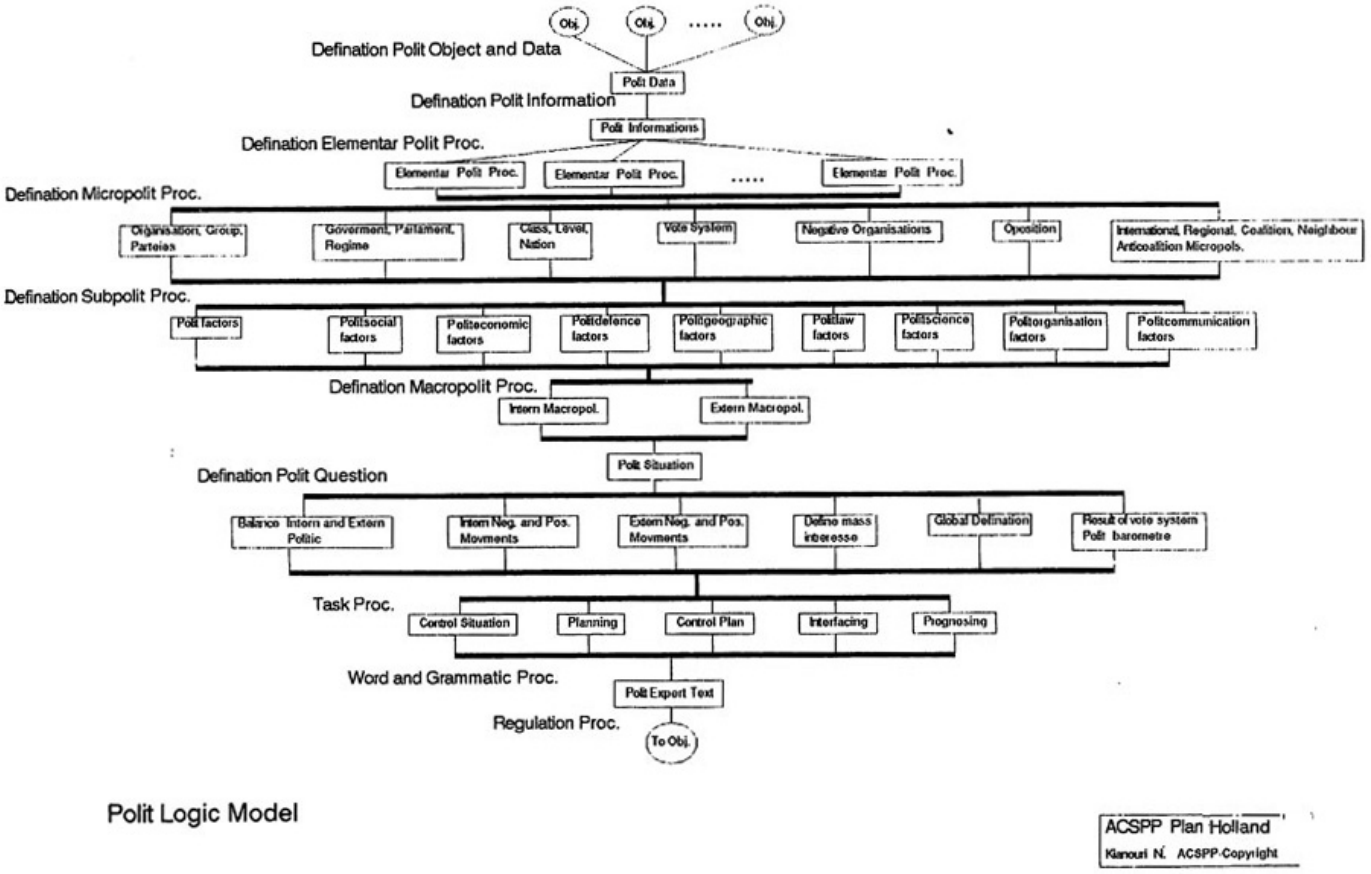


FIG. 14-1

FIG.14.1. IS AN EXAMPLE FOR POLIT SEMANTIC NETWORK.

Frame-Based Representation - Frame-based representation retains the fundamental notions of abstraction hierarchies and inheritance of properties from super classes, but it packages the descriptive attributes associated with each class or instance into more compact local data structures variously called **frames, schemas, or Units.** By representing abstraction hierarchies graphically, and permitting the other attributes of each class or object to be expanded and viewed only as needed for inspection and modification, fram-based representation provides a two-level user interface that makes possible the construction and manipulation of realistically large knowledge bases.

14.8- Defining the Expert Systems - The first goal of initial inquiry is to define what the expert systems will do. The success of an expert-system project depends on having a clear definition of the expert system before development begins. The definition of an expert system should be shared by four constituent groups:

- The knowledge engineers who will implement the system
- The experts who will provide the knowledge
- The system' s intended users
- The managers who will fund the project.

The first activity in an expert-system project should be a meeting to establish the context for discuss ions about system's definition. The agenda for this meeting should include:

- An introduction of the participants
- A brief description of expert-system technology
- An overview of the situation that the expert system should address
- Plans for the subsequent meetings define the expert system.

Through a series of group discussions or individual interviews, representatives of the four constituent groups should reach consensus on five facets of the definition of the expert system:

- The objectives the system's introduction should accomplish
- The task the system will perform
- The identity of the users of the system and how each class of user will use the system.
- The computing environment in which the system will operate.

- The identity of the experts who will provide the necessary expertise and how the experts will work with the knowledge engineers.

14.9- First Interviews - the first few interviews can be very trying for both the expert and the knowledge engineers. Careful preparation can help to control the anxiety of the entire project team. Follow these steps to prepare for your first interview.

- Make sure that all participants and goals of the project, the goal of the interview, and the agenda for the interview.
- Try to learn the basic terminology of the application area to improve your understanding of the expert's descriptions.
- Provide the expert with advice about, and examples of, the materials that he or she should prepare for the interview.
- Anticipate the possibility that the expert may prepare the necessary materials. Make a list of questions to ask during a discussion to obtain an overview of the task. Be prepared the expert to recall a recent example of performing the task.

Two activities can help you to obtain a general understanding of the expert system's task:

- A task overview in which the expert presents a summary of the process by which the task is performed and identifies the important and the difficult aspects of this process.
- Case discussions, which illustrate how the expert would perform the task in particular situations.

14.10- Transfer of Polit-Information During an Interview - The ultimate objective of any knowledge-acquisition interview is the transfer of information from the expert to the knowledge engineers. Successful information transfer requires' both the expert's verbal communication of information and the knowledge engineer's capture of the information in a permanent record. Knowledge engineers can facilitate verbal communication by providing a structure to each interview.

- An interview should begin with an introduction that orients the expert to the goals of the each interview.
- In the body of the interview, the knowledge engineers should lead the discussion smoothly from one topic to the next; as they do so, they should make sure the expert follows the change in focus.
- An interview should end with a closing presents a brief summary of the results of the interview. The closing should discuss plans for the immediate future so the expert knows what steps to take next.

Knowledge engineers can capture the information the expert communications by notes, by writing on display media, and by making audio or video recording of the interviews.

14.11- Interview Dialog - To keep the expert oriented to your goals during an interview, introduce each topic of discuss ion by explaining what you need to find out and why this topic is important. When you ask questions on the topic, pay attention to both the words you use in your question and the way in which you ask it. Before you go on to the topic, close the current topic with a summary of what you have learned, and ask whether the expert has anything to add.

After asking question, see whether it successfully elicits relevant answer from the expert. If not, determine what went wrong, and correct problems with your original questions. You will need to learn your expert's individual communications style in order to judge how long to wait for a response before deciding that a question will not produce an answer.

14.12- PES Interfaces with other CIPSE Stations:

14.12.1- PES/PISE (Developing Polit-Expert systems) - The process of developing a polit-expert system is similar to the process for developing other types of information systems. Polit-organizations is developing system solutions to policy problems. However, before developing an expert system, the following questions need to be answered:

- What applications are suitable for expert systems?
- What benefits and limitations of expert systems should be considered?
- Should the expert system be (1) purchased as a completely developed system, (2) developed with an expert system shell, or (3) developed from scratch as a custom system?

Polit-expert systems can be purchased or developed if a problem situation exists that is suitable for solution by expert systems rather than by conventional experts and information processing. The benefits of expert systems must be balanced with their limited applicability in many problem situations. If the decision is made to develop an expert system, the use of an expert system shell should be considered. It allows end users to develop their own expert systems in an interactive prototyping process.

The Polit-Expert System Life Cycle - One of the first steps in a new software development project is to decide on the life cycle steps that will be taken into account for the total project. The life cycle steps are often in use today for software system projects are defined as:

- Pol it-system concept
- Polit-system feasibility study
- Polit-user requirements gathering
- Requirements analysis
- Software specification
- Software design
- Software coding
- Software documentation
- Software unit testing
- Polit-system integration
- Polit-system testing
- Polit-user training
- User acceptance testing
- User acceptance
- Operations/maintenance.

The life cycle steps are usually followed sequentially- a step is not accomplished until the preceding step has been accomplished. We can divide this life cycle into 5 phases.

- Select the polit-problem; Good expert system opportunities are those that require expensive or rare experts to make fast decisions consistently.
- Develop a polit-prototype; a prototype system is a small scale model of an expert system. During this step, knowledge engineers learn everything about the problem they can from books reports, and teach the human experts how to articulate their knowledge about solving certain tasks.
- Design the complete polit-system; At this point, the knowledge engineer begins to turn development over to the experts and to monitor the project rather than actively~ participate in it. In turn, the expert, with all the insigh1 and experience gained during the development process, stars to implement the expert system.
- Test and Evaluate the polit-system; One the knowledge engineer and expert believe the system is complete; it can be tested against the performance criteria specified dourine prototyping.
- Implement and maintain the polit-system; until now, the expert system has probably been isolated from users. Now is the time to integrate it into the organization's workplace and provide training for prospective users.

14.12.2- PES/PESM (The Expert System Software) - Expert systems are among the most advanced user/machine interfaces developed for solving problems that require expertise. They use the computer' ~ capabilities to retrieve answers to questions and then provide c line of reasoning for the answers. The systems are consolidated knowledge base. The base is then programmed so that it can be use in a question-and-answer format. For a specific application, the expert system attempts to define the rules an expert would use in a particular decision process.

From the software point of view, there are basically two approaches to building expert systems. the first approach is based on programming languages and programming tools. The second approach is based on the use of expert system shells.

1- Languages - Building expert systems with a programming language and its associated tools often means developing all of the requisite expert system functional components (such as an inference engine) as well as developing the problem domain knowledge-base.

Expert system and tools developers chose languages like LISP, PROLOG, and OPS5 for various reasons.

The artificial intelligence community invested heavily in developing programming environments for AI languages1 most notably the environments that have been developed for the LISP programming

language.
We will examine three popular AI languages: LISP, PROLOG, and OPS5.

2-Expert system Shells - The purpose of expert system shells is to provide an expert system developer with most, if not all, of the requisite expert system functional components.
An expert-system shell is a software system that provides a framework on which expert systems can be developed. A shell contains an inference engine and supports representation formalisms in which knowledge can be encoded. Several expert-system shells are available commercially; others are only used internally by software houses that develop expert systems.
The key to the efficient building of expert systems today is to use expert system shells with components that support all the requirements of the system to be build. The basic components of expert systems were presented earlier:

- Inference engine
- Knowledge-base
- User-system interface
- Explanation facility
- Knowledge acquisition facility.

14.12.3- PES/PEHK (Managing Hardware for PES) - Computers specifically designed to support programming languages for expert systems have been commercially available for only a few years. Implementation for LISP) for example) features very powerful programming utilities that enable programmers to write) test) and debug complex applications much faster than previous programming languages. Although LISP implementation is available for computers with traditional) numerically oriented architectures, the structure of the language makes it execute somewhat slowly and inefficiently on such machines) even though it was developed on them. Because of the new direction on specific hardware for developing and implementation expert systems) the discuss ion to follow will highlight these new computer hardware developments.

14.12.4- Project of CIPSE/PES - PES is one of a new breed of expert system shells designed to integrate expert system technology with other automated systems technologies.
PES (Polit-Expert-System) is a knowledge engineering tool for developing real-time expert systems in the domain of process control. It allows knowledge representation through the use of rules and schematic representations of a political process. PES operates on the LISP Machine Inc. (LMI) LISP machine called the lambada/PLUS. The LMI machine is connected to a distributed process control system. PES supports both forward- and backward-interfacing mechanisms.
PES is composed of the following four elements: an inference engine) a knowledge-base) a user interface program called AI-base) and a C-coded software package called RTIME (Real-Time Intelligent Machine Environment) that PES the capability of monitoring real-time processes.
Today) polit-analysts spend most of their time determining the significance and implications of each new event as it occurs: in short, "strategists" still are largely reacting creatures. Few tools have been developed to assist in exploring contingencies. The Polit-Expert System (PES) project which uses knowledge-based simulation to generate scenarios of world actors responding to given events.
The Polit-Expert System (PES) is a knowledgebase simulation system for generating and analyzing alternative scenarios in geopolitical political situations. Given an event (or set of events») PES simulates the responses of various actors (countries) leaders) radical groups; etc) in the context specified by the particular scenario. These responses, in turn, generate new events which cause the process to repeat. A PES simulation continues until no new events can be generated or until the termination criteria of the simulation are met.
PES project is intended to become a tool that aids CIPSE intelligence analysts by evaluating the likely consequences of critical events. The basic need arises from the many documented human limitations) cognitive and institutional) which constrain strategic analysts from recognizing and anticipating potential situations. For example, these limitations engender "mirror imaging") which prevents analysts from viewing a situation from the perspective of the countries being analyzed.
In sum, because of time and human limitations, analysts are not always able to review important factors relating to their region of interest j and in many cases they are not able to perform detailed analysis of how events in their region might be related to events in other areas.