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THESIS

THE APPLICABILITY OF EXPERT SYSTEMS TECHNOLOGY TO INSURGENT IDENTIFICATION IN A TACTICAL MILITARY ENVIRONMENT

by

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Thesis Advisor: Tung Xuan Bui

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As the threat of large-scale, conventional warfare diminishes, the United States will increasingly find itself, and its military forces, involved in low-intensity, insurgency, revolutionary, and guerrilla warfare as an intervening power. One especially critical aspect of counterinsurgency operations is the rapid and accurate identification of insurgents and cause-sympathetic individuals. This task is normally accomplished by an experienced and knowledgeable expert in insurgent identifications, but appears to be particularly well suited for the application of expert system technology. This thesis is concerned with examining the applicability and feasibility of using expert systems technology for the development of a computerized screening system capable of assisting in the identification of insurgent and cause-sympathetic individuals in a tactical military environment.

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The Applicability of Expert Systems Technology to Insurgent Identification in a Tactical Military Environment

by

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of the requirements for the degree of

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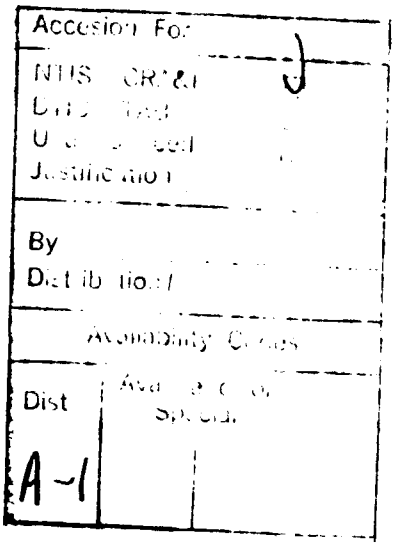
ABSTRACT

As the threat of large-scale, conventional warfare diminishes, the United States will increasingly find itself, and its military forces, involved in low-intensity, insurgency, revolutionary, and guerrilla warfare as an intervening power. One especially critical aspect of counterinsurgency operations is the rapid and accurate identification of insurgents and cause-sympathetic individuals. This task is normally accomplished by an experienced and knowledgeable expert in insurgent identifications, but appears to be particularly well suited for the application of expert system technology. This thesis is concerned with examining the applicability and feasibility of using expert systems technology for the development of a computerized screening system capable of assisting in the identification of insurgent and cause-sympathetic individuals in a tactical military environment.



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I. INTRODUCTION

A. THESIS OVERVIEW

The aim of this thesis is to investigate the possibility of developing a computer application capable of assisting in the screening and identification of insurgent individuals in a tactical military environment. This task is normally accomplished by an expert in insurgent identifications, but appears to be particularly well suited for the application of expert systems technology.

Expert systems are a subspecialty of applied artificial intelligence (AI) which have relevance for use in the military environment. Significant advances have been made in the area of expert systems, and numerous military applications are expected in the near future. [Ref. 1: p.29] By definition, expert systems are computer programs that derive the same or similar conclusions and results as those of a human expert given comparable facts and circumstances. Expert systems are designed to solve problems, to give advice, and to provide specific rationale for the particular decision reached.

Although several commercial examples exist, the most well known expert systems have been limited to applications in medical diagnosis, mineral prospecting, chemical analysis and computer configuration. The developers of commercial expert

systems make no pretext that these systems exactly duplicate the reasoning process that human experts commonly use in problem solving; instead they have concentrated on achieving results similar to those of the human expert. [Ref. 1: p.36] Not surprisingly, the majority of current expert system applications have been confined to non-military and non-tactical environments.

B. THESIS OBJECTIVE

The presence of insurgents is a problem with which many governments have had or will have to contend, particularly in undeveloped, transitional, or Third World countries. As the Cold War ends and the Soviet-Warsaw Pact threat diminishes, the United States will increasingly find itself, and its military forces, involved in low-intensity, insurgency, revolutionary, and guerrilla warfare as an intervening power.

In March 1990 the United States Marine Corps requested that the Naval Postgraduate School initiate a preliminary study to investigate the possibility of developing an expert system specifically designed to aid in identifying insurgent individuals in a tactical military environment. Due to size and time constraints, the project has been divided into three major areas of research. The objectives of the first phase include background information, problem definition, feasibility, content, and project applicability. The second phase of this project will include the actual development of

a basic insurgent identification expert system prototype. The third phase will determine the potential costs and benefits of developing and implementing a full-scale tactical expert system for counterinsurgency warfare.

This thesis will complete the first phase and serve as the foundation for the development of the basic insurgency prototype. Subsequent theses are expected to further prototype development and analyze the costs and potential benefits of full-scale system development and tactical implementation. At the request of the sponsor, this thesis is the logical continuation and modernization of a research paper completed in 1967 by Major R. L. Simonsen, USMC. Certain background and other applicable information from that paper is reproduced here with the permission of the author via the sponsoring service, and the sponsoring service.

C. THESIS PREVIEW

A brief discussion of the nature, phases, and strategies of insurgency warfare is provided in Chapter II. Chapter III presents a brief introduction of applied artificial intelligence. It is followed by an overview of expert systems. This overview includes basic discussions of problem solving, and knowledge engineering. Chapter III also discusses information on the various expert system types, the framework for expert systems, and the steps associated with the construction and implementation of an expert system.

Chapter IV is an introduction to insurgent identification procedures and presents measurable indicators of individual allegiance. Chapter V concludes the thesis with a brief summary and recommendations for further research.

II. INSURGENCY WARFARE

A. THE NATURE OF INSURGENCY

Insurgency warfare has played a major role in the military history of the twentieth century, particularly in the Third World. Even as the Cold War ends, it is widely believed that economical, ethical, political, tribal, and religious differences will continue to escalate into organized violence. This violence will be further hampered by fierce competition for both markets and resources in the emerging new world economy. The United States will increasingly find itself, and its military forces, involved in insurgency, revolutionary, and guerrilla warfare as an intervening power. The United States must understand the philosophy, nature, and process of insurgency warfare if it is to successfully serve its national interests in the Third World.

Before proceeding, the following definitions are provided to preclude any confusion concerning the terms most often associated with insurgency and counterinsurgency operations.

The word guerrilla is of Spanish origin, literally meaning a "small war." A guerrillero is any person involved in waging a small war. This use of the word guerrilla has largely been abandoned. Guerrilla is now used to refer to any person engaged in the waging of a small, unconventional war.

Guerrilla warfare is the employment of guerrillas in one or more of three possible uses: they may be used against a foreign invader, e.g., the Spanish irregulars and civilians who harassed Napoleon and his troops during his attempted expulsion of the English from Spain; they may be a weapon of insurrection, e.g., Mao Tse-tung's conquest of China; or they may be the agent of a foreign power, e.g., Viet Cong actions in South Vietnam. Whatever the use of guerrillas might be,

> "...guerrilla warfare is characterized by maximum employment of deception, concealment, intelligence, and improsation; by surprise attacks and quick withdrawals; above all, by the avoidance of open tests of strength with the enemy unless success is assured." [Ref. 2]

A guerrilla movement or insurgency, regardless of its motivation, may be defined as the effort to seize political control of a society. It may be further defined as:

> "...movement relying on the support of the people, fighting the government administering his country for an ideal believed not otherwise attainable; and avoiding combat except under circumstances of his own choosing." [Ref. 2]

An insurgency has three, four, or more stages of growth and usually employs guerrilla warfare in but only one of these stages. Each stage of growth has large variations in its time schedule and in its actual makeup, not only from country to country, but also from operational area to operational area within a given country.

Insurgents refers to the normally small group of dissidents who have caused the insurgency development, i.e., the intelligence behind the insurgent movement. Insurgent forces and counterinsurgent forces are sometimes used in place of the words guerrillas and counterguerrillas, respectively. The counterinsurgent is the government and/or intervening power trying to defeat the insurgency and depose the insurgents from any power they may have gained.

B. THE PHASES OF INSURGENCY

An insurgency generally begins when a group of individuals -- the insurgents -- becomes dissatisfied with the existing government, for one or more of any number of possible reasons, and decides to attempt to gain control of the government and the host society. Their organization, their operation, and their very existence will initially be of a clandestine nature, hidden from the government until they wish to make their presence known. Remaining in hiding, however, means that they will not be able to openly recruit civilians to their cause, buy weapons, train, or do any of the other prerequisites to waging open warfare or rebellion. In order to compensate for this deficiency and weakness, and to shield their covert activities from the government, they will attempt to secretly enlist the aid of the populace and to dissociate it from the incumbent government. If they are able to gain

physical control of the population and to obtain its active support, the insurgents may be well on their way to victory.

> "...in the final analysis, the exercise of political power depends on the tacit or explicit agreement of the population or at worst, on its submissiveness." [Ref. 3]

Insurgents require certain physical inputs from the general population. Guerrilla forces need recruits, information, shelter, and food, once the insurgency has reached the guerrilla warfare phase. Before the populace can be persuaded to supply these inputs, the insurgents must embrace some cause that will lure people to their side of the conflict. This cause must be plausible enough to attract initial supporters who will be able to sway public opinion, and bring an ever-increasing number of people into the insurgent camp. This cause will probably be the same issue that convinced the dissident group to attempt the overthrow of the government in the first place, unless the dissidents are in reality agents of a foreign power or are trying to wrest control of the country for personal gain. Although in the latter cases the cause may be fictitious in the eyes of the insurgent leaders, it must nevertheless seem real and plausible to the people.

An insurgent cause may take many forms. It may be appealing to the intellectuals and the proletariat in an industrialized society, or to the peasant class in an agrarian society; or one of independence from a colonial power. The

more closely the insurgent cause is allied to the religious, social, political, and personal aspirations of the society from which the insurgents seek support, the more support they will be able to muster.

Once the insurgents have a plausible cause, an insurgency usually develops according to a well-documented pattern. The four phases of the development of an insurgency are summarized in the following paragraphs. [Ref. 4: pp.6-56]

1. **Phase I**

The first phase of an insurgency begins with the recruitment of a small band of followers, consisting of active as well as passive -- but sympathetic -- supporters, and the formation of a political party. These loyal supporters may create front groups and infiltrate existing social and political organizations. The party is usually organized with its base in the proletariat or, in the case of underdeveloped countries having a small or nonexistent proletariat, in the peasant class. Once this has been accomplished, two strategies are generally available; (1) power seizure through legal election or appointment; (2) power seizure through armed struggle if the first alternative fails -- as it usually does -- on at least a nationwide basis.

2. **Phase II**

The second phase begins when the party leadership has decided that the time for armed insurrection is approaching.

Underground cells are formed, communication and supply lines between them are established, and the weapons that will be needed are collected and stored. Agitators and sympathetic news media spread anti-government propaganda, and mobs and riots discredit the government, showing sympathetic but passive followers of the insurgent movement that resistance to the government is possible. Persuasion, threats, and violence are used to subvert police and government officials and to gain control of the various towns and villages. Intelligence nets and small armed groups are formed, and control of villages, communities, and townships is consolidated.

3. **Phase III**

The third phase of an insurgency is often characterized by guerrilla warfare, the armed insurrection by which an ultimately successful insurgent will gain military and political control of the majority of the land mass of the country. During this phase, large military units are trained and equipped, large numbers of weapons are procured, and regular bases are acquired and established for use by the larger, more conventional military units of Phase IV.

Because the insurgent military forces are initially much weaker than those of the counterinsurgent, a direct confrontation between the two would almost certainly result in the annihilation of the insurgent. Thus, the insurgent leaders may select as the first operating areas for the

guerrilla bands those regions or districts of the country where:

1. The strength of the insurgent's organization among the population has been ensured by the preliminary work of the party.
2. The center of the counterinsurgent power is far removed.
3. The terrain and poor government communications continue to make them inaccessible.
4. Both sides of administrative borders are contained within them, making it difficult for the enemy to coordinate his reaction.

As insurgent strength increases, the movement will expand into areas where its initial strength was small and thus enlarge the insurgent's geographical area of control. [Ref. 3]

The objective of Phase III of an insurgency may be summarized by the following quote from Galula.

> "What makes it possible for the guerrilla to survive and expand? The complicity of the population. This is the key to guerrilla warfare, indeed to the insurgency. The complicity of the population is not to be confused with the sympathy of the population; the former is active, the latter inactive, and the popularity of the insurgent's cause is insufficient by itself to transform sympathy into complicity. The participation of the population in the conflict is obtained, above all, by the political organization (the party) living among the population, backed by force (the guerrilla gangs), which eliminates the open enemies, intimidates the potential ones, and relies on those among the population who actively support the insurgents..." [Ref. 3]

Guerrilla operations will be planned primarily to obtain support from the population and secondly to disrupt counterinsurgency operations. An ambush against a counterinsurgent patrol should be a military success, but more importantly, it should bring the support of the village or implicate the people of that village against the counterinsurgent. In other words, attrition of the enemy is a by-product of guerrilla warfare, not its essential goal. [Ref. 3]

4. Phase IV

The fourth phase of an insurgency is marked by the creation of large regular military units, capable of defeating the counterinsurgent forces in large-scale conventional warfare. If he has good military assets, solid political structuring, popular mobilization in the areas of his control, good operational subversive activities by his underground agents in the counterinsurgent's areas, and psychological superiority; the scope and scale of the insurgent's operations will increase rapidly. During this phase, offensive maneuvers will be aimed at the complete destruction of the counterinsurgent forces.

Valeriano and Bohannan refer to this four-phase concept of an insurgency as the Sino-Vietnamese concept and they warn against its use as an analytical tool by the counterinsurgent in each and every case of insurgency. Their contention is

that the concept of operations as outlined here is the doctrine of Chinese and Vietnamese Communist leaders and that it is not the established or traditional guerrilla practice.

> "There is, however, a course for guerrilla warfare, and approach to successful revolution, that closely parallels the traditional guerrilla practice. In this, the guerrilla seeks the weaken counterguerrilla forces and the government they support buy petty actions and petty harassments, inducing the government to waste its strength and lower the morale of its people by futile blows at the guerrilla, who is not there to receive them. Meanwhile, the guerrilla and his political leaders concentrate on building up popular support, organized and unorganized. At an opportune time, a quick blow, a quick 'national revolution' spearheaded by the guerrilla force or, as in Russia, by political leaders, the armed forces leaderless and the instrumentalities of government open to guerrilla control.
>
> "Because of the wide dissemination of the Sino-Vietnamese concept, it appears especially important that the intention of guerrilla forces be quickly and correctly recognized. It is critically important that counterguerrilla forces not be lulled by misconceptions, that an intended national revolution not be mistaken for the early stage of the Sino-Vietnamese pattern. If this mistake is made, a successful revolution can occur while counterguerrilla forces rest secure in the belief that an attempt at overthrow is far away." [Ref. 2]

C. COUNTERINSURGENT STRATEGY

The most popular and successful counterinsurgent strategy is characterized by a three-pronged offensive specifically aimed at identifying and separating the insurgent from the remaining population; defeating the insurgent militarily; and negating or neutralizing the original insurgent cause. Each

of these strategic functions is briefly described in the following paragraphs.

1. **Separation of the insurgent from the remaining population**

An insurgent movement may often be defeated or effectively neutralized by simply separating the insurgents from the remaining population. The insurgents receive much of their supplies and intelligence from the population in which they operate. By separating the two, this flow of food, weapons, ammunition, and information may be significantly reduced or completely eliminated.

One method of separating the insurgents from the remaining population is by governmentally imposed population controls on travel, food, individual registration, and the issuance of personal identification cards. Once these controls have been enacted, the government must see that they are enforced and remain effective. By establishing checkpoints where identification papers and travel permits may be inspected, and by conducting periodic searches and interrogations of individual residents, the government may be able to improve the effectiveness of their counterinsurgency operations.

The forces available for the enforcement of population control measures may be military or paramilitary units, police units, or a combined force of both. These forces are normally

referred to as screening forces regardless of their composition. Unfortunately, the maximum force available for screening operations is normally constrained by the size and disposition of the total force and by other missions that may be permanently assigned to some units. The applicability of expert systems technology to certain screening force functions will be discussed in Chapter IV.

2. **Complete military defeat of the insurgent**

The foundation of any successful counterinsurgent strategy must be based on the complete military defeat of the insurgent forces. This concept was employed in World Wars I and II with a great degree of success. There should be little doubt that the military forces of a powerful nation could eventually bring about such a defeat. Unfortunately, a strategy of pure military action would provide a valuable source of propaganda for the insurgents, and may provoke considerable popular embitterment toward the incumbent government and intervening power. Most importantly, the use of military force alone does not resolve the problems relating to the attitudes and loyalties of the general populous and the major role they play in the overall insurgency situation. The problem facing the counterinsurgent is not one of clearing an area of insurgent forces, but one of persuading the civilian population to keep their particular area clear of insurgent

activity. The problem has been clearly stated by Paret and Shy:

> "It is erroneous to think that military defeat pure and simple will be the final solution. Unless the population has been weaned away from the guerrilla and his cause, unless reforms and re-education have attacked the psychological base of guerrilla action, unless the political network backing him up has been destroyed, military defeat is only a pause and fighting can easily erupt again." [Ref. 5]

If the insurgents are defeated militarily but retain the support of the citizenry, the insurgents will most often revert to the clandestine cell type operations that characterized the first and second phases of the insurrection. The insurgents will most likely remain in this state until a more favorable atmosphere for their operations is perceived by the rebellion's leaders.

3. **Negation or neutralization of the insurgent cause**

Another essential element of any potentially successful counterinsurgent strategy requires that the incumbent government or counterinsurgent agent either negate the original insurgent cause or find some way to pacify the civilian population so that the cause loses its perceived significance. There have been situations in which counterinsurgents have been able to effectively adopt the insurgents' cause as their own, thereby reducing or eliminating popular support. Among the most notable examples is Britain's granting of independence to Malaya. The primary

cause for the Malayan rebellion was to achieve independence from restrictive British colonial rule. When the British promised independence in return for governmental cooperation, however, the insurgent movement lost much of its meaning. The war proved long and costly for both sides but the insurgents were destined to failure after losing cause they needed to maintain popular support.

This is not to say, however, that the negation of the insurgent's cause will assure victory for the counterinsurgent: it is a necessary but not sufficient requisite for victory. Once the insurgent infrastructure is organized and functioning, the existence of a particular cause loses much of its relative importance. The negation of that particular cause may make the conduct of insurgency operations more difficult, but not impossible. It is important to remember that the general population will continue to serve and support what they perceive to be their own best interests. Those individuals that were originally attracted to the side of the insurgent by means of a particular cause or issue will continue to maintain their complicity with the insurgent if there is no real or perceived benefit to be gained by switching allegiance to the government or intervening power.

It has been suggested that any successful counterinsurgent strategy must include specific actions aimed at influencing the general population toward more pro-government behavior as well as operations that will defeat the

insurgents militarily. It is not realistic to expect that popular attitude will be significantly changed by the work of a dedicated counterinsurgent. Actually, increased popular support and political loyalty for the incumbent government is more likely to be a consequence, rather than a cause of counterinsurgent success. The best that can be expected in the short run of counterinsurgent effort is an influencing of popular behavior and action so that attitudes and loyalties can be permanently altered in the long run. If, after the insurgent is defeated, the government works to establish and maintain a real and lasting rapport with the people, attitudes may begin to change and genuine political unity may be established.

D. INSURGENCY SUMMARY

Insurgency is the attempt by a militarily inferior faction -- the insurgents -- to usurp geo-political control from a military dominant faction or incumbent government. [Ref. 6: p. 12] Insurgent movements usually develop through a well documented four-phase growth process. The insurgent effort is usually characterized by guerilla or unconventional warfare tactics and population control measures.

Counterinsurgency is defined as the attempt by the military dominant faction, incumbent government, or governmental agent -- the counterinsurgents -- to prevent the insurgent movement from achieving control of the geo-political

system. [Ref. 6: p. 12] Counterinsurgent efforts are normally characterized by a three-pronged offensive aimed at identifying and separating the insurgent from the remaining population; defeating the insurgent militarily; and negating or neutralizing the original insurgent cause.

The specific counterinsurgent task of identifying insurgents and insurgent sympathizers is ill-structured and normally requires considerable experience and specialized knowledge. Because of these characteristics, tactical insurgent identification appears to be particularly well suited for the application of expert systems technology.

III. EXPERT SYSTEMS TECHNOLOGY

A. ARTIFICIAL INTELLIGENCE

Artificial Intelligence is a growing set of computer problem-solving techniques that are developed to imitate the human decision-making process. Marvin Minsky, Professor of Science at the Massachusetts Institute of Technology and founder of the field of AI, has stated that "artificial intelligence is the science of making machines do things that would require intelligence if done by men." [Ref. 7: p. 4]

The field of artificial intelligence offers a distinctive approach to complex problem solving. In conventional computing, the programmer creates computer program instructions that follow solution paths for each situation presented. The solution path is planned by the programmer using structured predictable steps, which enable the solving of problems that require a large amount of data to be processed. Artificial intelligence, on the other hand, uses techniques that are helpful in solving complex problem-symbolic processing. The symbols processed by artificial intelligence programs represent real-world entities, and instead of simply performing calculations, artificial intelligence programs manipulate the relationships among the symbols. [Ref. 8: p. 52]

B. AN OVERVIEW OF EXPERT SYSTEMS

As a subdivision of AI, expert systems investigate methods and techniques for the construction of man-machine systems that have specialized decision-making expertise. Expertise consists of knowledge about a particular domain, understanding of the domain problem, and skills at solving problems within the given domain. Knowledge can be gained publicly or privately. Public knowledge includes the published definitions, facts, and theories of which textbooks and reference material in the discipline of study are typically composed. Expertise usually involves much more than just public knowledge. An expert generally possess considerable private knowledge that has been published. This private knowledge consists of cognition, emotion, and rules of thumb used by the experts. The study of this private knowledge is commonly known as heuristics. Heuristics enable the human expert to make educated guesses when necessary, to recognize promising approaches to problems, and to deal effectively with incomplete or erroneous data. Elucidating and reproducing such knowledge is the central task in constructing expert systems. [Ref. 9: p. 4]

Expert systems differ from both conventional data processing systems and systems developed in other branches of artificial intelligence. Expert system applications generally involve distinguishing features, which include symbolic representation, heuristic search, and symbolic inference.

Expert systems also differ from the broad range of AI applications in several other aspects. First, they emphasize domain-specific problem solving strategies; Second, they employ self-knowledge to reason about their own inference processes and provide explanations or justifications for the conclusions reached; Third, they solve problems that generally fall into one of the following categories: interpretation, prediction, diagnosis, debugging, design, planning, monitoring, repair, instruction, or control. As a result of these distinctions, expert systems represent an area of AI research that involves paradigms, tools, and system development strategies. [Ref. 9: p. 52]

Using the above parameters, an expert system can be defined as a knowledge-intensive program that solves problems that normally require a human expert. An expert system performs many of the reasoning functions a human expert does such as asking relevant questions and explaining its reasoning. According to Frederick Hayes-Roth, characteristics common to all expert systems are: [Ref. 10: p. 264]

1. They reason heuristically, using what experts consider effective rules of thumb.
2. They interact with humans in appropriate ways, including the use of natural languages.
3. They manipulate and reason about symbolic descriptions.
4. They function with erroneous data and uncertain judgmental rules.

5. They contemplate multiple competing hypothesis simultaneously.

6. They explain why they are asking questions.

7. They justify their conclusions.

Compared to a human expert, most expert systems may appear narrow, limited, and shallow, lacking the human expert's experience, breadth of knowledge, and understanding of fundamental principles. Indeed, modern expert systems replicate the human decision-making process rather grossly. They make major decisions by elucidating many of the relevant criteria and by making many of the educated guesses that human experts might make if forced to verbalize their thought processes. Additionally, today's expert systems are limited in their ability to learn from experience. [Ref. 10: p. 264]

C. BASIC CONCEPTS OF PROBLEM SOLVING

The basic concepts of intelligent problem-solving are shown in Figure 1. These concepts motivate and explain the aspects of knowledge resident in modern expert systems. The central notion of intelligent problem-solving is that a system must construct its solutions selectively and efficiently for given alternatives. When the expert is resource limited, he needs to search his alternatives in order to achieve high performance by using knowledge acquired to effectively and efficiently solve his problem. [Ref. 9: p. 19] In most cases, experts face problems that are not easily formalized or

do not have simple algorithmic solutions. It is in these cases that heuristic methods must be used. Effective solutions depend on the timely use of private knowledge to identify promising alternatives, and rule-out those alternatives that appear less promising. The first three concepts in Figure 1 relate to the methods used by human experts to develop the knowledge that must be resident in an expert system. The fourth and fifth concepts aid the human expert in developing a more efficient knowledge base, and increase the ability of the system to solve more difficult problems.

D. KNOWLEDGE ENGINEERING

Knowledge engineering is the term that has been adopted by researchers for the discipline of formulating knowledge in expert systems. The burden of uncovering and formalizing the human expert's knowledge is incumbent upon the knowledge engineer. Through an extended series of interactions with an expert, the knowledge engineer should be able to define the problems to be attacked, discover the basic concepts involved, and develop rules that express the relationships that exist between these basic concepts. Knowledge engineering combines scientific, technological, and social methodology elements. One of the fundamental principles of knowledge engineering is that expert performance rarely conforms to an algorithmic process. As stated earlier, expert performance is often

1. Knowledge = Facts + beliefs + heuristics
2. Success = Finding answer with resources available
3. Search efficiency directly effects success
4. Aids to efficiency:
    a. applicable and discriminating knowledge
    b. rapid elimination of "blind alleys"
    c. elimination of redundant computation
    d. increased speed of computer operation
    e. cooperative sources of knowledge
    f. reasoning of abstractions
5. Sources of increased problem difficulty:
    a. erroneous data or knowledge
    b. dynamically changing data
    c. number of possibilities to evaluate
    d. complex procedures or possibilities

FIGURE 1: Basic Concepts of Problem Solving

tempered by private knowledge or heuristics, and empirical or causal factors. The essential tasks of knowledge engineering, therefore, include extracting, articulating, and computerizing as much of the human expert's private knowledge as possible. Finally, knowledge engineering addresses the problem of developing and building skilled computer systems which first

extract the experts knowledge, then organize it in to an effective implementation. [Ref. 9: p. 13]

E. EXPERT SYSTEM TYPES

Most expert systems are classified as one of several different types. Classifications and distinctions are usually made and justified according to the system's primary function or intended mission. Each of the major system types are defined and briefly discussed below.

1. Interpretation Systems

Interpretation systems infer situation descriptions from observations, which includes surveillance, speech understanding, image analysis, chemical structure elucidation, signal interpretation, and different types of intelligence analysis. An interpretation system explains stochastic data by assigning symbolic meanings describing the situation or system accounting for the data. Interpretation systems appear well suited for many military applications. In the counterinsurgency arena, interpretation systems may be used for threat and tactical intelligence analysis, surveillance programs, and foreign language translation.

2. Control Systems

An expert control system adaptively governs the overall behavior of a particular system. In order to accomplish this, a control system must repeatedly interpret the current situation, predict the future, diagnose the causes

of anticipated problems, formulate a remedial plan, and monitor its execution to ensure success has been achieved. Control system applications include air traffic control, business management, mission control and battlefield management. Control systems are extensively utilized in most weapon navigation systems, tactical aircraft systems, and ground combat vehicle systems. Adaptations of control systems for counterinsurgency operations might include intelligence monitoring systems, communication and message routing systems, and specific scenario exploration or wargamming applications.

3. **Diagnostic Systems**

Diagnostic systems infer system malfunctions from observable values. This category includes medical, electronic, mechanical, and software diagnosis. Diagnosis systems typically relate observed behavioral irregularities with underlying causes using one of two techniques. The first method uses a table of associations between behaviors and diagnoses. The second method combines knowledge of system design with knowledge of potential flaws in design, implementation, or components which generate candidate malfunctions that are consistent with the observations. Diagnostic systems are normally utilized by the military in various mechanical, electrical, and medical applications. Their direct application to the counterinsurgency scenario has yet to be determined.

4. Design Systems

Design systems construct descriptions of objects that will satisfy the constraints of the specified design problem. Such problems include circuit layout, building design, and budgeting. Design systems construct descriptions of objects that are in various relationship with one another and that verify that the configurations conform to stated constraints. The direct relevance and application of design system technology to counterinsurgency operations has yet to be determined.

5. Planning Systems

Planning systems design actions. These type of systems specialize in problems of design concerned with objects that perform functions. They include automatic programming as well as robot, project, route, communication, and military planning problems. At this time, most military planning system research and development is being limited to the strategic level and certain wargamming applications. At the tactical or counterinsurgency operations level, planning systems may have future relevance to the conduct of operations, route selection, and communication or control systems.

6. Monitoring Systems

Monitoring systems compare observations of system behavior to features that are crucial to successful plan

outcomes. These crucial features correspond to potential flaws that may be present in the plan. Generally, monitoring systems identify vulnerabilities in two ways. The first type of vulnerability corresponds to an assumed condition whose violation would nullify the plan's rationale. The second type of vulnerability arises when some potential effect of the plan violates a specified planning constraint. Many computer-aided monitoring systems exist for nuclear power plants, air traffic, disease, and regulatory fiscal management tasks. Although indirect, monitoring systems may have a significant and positive affect on the various levels of counterinsurgency operations. Many monitoring systems are utilized for military weapon guidance and deployment systems, tactical air traffic control systems, and combat field medical service systems.

7. **Repair Systems**

Repair systems develop and execute plans that administer a corrective action for diagnosed problems. Most of these systems incorporate debugging, planning, and execution capabilities. Computer-aided repair systems are occurring in the domains of automotive, network, avionic, and computer maintenance. Although extremely important for many other military applications, the benefit and advantage of repair system utilization in the counterinsurgency scenario has yet to be determined.

8. Instruction Systems

Instruction systems debug and diagnose behaviors. They incorporate diagnosis and debugging subsystems that specifically address certain problems. These systems begin by constructing a hypothetical description of the knowledge pertaining to the problem, then diagnose weakness in the knowledge and identify an appropriate remedy. Instruction system technology is used extensively by the military for the construction of various education and qualification systems. Instruction systems may be specifically applicable to the conduct of counterinsurgency operations as foreign language tutors; scenario exploration and wargamming programs; and weapon system training, qualification, and support systems.

9. Prediction Systems

The last type of expert system are known as prediction systems. Prediction systems infer likely consequences from given situations or input conditions. This category includes weather forecasting, demographic predictions, traffic predictions, crop estimations, and military forecasting. A prediction system typically employs a parametric dynamic model with parameter values that are fitted to the given situation. The counterinsurgency screening and identification system to be investigated by this thesis will be classified as a prediction system, and directly supports the extensive applicability of this type of system for counterinsurgency

operations. Other potential prediction system applications in the counterinsurgency scenario might include demographic forecasts; tactical and strategic operations models; force movement predictions; and insurgency support, strength, and growth estimates. [Ref. 9: pp. 13-16]

F. A FRAMEWORK FOR EXPERT SYSTEMS

One of the most important aspects of an expert system is that it can make decisions or help people make decisions. Using this basic capability, the essential framework behind expert system can be illustrated. One of the characteristics of an expert system is the emphasis on qualitative logical reasoning, vice quantitative calculations. Logical inference uses logical data, and consequently, the database of an expert system may or may not contain numerical data. The logical data in an expert system is commonly known as the knowledge base.

A key feature of a knowledge base is that its contents are not necessarily abstract symbols like numbers or conditional probabilities. Another important characteristic of a knowledge base is the body of facts which represent the way in which concepts are related to each other. In expert systems, meanings are explicitly represented by recording relationships in a form that the computer can exploit, and not by reducing data to abstract quantities. [Ref. 11: p. 129]

The most primitive element shared by computer programs is the symbol. Symbols are simply character strings which stand for or suggest something by reason of relationship, association, convention or accidental resemblance When elements are progressively added, the ability of these symbols becomes richer and much more useful. After the descriptions and relationships have been instantiated, the rules of the knowledge base are constructed. Given data, the rules should be capable of making inferences via some type of control process. A skillful decision maker does not apply rules blindly to a situation, but rather in a controlled manner, and an expert system must be similarly controlled. The inference engine of a knowledge based decision process usually provides this control.

The inference engine in a knowledge based system uses information presented in the knowledge base to infer conclusions. The inference engine interprets the rules in the base in conjunction with the control options in order to infer solutions to consultations. There are two main ways in which inference engines control the use of knowledge in solving problems. In the 'data-driven' (forward-chaining) method the inference engine examines the data that is available and applies all the rules which are satisfied to derive the new data. The conclusions which are made contribute to the body of data and may in turn allow other rules to operate. This cycle may be repeated many times until a diagnosis is reached

or a recommendation is concluded. The second method, the 'goal-driven' (backward-chaining) approach begins at the opposite end of the logical process. The goal-driven approach identifies the conclusions that it needs to establish its goals, and then examines the rules to see which ones contribute to these goals. The next step is to look at the "If..." part of the "If...Then" rules and locate any missing data that may be needed to reach the conclusions. Missing data is then filled in as new 'subgoals' or through an interactive process with the user. As with the data-driven method, the cycle may be repeated many times, and it may require many generations of subgoals before the expert system is able to obtain all the necessary data to achieve a conclusion. The power of any particular expert system comes from the quality and comprehensiveness of its knowledge base, and not from the sophisticated features of the system. [Ref. 11: p. 131]

G. STEPS IN CONSTRUCTING AN EXPERT SYSTEM

The development and implementation of an expert system requires careful planning and a thorough understanding of the decision making process that is being duplicated. Expert system development requires a well planned and flexible design strategy. The phases involved in constructing an expert system are:

1. Determine task suitability for expert system technology.
2. Knowledge acquisition.
3. Implementation stage.
4. Initial system design.
5. Building a prototype system.
6. Analysis, redesign, and fine tuning.
7. Periodic system maintenance.

1. Determine task suitability for expert system technology

One of the major reasons for the development of expert systems was for applications and solutions to problems with situations where a programming algorithm would not be practical. An analysis of the task to be performed should be accomplished to ensure that the expert systems approach is the best and most practical way to address the problem, or perhaps the problem is best suited for some other type of programming technique.

There are several characteristics that are commonly associated with the use of expert system technology:

a. Tasks which involve knowledge that can be expressed as "rules of thumb."
b. Problems which human experts usually perform.
c. Tasks which involve knowledge that is rapidly changing.
d. Tasks which do not rely heavily on "common sense."
e. Tasks which involve inexact reasoning.

f. Tasks that can be represented as a set of independent actions or conditions.

Other factors that should be considered include the amount of time needed to create the expert system and the financial costs associated with actual system development and implementation.

2. **Knowledge acquisition**

The knowledge acquisition phase involves the gathering of information and formalization of data that will be necessary to develop the expert system. Knowledge acquisition includes the identification of all parameters, including participants, problem characteristics, resources, and goals which are associated with the tasks or problems under consideration. During this phase, the major components of the reasoning process and identification of the elements that should be included in the expert system are determined.

Refinement of the acquired knowledge and organization of key elements has to be accomplished before any further system development. Analysis of the interrelationships of the knowledge elements and reasoning paths should be noted and identified. Instances where two or more reasoning paths make use of the same information, identification of how these reasoning paths are related should documented. This will allow the developers of the expert system to continually refine the knowledge acquired and help eliminate unnecessary

or redundant information. The concepts and relations that are identified in the first phase are analyzed and made explicit during this phase. This analysis of the knowledge should be completed to a level where it can be organized into a framework or representation of the information. It is this framework that will be used to develop the prototype system.

3. **Implementation stage**

Implementation involves the mapping of the formalized knowledge into the represented framework associated with the tools to solve the problem. As the knowledge in this framework is made compatible, consistent and organized, the framework becomes an executable program. The knowledge engineer then evolves a useful representative for the knowledge collected and will use it to develop a prototype expert system. The development of the prototype system is an extremely important step in the construction of an expert system. The prototype knowledge base is implemented by using the knowledge engineering aids available and chosen for development of the program. The formalization involves mapping the key concepts, subproblems, and information flow characteristics that have been isolated during the knowledge acquisition phase, into formal representations based upon knowledge engineering tools or frameworks. The design should reflect the most efficient manner in which to represent the acquired knowledge.

4. Initial system design

This next phase involves the organization of information acquired during the knowledge acquisition phase and modelled in the implementation stage, into a form that will be usable by the expert system. The overall purpose of the expert system should be kept in mind when designing the system. The design should continue to reflect the most efficient manner in which to represent the acquired knowledge, and should also provide a user interface that will be appropriate for users who may not fully understand expert systems. In system design, representation of the knowledge needs to be understood, and a determination needs to be made as to the best way to represent the knowledge that will be used by the system. The expert system makes use of a taxonomy file and a rule base file to store the knowledge that has been acquired and refined by the experts.

5. Build a prototype system

After the initial system design has been finalized, the next phase is to build a prototype of the expert system. This phase incorporates the following steps:

1. The initial taxonomy and rules are constructed.
2. Production of an interpreter that incorporates the elements of the taxonomy.
3. Validity of the taxonomy and rule base is tested through the use of expert system predicates.

The development of the prototype system should be accomplished incrementally. Small versions of the rule base file and the taxonomy file should be coded and tested. Once these initial rules and taxonomies have been tested then further construction of these two files can be accomplished and incorporated with the original files. The finished prototype should be a complete working system. From this working prototype, the human expert should be able to determine if the expert system is functioning as expected when presented with circumstances from within the specified problem domain.

6. **Analysis, redesign, and fine tuning**

The prototype system that has been developed should be tested extensively by the experts who provided the knowledge. These experts are best qualified to determine if the conclusions generated by the expert system are valid. They can provide information previously overlooked and recommend changes and improvements to the system. Test examples should be of a magnitude that they determine the weaknesses of the system, knowledge base, and inference structure. The elements that normally cause poor performance are input/output characteristics, control strategies, inference rules, and the test examples used on the system. Through this analysis and redesign phase, areas may be discovered by the experts where there needs to be further explanation given for the actions

taken by the system in reaching a conclusion. The search paths used and reported by the expert system should be checked to ensure they are both reasonable and valid. Through this analysis process, any changes that need to be made by the expert system can be identified. Once analysis of the system has been completed, designers can continue to modify and improve the system prototype based upon the findings of system analysis.

After the initial analysis has been accomplished and the recommended changes have been incorporated into the initial design, the system should be ready for final testing and evaluation. It is recommended that the same individuals who tested the initial system also test the revised or final system.

7. **Periodic system maintenance**

Expert systems are often used for tasks in which the input information regularly changed, updated, or revised. Whenever this occurs, the system may need to be analyzed and tested to see if the conclusions generated by the expert system are still valid and best for the situation. Updating and additional system development is preferably accomplished by those persons who did the knowledge acquisition, in order to maintain system organization and systematic programming.

Attempting to replicate expert decision-making with a computer requires a well and carefully planned design

strategy. The construction of an expert system from the initial design to a working system roughly follows the above defined steps. Development of a full-scale expert system requires extensive analysis, redesign, and testing of system concepts, elements, and reasoning processes. Numerous reworkings may be required before an accepted performance level is achieved.

H. EXPERT SYSTEMS SUMMARY

Expert systems investigate methods and techniques for the construction of man-machine systems that have a degree of specialized decision-making expertise. Expertise consists of knowledge about a particular domain, understanding of a domain problem, and skills at solving the problem within the specified domain. The formulation of knowledge in an expert system is accomplished by the knowledge engineer who gathers knowledge from public and private sources on a particular subject. This knowledge is then used to develop the basic concepts to be used in an expert system. Identification of relationships that exist between the basic concepts leads to the formulation of a rule base. The construction of an expert system prototype then enables the expert to evaluate rule base design and system execution. Final development of a full-scale expert system requires extensive analysis, redesign, testing, and evaluation.

Following the methods and techniques described in this chapter, knowledge engineers and system developers may begin to construct a prototype expert system capable of assisting with the identification of insurgent individuals. Prior to this initial system development, however, the knowledge engineer must fully understand the current insurgent identification process and the applicable and measurable indicators of popular support.

IV. INSURGENT IDENTIFICATION PROCEDURES

A. SCREENING FORCE FUNCTIONS

During the conduct of counterinsurgency operations, screening forces are primarily utilized for population surveillance and control missions. As described in Chapter II, these forces may consist of military or paramilitary units, police units, or any combination of these forces. An extremely important secondary mission often assigned to the screening force is the interrogation and detention of suspected insurgent and cause-sympathetic individuals. Unfortunately, screening forces are not formally trained or qualified to definitively identify insurgents and insurgent sympathizers. This task is normally accomplished by an expert or specialist in insurgent identifications temporarily assigned to or requested by the screening force commander. A diagram depicting how a computerized expert system might assist in identifying insurgent and cause-sympathetic individuals is included as Figure 2. As indicated in the diagram, the actual identification of suspected individuals as a probable insurgent or insurgent sympathizer is normally based on available personal data, known political

affiliations, crime statistics, and a personal interview to illicit or otherwise determine individual allegiance. [Ref. 12]

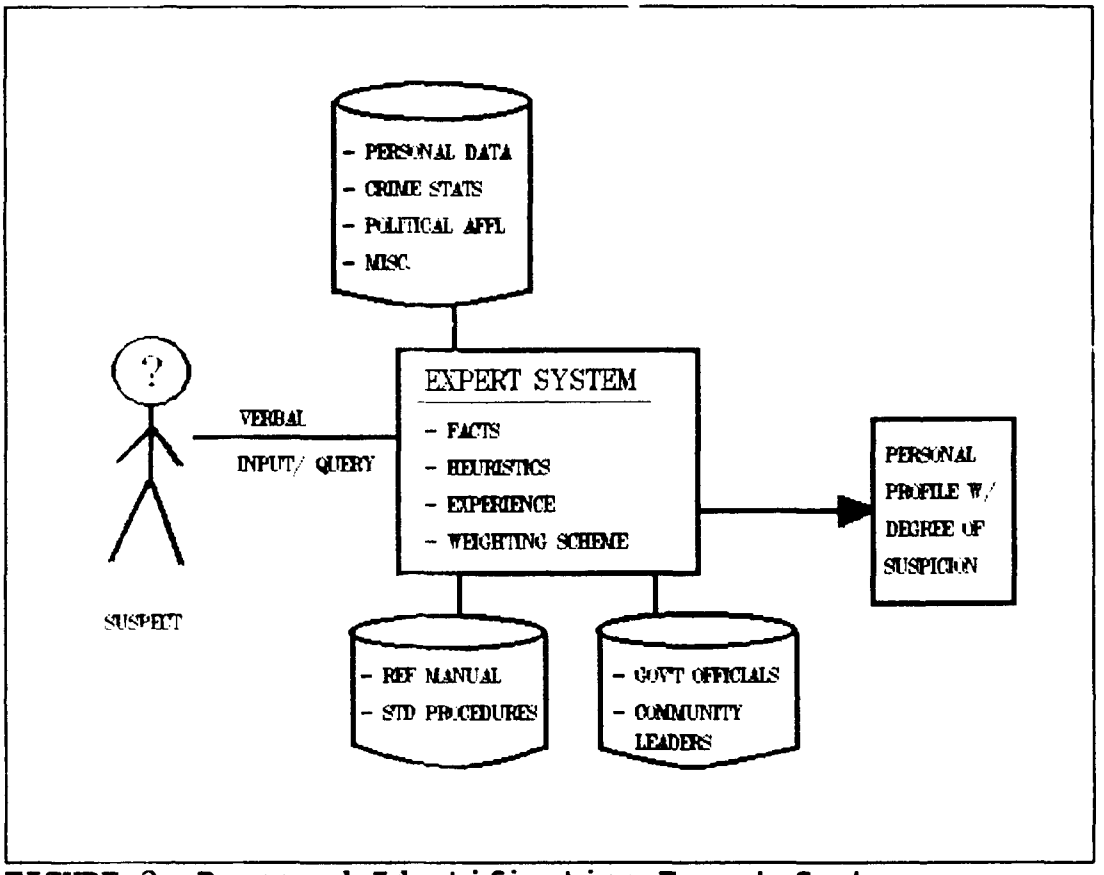

FIGURE 2: Proposed Identification Expert System

B. ALLEGIANCE

The concepts of allegiance, loyalty, and patriotism are not interpreted in the same way by all nations or peoples. It would, for example, be extremely difficult to measure the governmental allegiance of a transitional country using measures relevant to the concept of patriotism in the United

States. It would perhaps be more appropriate to measure a population's or individual's willingness to cooperate with their government, to heed governmental advice, and to accept and participate in various governmental programs.

In attempting to capture the "hearts and minds" of the people whose country is torn by an insurgency, we must be realistic as to the extent to which this is possible. It is quite probable that the Western concept of allegiance will need to be tempered during the initial phases of counterinsurgency operations. Counterinsurgent forces should, at least initially, be satisfied with something less than complete "Western allegiance" from the insurgency-wracked civilian population. It is anticipated that as the insurgents' influence among the populace diminishes, the people will begin to identify with their government, and a true attitude of allegiance and cooperation will begin to develop.

C. ALLEGIANCE INDICATORS TO BE MEASURED

During the Viet Nam era there were many attempts to identify the indicators of popular support that comprise the overall control of the people by an insurgency movement. In 1966, S. N. Bjelajac compiled what most officials consider the most extensive and detailed list. [Ref. 13] Bjelajac identified eleven interactive guidelines that collectively represent a comprehensive measurement of the overall control

and influence enjoyed by the insurgent. These guidelines are also relevant measures of an individual's identification with and sympathy for the insurgency movement. Many of these guidelines will be discussed below, along with some sample questions which give an idea of the type that might be incorporated into an expert system designed to measure the allegiance of an individual residing in an insurgency-torn country. A much more comprehensive list of questions is included as Appendix A. The remaining two guidelines outlined by Bjelajac are primarily concerned with security measures and are considered beyond the scope of this thesis.

In the following discussion, all quotations are taken from Bjelajac's thesis. [Ref. 13] Bjelajac's guidelines and statements will be used to formulate questions for possible inclusion in the proposed counterinsurgency expert system.

1. Political Control

Bjelajac states "the degree of political control exercised over the administrative subdivisions of a given area can be measured in terms of control of the many individual institutions by which political and governmental activities are manifested."

In order to make the counterinsurgency system useful, it will be necessary to avoid questions that are too general in nature. Care must also be taken to tailor the specific questions to the individual being interviewed or interrogated.

While support of the government's counterinsurgency programs by the community council or elders is important, it is not a measure of governmental acceptance by any particular individual. Examples of questions tailored for and directed at an individual might include:

a. If you were offered a position of responsibility in your community, would you unhesitatingly accept?

b. Would you be willing to serve on the police force of your community?

c. Would you consider becoming a candidate in a local political election?

Although these questions do not directly measure loyalty, they may demonstrate an individual's belief in the government's security programs. They may also serve to illuminate an individual's perception of continued safety or relative security in a particular geographical location. It is believed that these questions will have merit in their proposed task, especially when considered in conjunction with the other questions in the expert system.

2. **Control of Intelligence**

> "The pattern of the flow of intelligence is an excellent general barometer of progress in insurgency/counterinsurgency. The details of this pattern must be analyzed systematically, for the conclusions to be drawn vary widely with such factors as the quantity and quality of intelligence, its subject orientation, its method of acquisition, and its sources."

The source of intelligence information is a very significant indicator of counterinsurgent progress. For example, intelligence information volunteered by the local or general population may indicate a willingness to support or cooperate with the government or pro-government forces. Specific questions aimed at determining source-intelligence information might include:

a. If you knew of something the insurgents were doing or were planning to do that was detrimental to counterinsurgent forces, would you report it to your local government officials?

b. If you knew of an ambush or attack planned by the insurgents, would you warn the government forces?

Also significant is the type and amount of information that is volunteered. We would expect that an individual who is completely pro-government would volunteer all types of information about insurgent activities and, in particular, information concerning operations within or near his community. In this regard, another helpful question might be:

c. If you knew that a member of your village or someone living within your community were working for the insurgents, would you report him to the government?

The scope of government intelligence coverage is also very important but not as easy to measure. Data on the endurance of government intelligence nets in enemy controlled areas may well have to be garnered by evaluation of local area advisors. One measure of the scope of intelligence might be

the willingness of individuals to risk reporting minor as well as major insurgent plans and activities. It is conceivable that an individual would risk insurgent reprisal to report known plans of a major insurgent operations, but that they would be less eager to risk themselves to report plans of comparatively minor activities.

3. Public Opinion and Propaganda

> "Popular allegiance and support - not geographic areas under control - are the ultimate measures of success for either side. When attitudes need to be changed, the professional propagandist normally bases his appeals both on sentiment and logic. Each of these are in themselves composed of many factors. Either may predominate; however, more often appeals to sentiment carry the greater weight."

There are several approaches to estimating the extent to which the insurgents or the counterinsurgents are successful in disseminating their information policies and the degree to which these disseminations appear to influence public opinion. Unfortunately, many are of the type that cannot be investigated by questioning or polling individuals. The extent to which the press and other public media contribute voluntary government support and the amount of influence the government is able to exert over non-governmental public and private organizations are two examples. Individual responses to the use of government-oriented news and propaganda media could prove useful, as well

as an individual's attendance at pro-government meetings and rallies. Possible system questions might include:

a. Would you rather read an insurgent news publication or a government news publication?

b. Which newspaper do you believe contains the most accurate and complete information?

c. Would you be willing to attend a pro-insurgent meeting or rally?

4. Political Aspects of Education

> "The term political aspects of education is, for the sake of this discussion, intended to embrace those aspects of ideological indoctrination carried out within the institutional framework of the public educational system."

Once again, there are many areas of educational concern that may not be measurable by individual responses. These factors might include the number of schools active within the education system, the overall attendance rate, the competence of the teachers, general curriculums, etc. While these factors provide important information by themselves, they are perhaps most useful when considered in relation to an individual's response to specific questions about his own educational beliefs and practices.

The willingness of an individual to send his children to a government school; the willingness of an individual to aid in the re-establishment of the government school system in the event of military, guerrilla, or terrorist disruption; and

an individual's support for pro-government teachers are all direct indicators of a pro-government ideology. Specific questions directed at an individual's educational beliefs and practices might include:

a. Are you in favor of the government sponsored educational system?

b. Are you against paying taxes to help fund the government educational system?

c. Would you volunteer to help teach or tutor at an insurgent sponsored school?

5. **Control of the Legal System**

Bjelajac states that there must be "...respect for the courts, laws, and other legal instruments of government by the public, as opposed to acquiescence to insurgent attempts to establish their own shadow government."

This may be measured in part by the willingness of the people to resolve any legal disputes they may have through the community, district, or province legal processes.

As in all areas dealing with human emotions and opinions, individual perception is of prime importance. Stated differently, no matter how effective government legal agencies, unless the people believe they are being equally and fairly protected by the law, attempts to alter public opinion from pro-insurgent to pro-counterinsurgent will prove unsuccessful. Therefore, sample questions for our expert system might include:

a. Do you believe government supporters and sympathizers are adequately protected by the legal system?

b. Do you believe the government laws are fair and just for all people?

c. Do you agree with the government policy of severe punishment for those convicted of political, economic, or other crimes against the security of the country?

Also important is the trend of popular opinion over time; the changing of public opinion from anti-government to pro-government. Trend analysis questions should probably be incorporated into each of the "interactive guidelines" when the actual expert system is developed and ultimately implemented.

6. **Community Services and Civic Action**

The question of who effectively controls civic functions in an area and thereby plays the role of social reformer is in itself one indicator of the trend of political control within a particular area. Each area must, of course, be evaluated in the light of its actual political, psychological, and military situation, taking into account the fact that some areas are of greater strategic importance than others. Political trends within the country as a whole may be derived from a careful and weighted analysis of such trends within individual areas.

We cannot say that merely doing what we perceive to be the best for the people will constitute an adequate civic

action program. Here again, it is of paramount importance to consider not only our own perceptions, but also the perceptions of the general population. An extensive post-high school educational system or highway road system is extremely important in modern Western civilizations. The population of an insurgency-torn country, however, may not favor the intrusion. Expert system questions, therefore, should pertain to an individual's opinion as to whom is responsible for the development, construction, and maintenance of state and community services. Possible queries might include:

a. Do you believe government taxes are fair and necessary?

b. Would you volunteer to be a government sponsored policeman or fireman in your community?

c. Would you be willing to work for the public good in your community?

In Vietnam, Revolutionary Development Teams were continually harassed and attacked by the Viet Cong. It is believed that repeated attacks by insurgents on any government program may be taken as a direct indication of the success of that particular program. An individual's or community's willingness to help rebuild the accomplishments of the program after an insurgent attack would seem to reflect a belief in the program and in the program's sponsor. Recognizing this, another potential question might be:

d. Would you voluntarily help rebuild a government hospital that was destroyed or damaged by the insurgents?

7. Control of Transportation and Communications

The control of transportation and communications is a larger and more general type of measurement. It is not directly relatable to individual interrogation. However, an individual might be asked about his trepidation, or lack of it, in travelling the public roads of the country. Also, his willingness to work in or become part of a government warning net would be a positive indication of government support. As with other categories, the voluntary reporting of insurgent activities to government forces is indicative of government progress in the area. Possible questions within this topic area might include:

a. Would you lead government forces down roads, trails, and paths in your community's area?

b. Do you believe the government keeps the roads and waterways safe in your area?

c. Would you volunteer to help build or maintain a government sponsored road project?

8. Control of Recruitment

The ability to gain voluntary recruits is extremely beneficial for both insurgent and government forces. On the other hand, the necessity to use political controls or other coercive forms of persuasion or social pressures to gain necessary recruits is extremely negative. The positive involvement of a potential recruit's family is also considered

a favorable factor. Therefore, the expert system may pose questions on the willingness of a parent to allow his/her son to enlist or become part of the government's military or police forces. Obviously, the willingness of the individual to become or allow his/her dependents to become members of the insurgent infrastructure is a negative indicator. Possible questions might include:

a. Would you be unhappy if your son enlisted in the insurgent armed forces?

b. Would you be proud of a son in the government's armed forces?

c. Would you be willing to fight or even die for government preservation?

9. **Economic Controls**

The relative ease of collecting taxes from the populace is an important measure of pro-government attitudes, while increasing difficulty in tax collection becomes a measure of escalating pro-insurgent feelings. Potential questions might include:

a. Are you angered by the need and the amount of taxes you pay the government?

b. Do you think you should pay taxes to the insurgents?

c. Do you believe the insurgents would take their taxes by force or coercion?

Without a strong sense of allegiance to the government, it is reasonable to expect an individual to sell

his agricultural produce to the highest bidder in an open market. Thus, another question might ask:

d. Given equal prices, would you rather sell you goods to the insurgents or to the government?

D. AN ALLEGIANCE TESTING METHOD

It appears that a method whereby the people of an insurgency wracked country are used to evaluate their own attitude would be of great value in developing an expert system capable of assisting in insurgent identification. It is believed that the key to an accurate measure lies with the people themselves who seem to be an obvious source for answers to the problem of measuring loyalty and allegiance. This is not to say that direct questioning of individuals about their loyalties would necessarily yield useful information. There is the possibility that the answers to such questions would be what the individual - if he understood the question to begin with - thought his interrogator wanted to hear rather that what he actually felt. In spite of this possible detriment, the use of the people to evaluate their own attitudes is worthy of our consideration.

Because opinion symbolizes attitude, the proposed expert system should solicit an individual's opinions as the means for measuring his loyalty attitude. In this case, the statement or opinion is referred to as the objective index

while the inferred subjective inclination of the person being examined is called a specific attitude variable. It is obvious that some discrepancy exists between an individual's opinions and his overt acts, which we should use here as an index, and the true attitude which we infer from such an index. Every time we measure something however, we postulate an abstract continuum, such as height or weight, and the thing measured is referenced to that continuum through one or more indices. The actual values of what we are trying to measure are inferred from the relative consistency of the indices, since we never know the values exactly. For many years, psychologists have attempted to use attitude scales to measure many intangible aspects of human behavior. For our purposes, the method of summated ratings is most applicable.

The method of summated ratings presumes that the statements or questions can be accurately divided into two classes, favorable and unfavorable. Individual subjects are then directed to separate the statements into five categories; strongly disagree, disagree, undecided, agree, strongly agree. Each of these categories may have a corresponding numerical value from one to five that will allow the system to identify those individual's with cumulative scores below an acceptable, pre-determined level. As stated earlier, the method of summated ratings also affords the system the capability of phrasing questions and statements either negatively or positively. For example, a 'strongly agree' rating to an

unfavorable statement would result in a zero score, as would a 'strongly disagree' rating to a favorable statement.

Finally, in this method of psychological testing, it is the local population who could actually determine the acceptable scale values to be used in the system, resulting in a 'relative scale' for use within that group or community only. This relativity may be best accomplished via traditional interviews and close associations with known governmental or counterinsurgent force supporters from the local community.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The primary goal of this thesis was to investigate the feasibility and applicability of expert systems technology to certain aspects of counterinsurgency operations in a tactical military environment. Particular emphasis was placed on a possible expert system contribution to the formidable counterinsurgency screening force function of identifying insurgent and cause-sympathetic individuals. The effort to automate this function has the potential to significantly improve both the effectiveness and efficiency of the counterinsurgency screening force.

Chapter II presented a necessary introduction to the nature, phases, and strategies of insurgency warfare. Chapter III briefly discussed applied artificial intelligence and presented each of the major expert system types with specific focus on their current or potential contribution to counterinsurgency operations. Most importantly, Chapter III presented the steps required to construct an expert system capable of aiding the screening force in identifying insurgent and cause-sympathetic individuals. Chapter IV discussed the current counterinsurgency screening force individual identification process and suggested a method of optimizing

this process via the application of expert systems technology. Finally, Chapter IV presented specific, measurable indicators of individual allegiance. These indicators are based on eleven interactive psychological guidelines identified by S. N. Bjelajac in 1966. Bjelajac's guidelines provide the basis for questions formulated for possible inclusion in the insurgent identification expert system under investigation. These potential questions are included in Chapter IV and Appendix A.

B. CONCLUSIONS

This thesis provides a foundation and basis for further research and development in the application of expert systems technology to the counterinsurgency scenario of tactical military operations. Further research and the actual development of an expert system prototype capable of aiding in the identification of insurgent and cause-sympathetic individuals are expected to provide significant improvements in the conduct of counterinsurgency operations.

C. AREAS FOR FUTURE RESEARCH

As stated earlier, this thesis represents the first phase of a three phase project to investigate the feasibility and applicability of expert systems technology to the insurgent and cause-sympathetic identification process of counterinsurgency operations in a tactical military

environment. The second phase is expected to further research and provide for the development of a basic insurgent identification expert system prototype. The third phase of this project will finalize prototype development and explore the potential costs and benefits associated with developing and implementing a full-scale tactical expert system for counterinsurgency warfare.

Once the final prototype system has been developed, research attention can be focused on three distinct areas: (1) training and tutoring of inexperienced screening force personnel, (2) incorporation of external data sources with the expert system prototype, and (3) expanding expert system technology to other areas of counterinsurgency and tactical military operations.

1. **Training and tutoring**

With further research and development, variations of the expert system prototype to be developed during the second phase of this project could be used for instructional and training purposes by screening force personnel. The detail, rationale, and feedback ability of expert systems could enhance the screening force personnel's ability to recognize, interpret, and analyze the tremendous amount of information associated with the identification of insurgent and cause-sympathetic individuals.

2. **Incorporation of external data sources**

An extremely important area for further research would be to examine the feasibility and practicality of interfacing the insurgent identification expert system prototype with existing international and national police, driving, financial, birth registration, voting, and various other archived information data sources. Access to this amount and type of information would significantly enhance the ability of the prototype system to make and justify individual allegiance determinations. Additionally, successful research in this area would increase the credibility of utilizing expert systems in tactical military operations.

3. **System expansion**

The task considered by this thesis and the overall project has been limited to the identification of insurgent and cause-sympathetic individuals during counterinsurgency operations in a tactical military environment. Subsequent research should expand the use of expert systems technology to other counterinsurgency scenarios, and other tactical military applications not specifically associated with the conduct counterinsurgency operations.

APPENDIX A

SAMPLE QUESTIONS FOR POSSIBLE INCLUSION IN THE CONSTRUCTION OF AN EXPERT SYSTEM CAPABLE OF AIDING IN THE SCREENING AND IDENTIFICATION OF INSURGENT INDIVIDUALS

The following are questions for possible inclusion in the proposed insurgent screening and identification expert system. This set of sample questions is provided for illustrative purposes only, and should by no means be considered exhaustive. It should also be emphasized that these questions are furnished as simple examples, and in many cases would require additional thought and effort as to type and format. For the construction of the actual system, statement and question formulation should be assigned to experienced counterinsurgency interrogation specialists and psychological testing and evaluation professionals.

The favorable answers to the following questions are obvious to those of us in this country. Unfortunately, the favorable responses may also be obvious to the individual being questioned. This type of question should be avoided as often as possible. Perhaps it is the simplicity of the questions that is bothersome. It is quite possible that the questions could be couched in terms so as not to appear so

obvious. Also, a greater percentage of the questions should be written in a negative context. This would preclude the individual who simply answers in the affirmative from being automatically classified as possessing wholehearted government allegiance.

A. (1) Would you be willing to serve on the police force of your community or village?

(2) Would you accept a position of responsibility in your community or village if the government requested you to do so?

(3) Are the insurgents, in your opinion, trying to establish a good government?

B. (1) If you knew of an ambush planned by the insurgents, would you warn the government forces?

(2) If you knew that a member of your community or village was working for the insurgents, would you report him to the government?

(3) Would you report the location of an insurgent's mine if you knew where it was?

(4) Would you be willing to serve on a government intelligence net?

C. (1) Have there been any pro-government meetings or rallies in your community or village?

(2) Would you attend such a meeting or rally?

(3) If you could have either one, would you rather read a government newspaper or an insurgent newspaper?

D. (1) If you have/had children, would you like to have them attend a school that was built and sponsored by the government?

(2) Would you willingly help rebuild a school that had been purposely destroyed or damaged by the insurgents?

(3) Do yo think teachers should teach about and support the government?

E. (1) Do you believe government supporters and sympathizers are adequately protected from the insurgents?

(2) In your opinion, are the government laws fair and just for all?

(3) If you had a dispute with a neighbor, would you go to the government police and courts for settlement?

(4) Do you agree with the government policy of severe punishment for those convicted of

political, economic, or other crimes against the security of the country?

F. (1) Who, in your opinion, is responsible for the security and general well-being of your community or village, the insurgents or the government?

(2) If the insurgents destroyed the effects of a civic program team, would you help to rebuild it?

(3) Are the government teams or forces helping your community or village build what you think needs to be built?

G. (1) Do you feel safe whenever you must travel along the roads or waterways?

(2) Who controls the roads and other transportation means in the area, the government or the insurgents?

(3) Are communications between communities or villages adequate for your community's needs?

H. (1) Would you be willing to work with the insurgency underground?

(2) Would you be unhappy if your son joined the government armed forces?

(3) If you were able to serve in the armed forces, would you rather join the insurgent or the government forces?

I. (1) To whom would you sell your manufactured or agricultural products to if both the government and the insurgents offered to buy for the same price?

(2) Would you pay taxes to the insurgents if they promised not to use force to collect them?

(3) Do you think it's unfair to have to pay taxes to the government?

(4) Do you try to hide or find some way to avoid the government tax collector when he comes to your village?

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