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HIGH TECH DECISION MAKING IN THE AIRPOWER AGE

A Research Paper

Presented To

The Directorate of Research

Air Command and Staff College

In Partial Fulfillment of the Graduation Requirements of ACSC

by

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Preface

As each of us is well aware, the computer age is not going to just 'go away.' Much the same way our parents watched in awe as we mastered the use of the calculator to perform complex mathematical problems in school, we are amazed at the manner in which our own children have mastered the use of the personal computer. As America's military decision makers, we cannot afford to fear the astounding rate of high-tech change we've witnessed in our lifetimes. We must embrace this change and recognize it for the wonderful opportunity it is. With first, the creation of local area networks; and subsequently, the advent of the World Wide Web, we have access to an electronic universe of information. This research paper looks at the potential of linking an unlimited number of decision makers in cyberspace to brainstorm solutions to complex problems.

I'd like to express my sincere appreciation to the following people for their assistance during this busy academic year:

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Abstract

The purpose of this research was to explore whether electronic brainstorming and problem solving software are feasible for and add value to Air Force organizations, specifically Air Command and Staff College (ACSC).

The author's literature review verified traditional nominal group brainstorming (group members working separately to generate ideas) is superior to traditional face-to-face group brainstorming. Further, previous research also showed electronic brainstorming was as effective as, and in some cases superior to, traditional nominal group brainstorming.

The author reviewed the capabilities of several electronic problem solving/brainstorming software tools. He tested the capabilities of one such tool, *CM/1* (Corporate Memory/1), because ACSC currently owns 15 *CM/1* site licenses. *CM/1* allows group members the capability to use an issue-based decision making process in cyberspace.

The author demonstrated the feasibility and value-added use of *CM/1* at ACSC through successful software installation on the ACSC computer network, use by a student group brainstorming research ideas, and use by a faculty group attempting to solve an ACSC organizational problem over their local area network. Aerospace applicability was demonstrated throughout the project.

The author concluded with recommendations for using *CM/1* at ACSC and other organizations, and suggested areas for related future research.

HIGH TECH DECISION MAKING IN THE AIRPOWER AGE

I. Introduction

Background

Whether one knows it as a revolution in military affairs (RMA) or the military technological revolution (MTR), one probably associates the concepts with radical advances in weapon systems. Another aspect to consider under RMA is the recent technological improvements in a military's, or even a nation's, ability to rapidly and effectively make quality decisions. All modern organizations possess some form of John R. Boyd's **Observation-Orientation-Decision-Action (O-O-D-A) Loop**, which they use to evaluate information and make decisions.[1] The **O-O-D-A Loop** technique is a form of problem solving where participants examine issues and establish logical positions from which to make intelligent decisions. Brainstorming is arguably the critical component in all steps of the group problem solving process.

While face-to-face brainstorming has traditionally been the preferred method used during problem solving, this method often has its flaws. President Kennedy's decision to invade Cuba in 1961 was the result of incomplete brainstorming. The strong, often domineering personalities of John F. Kennedy and his brother, Attorney General Robert Kennedy, stifled the creative thoughts of others during White House discussions.[2] During the brainstorming leading up to the Bay of Pigs decision, several senior advisors held serious reservations about such a move.[3] However, because these advisors were either

unwilling to speak up or too timid to express their ideas forcefully, important facts were glossed over and relevant opinions ignored. This author argues network electronic brainstorming would have produced a superior quality and quantity of ideas during Kennedy's brainstorming sessions. No one will ever know if President Kennedy would have made a different decision concerning the Bay of Pigs incident had all the information been out on the table. However, using today's electronic groupware technology, he certainly would have had better information from which to make his decision.

Current Air Force leadership is not only aware of but, has also begun taking advantage of some of the recent quantum leaps in electronic brainstorming computer technology. The United States Air Force (USAF) Air Staff recently embarked on a journey to enhance the manner in which high level decision makers solve complex problems. The Air Force Innovation Center (AFIC), located in the Pentagon, is now equipped with a new issue-based electronic problem solving software tool. The application software, called *CM/1* (Corporate Memory/1), proposes to aid in the group problem solving/decision making and tracking process in numerous ways. Most notably, *CM/1* software is purported to link multiple decision makers in cyberspace, whether located together or geographically separated. This capability eliminates many time, monetary, and space limitations imposed by the traditional meeting approach.

AFIC graciously provided Air Command and Staff College (ACSC) with a 15-station site license for curriculum use and research into advanced staff actions. AFIC originally hoped a team of 3 to 15 research students would examine advanced decision making and staffing techniques using *CM/1*'s issue-based problem solving process. They

also requested publishable findings and recommendations for possible future studies on and uses for *CM/1*. Because the author was the only ACSC volunteer for this project, the original request was slightly rescoped.

Scope of Research Approach and Limitations

The author slightly rescoped the original request to accomplish, what he believed, were important, necessary, relevant, and manageable objectives for not only AFIC and ACSC, but his single-member research team as well. First, because this became an individual student research effort, the author focused more broadly on the usefulness of *CM/1* and the basic education of readers on issue-based problem solving. The intent was to investigate its practical application and begin the ball rolling for *CM/1*'s initial use at ACSC and/or follow-on research. Therefore, the author did not conduct strict scientific testing and does not make any claims of achieving statistically significant results. Second, because the author was attending an airpower school, he incorporated as many Air Force and airpower examples as seemed practical in his research. Lastly, because the research was conducted at ACSC with both students and faculty, the author concentrated a great deal of the focus on the value and feasibility of using a tool like *CM/1* at ACSC in the future. However, the author also endeavored to examine issues and uses which would equally apply to AFIC or any other properly-equipped group of decision makers.

Broad Problem Statement

The purpose of this research was to examine whether *CM/1*, or similar electronic brainstorming/decision making software, adds value to the group problem solving process and is feasible in Air Force organizational settings.

Research Objectives

In order to answer the research question, the author had to accomplish several objectives. The author satisfies the following objectives in the *Literature Review*, Chapter II; these objectives have been validated by previous research:

(1) establish, through past research, that problem solving/decision making using electronic brainstorming is as effective or superior to traditional methods, and

(2) show the technology required for interactive electronic brainstorming, using stand alone personal computers or a network configuration, exists and is a value-added option in certain organizational settings, such as ACSC.

The author satisfies the next set of objectives in the remaining chapters as a result of this research project:

(1) educate readers on the process of issue-based problem solving and the basic use of *CM/1* via a hypothetical airpower brainstorming example,

(2) train a student research group to use *CM/1*, in stand alone mode, to brainstorm an issue and examine their success,

(3) successfully install *CM/1* on the ACSC network and report the ease or difficulty of doing so,

(4) test some of *CM/1*'s network capabilities and report software strengths and weaknesses (bugs),

(5) train a faculty group to use *CM/1*, in the network mode, to address an issue in cyberspace and examine their success, and

(6) state the conclusions of this research and recommend viable uses and follow-on research possibilities for *CM/1* and electronic brainstorming through issue-based problem solving.

Research Hypotheses

Hypothesis I: Electronic brainstorming software, specifically *CM/1*, performs with current ACSC computing capability; individual personal computers, working both stand alone and as part of a network.

Hypothesis II: CM/1 brings a positive, value-added capability to ACSC faculty and students; enhancing ACSC as both an organization and higher learning institution.

Research Outline

The remainder of this research paper is organized in the following manner.

Literature Review, Chapter II, contains a review of relevant research in the areas of: group problem solving application and theory, *groupthink*, nominal group and combined group problem solving, *wicked* problems, issue-based information systems (IBIS), electronic brainstorming, and electronic brainstorming software. The author completes the chapter by discussing some logical conclusions he draws as a result of reviewing selected literature.

Methodology, Chapter III, briefly reviews the IBIS process, *CM/1's* capabilities, and provides a hypothetical airpower example to familiarize the reader with *CM/1* software use. This chapter also describes the methodology used to test *CM/1* in a number of ACSC settings: software use by a student research group in stand alone mode, software installation on the ACSC computer network, initial tests of *CM/*1's basic functionality on the ACSC network, and network use of *CM/1* software by a faculty group solving a real world ACSC problem in cyberspace.

Data Description and Analysis, Chapter IV, provides the results of the author's tests on the feasibility and value of using an electronic brainstorming tool at ACSC.

Findings and Conclusions, Chapter V, explains the author's final conclusions and the significance of his findings. Lastly, the author presents his recommendations for *CM/1* use at ACSC and other organizations, some prospects for future research, and his concluding remarks.

The author provides *appendices* which include a review of electronic brainstorming software, sample *CM/1* map view and text view printouts, a *CM/1* user critique, and a description of ACSC's network technical specifications.

The *Bibliography* contains a list of all reference material cited in the research paper.

The *Vita* contains biographical information about the author.

II. Literature Review

Introduction

Topic Statement. This chapter provides an overview of previous research on the theory and application of the problem solving process, different methods of problem solving, and recent innovations in electronic brainstorming.

Scope. The author selected the majority of literature in this review from articles found using computer literature searches of the Air University Library, Maxwell Air Force Base, Alabama. He obtained other referenced literature from Corporate Memory Systems, Incorporated, Austin, Texas; Group Decision Support Systems, Incorporated, Washington, DC; and Ventana Corporation, Tucson, Arizona. The key words the author used in the searches were problem solving, group problem solving, computer problem solving, group decision making, and electronic brainstorming.

Organization. The author begins the literature review by examining literature on basic problem solving; whether by individual or group, manual or computer-assisted. Second, a phenomenon effecting group problem solving called *groupthink* is mentioned. Third, the author briefly discusses and compares nominal group and combined group problem solving. Fourth, the notion of *wicked* problems is addressed. Next, the author elaborates on the IBIS concept. Sixth, the author examines combined group electronic brainstorming, and its possible benefits. Next, some of the existing electronic brainstorming or problem solving software currently available is discussed and reviewed.

And finally, the author draws some logical conclusions from the reviewed literature to better focus the reader for the research explained in the subsequent chapters of this paper.

Review of the Literature

Problem Solving Process. While reviewing previous literature on various types of problem solving the author found numerous methods and steps involved in the process. Aldag and Fuller list the following steps: problem identification, alternative generation, alternative evaluation and choice, decision implementation, and decision control.[4] Pastrick, while reviewing computer brainstorming packages, emphasized the two steps he felt most critical to the problem solving process: clear identification and definition of the problem or situation and focusing on goals by setting an objective.[5] Walker, during his review of virtually interactive brainstorming, listed the following seven-step process: clearly define the problem and the decision authority, clearly communicate the problem to management at the decision authority level and get their support, clearly establish a project tasked to resolve the problem by defining its scope, arrange for a temporary electronic mailbox to support the project, communicate the essential elements of the project to the team members, collect the ideas and consensus of the team members that will be used to resolve the problem or issues, and continue the process until a consensus is reached by 75 to 80 percent of the members.[6] The Air Force's Squadron Officer School has successfully used the following systematic problem solving model to train USAF company grade officers since 1953: recognize the problem, gather data, list possible solutions, test each solution, select the best solution, and apply the solution to the problem.[7]

Groupthink. Factors which influence group problem solving include organizational power and politics, group cohesiveness, social control, and directive leadership.[8] Any of these factors can lead to solutions affected by *groupthink*. Groupthink results when group members' wishes to remain cohesive and in agreement override their desire to decide on the best course of action.[9] There is considerable disagreement among behavioral scientists as to whether groupthink is inherently dysfunctional during group decision making.[10] Therefore, groupthink was excluded from serious consideration during this research project.

Nominal Group and Combined Group Problem Solving.[11] Although the opposite seems intuitively true, nominal group brainstorming (individuals working alone, but still part of the same group) during problem solving generates not only more, but also more creative ideas than combined groups (group members working together, face-to-face). In other words, several people brainstorming a problem separately, nominally, are more effective than the same number of people brainstorming a problem together. Since the late 1950's, over 50 studies comparing nominal group brainstorming to combined group brainstorming have confirmed the preceding. In addition, nominal groups outperform combined groups on an even larger scale as one increases the size of the groups. While combined group, or face-to-face, problem solving offers the proven benefit of "piggybacking," or synergy, it also introduces three brainstorming inhibitors to participants: production blocking, evaluation apprehension, and free riding. *Production blocking* occurs in combined groups because only one member can contribute verbally at a time. Production blocking can have three negative effects on the problem solving process.

First, members who do not get their ideas into the process as they think of them may not get them in later because they have either forgotten them or don't feel they are as important later. Second, members may lose focus on the brainstorming process and miss ideas because they are concentrating on the idea they want to get into the process. And finally, members may not have time to think of ideas because they are not able to listen to others and generate their own ideas simultaneously. *Evaluation apprehension* results due to members holding back ideas for fear of rejection or ridicule by the group. Lastly, *free riding* occurs when members let the rest of the group do the work. For various reasons, members may not feel it is worth fighting their way into the discussion to present their ideas.

***Wicked* Problems.** *Wicked* problems differ from the tame, or usual problems facing groups. Groups have traditionally solved tame problems using some of the methods discussed in the previous section. Wicked problems do not easily lend themselves to the same scientific approach or logical sequence. Wicked problems are so complex and changing, that often one has begun implementing a solution only to find circumstances so different from the starting scenario that it is necessary to redefine the original problem.[12] One can consider tame problems as more limited and static; the problem doesn't change much before you have time to implement your solution. An example of a tame problem might be: Given five people and a 200-piece, standard, one-sided puzzle, identify the process the group should use to successfully complete the puzzle in a 2-hour period. Here, a group of problem solvers has important information needed to brainstorm an optimal solution, specific numbers of physical and personnel resources and a

time constraint. On the other hand, wicked problems are more dynamic. The nature of the problem may change frequently, even after one has started implementing a solution. An example of a wicked problem might be: Not knowing how many people you'll have to complete the task, identify the best process to put together a one- to multi-sided puzzle, in a yet-to-be-determined amount of time. In this example, the group must develop a more generic solution which will have to be optimized as further information becomes available. The group inevitably will need to refine the problem definition as well as part or all of its solution.

Issue-Based Information System (IBIS).[13] To handle the wicked problems mentioned above, Horst Rittel and associates, in the early 1970's, developed a conversational methodology called IBIS. IBIS avoids the traditional roadblocks problem solvers create by rephrasing misunderstandings and disagreements into the form of issues, or questions. Disagreements quickly become a more non-threatening inquiry in which all members of the group work together in partnership toward a common goal. By focusing the process on a series of questions, group members are not allowed to impulsively offer quick answers which may stifle the creative thoughts of others. This process prevents the discussion from deteriorating into a "Yes, it is! - No, it isn't! cycle."[14] where participants feel as though they either win or lose with each of their inputs. IBIS attacks problems as a series of **Issues** (or **Questions**). Different **Positions** (or **Ideas**) respond to each **Question**, and **Arguments**, **pro and con**, (supporting or objecting to **Positions**) are presented for each **Idea**.[15]

Using the author's own simplistic example, a branch of the 'Problem' tree might read as in Figure 1.

1. Question: What aircraft should we purchase?
  1.1 Idea (Responds to Question 1): F-98.
    1.1.1 Argument, Pro (Supports Idea 1.1): Successful prototype already developed.
    1.1.2 Argument, Con (Objects to Idea 1.1): Doesn't meet 2 of our 5 requirements.
  1.2 Idea (Responds to Question 1): F-99.
    1.2.1 Argument, Pro (Supports Idea 1.2): Paper study shows it meets all requirements.
    1.2.2 Argument, Con (Objects to Idea 1.2): Twice our budget, 1 year longer to develop.

Figure 1 IBIS Issue Development

A question can lead to a related question, as depicted in Figure 2.

2. Question (Expands on Question 1): Why purchase new aircraft?
  2.1 Idea (Responds to Question 2): Keep flying F-97.
    2.1.1 Argument, Con (Objects to Idea 2.1): Doesn't meet new requirements.
    2.1.2 Argument, Con (Objects to Idea 2.1): Money authorized for new; use or lose.
  2.2 Idea (Responds to Question 2): Upgrade F-97.
    2.2.1 Argument, Pro (Supports Idea 2.2): Meets new requirement.
    2.2.2 Argument, Pro (Supports Idea 2.2): 10-year lifecycle costs less than new aircraft.
    2.2.3 Argument, Con (Objects to Idea 2.2): Accident rate perceived high by public.

Figure 2 IBIS Issue Development, Related Issue

This data gathering can take place in a single setting or over an extended time, whatever is necessary under the circumstances. Once the original question and related questions are fully developed a decision is made. Following a decision, any information discovered at a later date is added to the above example. If there are significant new developments the

entire question, or issue, can be reconsidered. These new developments could result in an entirely different decision by the group at a later date.

Combined Group Electronic Brainstorming.[16] In combined group electronic brainstorming, computer inputs replace verbal communication. Individuals enter their comments into a computer workstation. As group members read other member's inputs, they electronically build on previous ideas. A continuously updated electronic file acts as the group's collective memory. Combined group electronic brainstorming combines the positive facets of both traditional verbal combined group and nominal group processes, while eliminating negative factors associated with each. Because members have ready access to every other member's inputs, piggybacking on ideas is still possible. Members can contribute simultaneously using combined group electronic brainstorming. This ability to enter ideas immediately helps reduce production blocking. Competition for speaking time is no longer a factor since members do not have to wait for an opportune moment to make their input. Additionally, combined group electronic brainstorming can also include an optional feature to ensure participants' inputs are kept anonymous which alleviates the fear of evaluation apprehension. Depending on the group members, anonymity can either increase or decrease free riding. If an individual views anonymous inputs as a liberating means of expressing himself without fear of retribution, free riding is decreased. However, if an individual sees anonymous inputs as an excuse to let others do the work, free riding is increased. Examining the research data of three previous combined group electronic brainstorming tests on large groups, Alan R. Dennis and his research team conducted their own combined group electronic brainstorming research on a sample size

of 276 business college juniors and seniors. As the previous three studies indicated, Dennis and his research team's test confirmed combined group electronic brainstorming was comparable to nominal group brainstorming in small numbers ($N \leq 8$) in producing both quantity and quality of ideas. However, when more than eight members were involved in a group ($N > 8$), combined group electronic brainstorming indicated superior results to the nominal group approach. In sum, Dennis et al's findings indicate combined group electronic brainstorming with small groups is just as effective as using the nominal approach. More importantly, the research appears to indicate combined group electronic brainstorming is the superior approach when larger numbers of participants are involved in group problem solving, or brainstorming.

Electronic Brainstorming and Problem Solving Software. Numerous software packages exist to aid in the brainstorming and problem solving processes. This category of software is often referred to as groupware. The author reviewed only a small sample of the many existing electronic brainstorming, or groupware, software packages currently on the market. Many of the packages have been developed for use in specialty fields (e.g., advertising, creative writing, etc.). In the past 5 years, several companies have developed brainstorming software to handle business-type problem solving tasks. While written more specifically for the business market, these packages appear easily adaptable to the same types of problems military and other government agencies face on a regular basis. These software applications vary in complexity and cost; all prices the author lists are quoted from the date of their associated reference material. Additionally, all listed software is disk operating system (*DOS*) based, unless otherwise noted.

The author provides the following basic information on several electronic brainstorming software tools. *CM/1*, the focus of this research, is the only electronic brainstorming tool explained in depth in this chapter. The author provides a more detailed explanation of the other software tools in Appendix A.

Brainstormer.[17] ***Brainstormer***, Version 2.21, by **Soft Path Systems,** allows users to focus their random thoughts by freeword association to produce viable ideas and options. Specifically, the software guides one through the first steps of problem solving; problem definition and goal setting. Groups can generate many ideas, but the software does not lead them through a discovery process, nor does it carry them through to a problem solution. *Brainstormer* is a stand alone program; the group makes inputs through only one computer.

IdeaFisher.[18] ***IdeaFisher***, Version 3.1, by **Fisher Idea Systems, Incorporated**, uses free association based on the user's inputs, to function similarly to the way our own human creative thought processes work. By prompting and questioning, the software leads the user(s) through all steps of the problem solving process, soliciting and encouraging brainstorming inputs along the way. *IdeaFisher* is also a stand alone program; one or more users make inputs to a single computer.

The Idea Generator Plus.[19] ***The Idea Generator Plus***, Version 3.1, by **Experience in Software, Incorporated**, is based on a more narrative approach to brainstorming. The software takes the user through a series of exercises to define the problem and focus goals, generate ideas, prioritize ideas, and produce a report of the brainstorming session.

Idegen++.[20] ***Idegen++***, by **FinnTrade**, helps the user clarify the problem and begin listing possible solutions. The software facilitates defining goals, identifying key players in the process, looking at the problem from new angles, developing creative solutions, selecting the best solution, and creating a report of the brainstorming session. Like the three previous applications, this software tool only operates stand alone.

Group Systems V* and *Group Systems for Windows*.**[21] ***Group Systems V, Version 1.1 and, the recently developed *Windows* version of this software, ***Group Systems for Windows***, Version 1.0, by **Ventana Corporation**, are network electronic brainstorming and electronic meeting support software packages. These tools support face-to-face combined group and nominal group electronic brainstorming on and off a network. *Group Systems* software allows users to:[22] create, share, and analyze ideas; observe new agenda items for discussion; track personal inputs during meetings; retain other frequently used software internally; poll other members for their opinions; make relevant information available to other group members; draw free-form pictures; send out surveys to group members; and apply reengineering principles to evaluate organizational processes.

CM/1*.**[23] ***CM/1, Version 2.0, by **Corporate Memory Systems, Incorporated**, is the focus of this research project; therefore, this software is presented to the reader in greater detail. *CM/1* is more sophisticated than all previously mentioned electronic brainstorming software packages, except *Group Systems V* and *Group Systems for Windows*. The *Group Systems* packages provide a wider variety of electronic groupware tools than *CM/1* and are impressive total meeting managers. However, while

not as sophisticated as the *Group Systems* products overall, *CM/1* does rival them in the actual areas of electronic group problem solving and brainstorming. Both *CM/1* and *Group Systems* have their strong points. The first four software packages the author reviewed require at least 256 kilobytes of random access memory (RAM) and are designed for a 80286 computer. *CM/1* requires at least 4 megabytes of RAM, a 80386 computer, and at least 5 megabytes of free disk space on the computer's hard drive. The cost is currently $535 per site license. Group discounts are available: 5-users, $2,395; 10-users, $4,395; 25-users, $9,975; 26+ users, negotiable. A large organization, the size of ACSC, could expect to pay less than $400 per site license purchasing the software in volume. (**Note:** These prices are current as of 16 March 1995 and include the most recent software version. Corporate Memory Systems, Incorporated, recently renamed the new software *QuestMap*.[24] To avoid confusion in the paper, and because all research was conducted on software with the *CM/1* trademark name, references to the software will remain CM/1 throughout this effort.)

CM/*1* uses both a pictorial and text format as the user builds a map of his problem, collects data, lists possible solutions, and makes decisions. Printing pictorial map representations, or map views, directly from *CM/*1 requires *PostScript* printing capability because the maps are saved in *PostScript* files. Briefly, *PostScript* is "A proprietary language developed by Adobe Corporation to tell a printer what to print on a particular page."[25] *PostScript* printers have the "circuitry needed to decode and interpret printing instructions phrased in *PostScript*."[26] In laymen's terms, these printers operate a little differently than laser and dot matrix printers. *PostScript* printers are generally more

expensive than laser printers. Unfortunately, there are no *PostScript* printers at ACSC. Users can print maps on other types of printers (i.e., laser, dot matrix, etc.) by following procedures outlined in *Methodology*, Chapter III.

CM/1 is the only software this author found to operate under the IBIS methodology. Figure 3 depicts a sample *CM/1* pictorial map view.

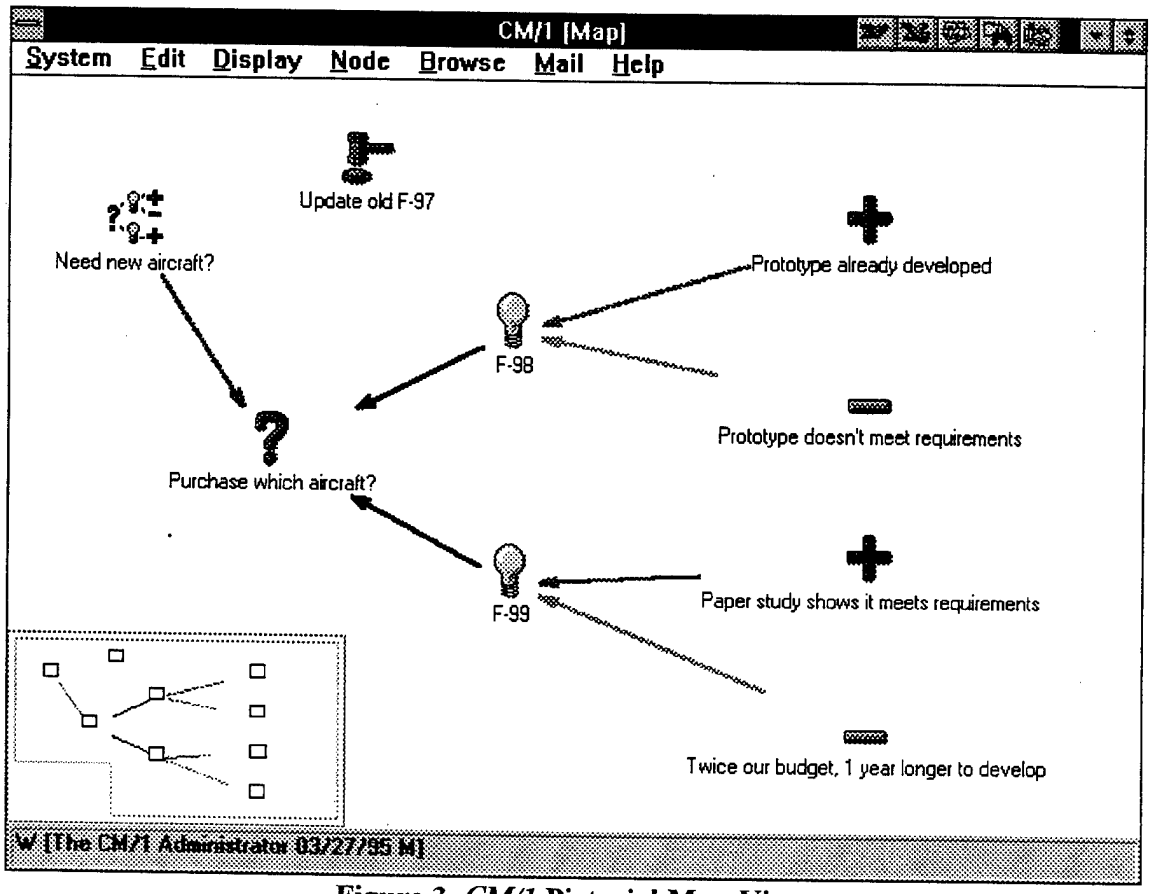

Figure 3 *CM/1* Pictorial Map View

Some of *CM/1's* advertised benefits include: enhanced productivity and communication, decreased problem resolution time, improved information management, and better fostering of organizational learning.[27] *CM/1* is *DOS* based and operates either

stand alone (i.e., single computer, not connected to a network) or as a virtual whiteboard in a network configuration. In other words, *CM/1* allows either nominal group or traditional combined group operation when used stand alone. But in the network environment, *CM/1* permits interactive combined group electronic brainstorming. Once a user group is defined in the network configuration, geographically separated group users can simultaneously brainstorm a problem in cyberspace. All inputs are clearly tagged with the author's name. *CM/1* has its own separate electronic mail function to allow network users to communicate at any stage of problem solving. *CM/1* also has security features to prevent unauthorized access. The program is built to interact with other application programs and possesses database import/export functionality. One may display or print both pictorial map and text view versions of a particular issue-based electronic brainstorming session. Documentation and a help menu answer most users' questions.

Along with its strengths and benefits, *CM/1* also has a few minor drawbacks. First, *CM/1* offers group members no anonymity of authorship. Second, unlike the previously mentioned software packages, *CM/1* is not a free association idea generator. If used without a facilitator, users must already be familiar with the rules of brainstorming and the concept of IBIS.

Logical Conclusions

Problem solving is a critical function in all modern organizations. While many problem solving steps and methods were defined earlier, all are usually similar in their basic approaches: define the problem, collect data, compile possible solutions, chose the best solution, implement the solution, and monitor the solution. Brainstorming during

each of the problem solving steps ensures the group considers more ideas and decides on a higher quality solution. Previous research reviewed in this chapter revealed groups reached different levels of success by following varying methods during brainstorming of an issue or problem. Previous research also indicated the nominal group approach superior to the traditional face-to-face combined group brainstorming approach in producing both better quality and quantity of ideas. Subsequent research showed combined group electronic brainstorming is as effective as the nominal approach in small groups and superior in larger groups. Combined group electronic brainstorming appears to produce the positive qualities of both the face-to-face combined group and nominal group processes. Many software tools exist to aid organizations in the group brainstorming process. One available software package, *CM/1*, facilitates both the nominal group and face-to-face combined group brainstorming techniques. In addition to supporting both these brainstorming processes, *CM/1* incorporates the facilitative IBIS process, aids groups in solving even the most wicked problems, and provides both a graphic and text record of the problem solving process. While *CM/1* is not as sophisticated as *Group Systems V* and *Group Systems for Windows* in the number of meeting assistance tasks it performs, it is comparable in actual electronic brainstorming capability. More importantly, *CM/1* is immediately available for ACSC research and use. This author did not review all software packages on the market with electronic brainstorming capabilities; he only reviewed a sample. Regardless of whether similar software is superior to *CM/1* or superior software will be developed in the near future, *CM/1* is available now and in use by the Air Force and other Department of Defense

(DoD) organizations. The main thrust of this research project is in investigating *CM/1's* utility and limits.

Summary

This chapter reviewed previous material on topics applicable to this research project. These topics included multiple forms of brainstorming and problem solving. Additionally, the author discussed numerous electronic brainstorming software tools with emphasis on *CM/1*. Finally, the author drew some logical conclusions from the reviewed material to lend better focus to the following original research.

III. Methodology

Overview

This chapter begins by reviewing the highlights of issue-based decision making and the use of the *CM/1* software tool. This review is the reader's first building block in his journey through the author's original research. Second, the author discusses a hypothetical airpower example as if a group of Army air planners brainstormed their historical issue using *CM/1*. This preliminary instruction is presented to enhance the reader's understanding and appreciation of how issue-based decision making and the use of an electronic brainstorming tool can be used in a military organizational context (i.e., airpower). Next, the author presents his overall approach to study *CM/1* use at ACSC: study a student research group using *CM/1* in a stand alone capacity, examine *CM/1* installation on the ACSC network, initially test the software's functionality on the network, and study a faculty group solving a curriculum issue using *CM/1* on the ACSC computer network. The author believed successful tests in these areas would demonstrate *CM/1's* value to ACSC and similar organizations.

Fundamental Understanding of Approach

To better understand this research the author must begin by establishing a common framework for the reader. Portions of the following information are reiterated from *Literature Review*, Chapter II. Comprehending the issue-based problem solving philosophy and basic functionality of the *CM/1* software package are critical to

understanding the importance of the following research. However, the author does not intend the discussion of *CM/1* as a tutorial on its use. Anyone interested in using *CM/1* should receive some basic, hands-on training before attempting to begin their own electronic brainstorming. Careful examination of the hypothetical airpower example should provide insight to the reader as to the universal applicability of *CM/1*, or any similarly developed electronic brainstorming software product.

Issue-Based Information System (IBIS). Issue-based problem solving is just one method of problem solving. Most Air Force members are familiar with the Systematic Problem Solving model taught at Squadron Officer School. The steps in that process logically lead a group through a sequence of recognizing the problem, gathering all relevant data, brainstorming possible solutions, testing solutions, and picking the best solution for implementation.[28] Most of us go through this or a similar process whether in a group or solving a problem on our own. While this process works well in relatively simplistic scenarios, it can fall short on more complex problems. These problems may be more difficult to define and also may require frequent reevaluation as new information becomes available. As outlined earlier, the issue-based problem solving process works well in helping solve such wicked problems. In many cases wicked problems are difficult to define until after a group has started implementing the solution. Additionally, the nature of a wicked problem changes over time, requiring constant reevaluation of the problem and portions of the solution.[29] In effect, under the traditional problem solving approach the group would need to reconvene and more than likely totally re-solve the entire problem. In a military organization many of the people involved in the original

problem may no longer be available (i.e., new job, on temporary duty, departed on permanent change of station, etc.). Additionally, documented reasoning behind each decision made to solve the original problem may no longer exist.

To handle such wicked problems one may use a conversational methodology known as IBIS. This methodology is discussed extensively in the *Literature Review*, Chapter II, of this paper. In short, IBIS avoids traditional brainstorming roadblocks by rephrasing disagreements in the form of issues, or questions. The group quickly begins to work together in partnership toward a common goal. Through a series of questions, or issues, the process prohibits impulsive answers which may stifle creative thought. Data gathering takes place in a single setting or over an extended time.[30] Once the original question is fully explored, a decision is made. Any information discovered at a later date, after a decision is made, can easily be updated to the scenario. If there are significant new developments a group can reconsider the entire question, or issue; this reconsideration may reveal an entirely different solution.

***CM/1* Functionality.**[31] While the IBIS process was well conceived, the required manual tracking quickly overwhelmed users once questions and their logical relationships grew in complexity.[32] Corporate Memory Systems, Incorporated, recognized a need for and developed a software package, *CM/1*, to manageably track the IBIS process. (**Note:** except where necessary (e.g., software specifications), this research paper is written for those with minimal computer literacy.) Corporate Memory Systems, Incorporated's *User's Guide*[33] and *Installation Guide*[34] are excellent references for greater technical detail. However, since *CM/1*'s main strengths lie in its ability as a user-friendly electronic

brainstorming and decision tracking tool, this paper focuses more on the IBIS process using 'a' software tool. The author specifically addresses *CM/1* software use because Corporate Memory Systems, Incorporated, has displayed foresight in recognizing the value of enhancing the group problem solving and electronic brainstorming processes through the use of both single computer and network software. *CM/1* is also the only known commercial software product which uses the IBIS methodology. *CM/1* software works on a stand alone system, as well as on a network. Stand alone, the traditional group can meet and use *CM/1* on a single computer to brainstorm their problem together. This single user approach is enhanced if a large screen monitor or display is available. On the network, there is no logical limit to the number of people who can participate in the problem solving process using *CM/1*. In fact, geographically separated users can work on the same problem simultaneously and see each others' inputs, real time, as they occur. In other words, the system acts as a virtual whiteboard; multiple users sharing the same work area in cyberspace. The author provides examples later in this research of both stand alone and network uses of *CM/1*.

CM/1 offers users the ability to see and/or print their problem in graphic tree (tree diagram with meaningful symbols and links in the form of a pictorial map view; see Appendix B) or hierarchical text (see Appendix C) form. (**Note:** Because ACSC has no *PostScript* printing capability users have two options for printing map views. The first option is to fill out a work order and request printing through Maxwell Air Force Base's Base Reproduction Center, Gunter Annex. The second option is to accomplish the following steps. First, the user must copy the desired *CM/1* map view to the *Windows*

Clipboard and paste it into another applications software program (e.g., *Power Point*). From here the user has some limited editing capability to produce a printed copy of the map. The quality of these map views is sufficient for most user's needs. In fact, this is the method the author used for all the map views located in the appendices of this research paper.) To continue, physically separated users can solve problems and communicate the fact they have added new ideas if working in the *CM/1* network configuration. New ideas are automatically advertised through *CM/1*'s use of color coding nodes and/or manually, via electronic mail. The author presents some elaboration of the slightly more complex features of *CM/1* later in this paper, but the focus remains its basic functions.

Stop and reflect for a moment on the number of meetings you are asked to attend. In many cases, the group wastes a lot of time rehashing old ideas and participating in confusing side-conversations. As an example, imagine you are tasked as a member of a tiger team or process action team to solve a high visibility problem. Typically, your team leader presents the problem at the initial meeting. You brainstorm the number of important issues you have time for and then agree to meet once a week for the next 3 months to solve the problem by your boss' deadline. Think about the time you would save and the higher quality decision you would reach if you could brainstorm solutions around your own schedule. You would spend as much or as little time brainstorming, dependent on how important the issue was to you and the expertise you bring to a particular problem. Groups could physically meet less frequently and save these meetings for making actual decisions based on less time-constrained analysis. Equally important, group members would not have to wait until the weekly meetings, which may conflict with their

schedule, to add valuable information and seek needed inputs from their colleagues. While many features exist in *CM/1* to further add to the 'meetingless' brainstorming process, this research will concentrate on the basic functions required to get a group started and on the road to more effective and efficient problem solving.

***CM/1* Use.** The author's research shows *CM/1's* use has been limited at this point to predominantly the single user version, or stand alone operation. In other words, *CM/1* has been used for group problem solving in only two ways; as a tracking device and as an electronic chalkboard. As a tracking device, an individual simply tracks the group brainstorming process and then presents the results to the group later in the brainstorming process or after it is finished. As an electronic chalkboard, a facilitator or group leader projects all member inputs to the entire group through some form of overhead presentation media as brainstorming occurs. Lieutenant Colonel Nutz, ACSC/CAT, has used *CM/1* extensively in these capacities. In addition, he has begun using *CM/1* to help ACSC prepare a submission for the Malcolm Baldrige National Quality Award and in preparing the school's unit history. Lieutenant Colonel Nutz and the author met with the leader of the ACSC Baldrige Award write-up team to show her how her team of over 100 people could use *CM/1* to brainstorm, track, and record their progress in the stand alone mode. (**Note:** To actually allow 100 people *CM/1* use, ACSC would have to purchase more software licenses.) Prior to conducting the main portion of his research, the author used *CM/1* and a video monitor to track a discussion and brainstorming session on the subject of *Revolution in Military Affairs* at Air University's School of Advanced Airpower Studies (see Appendix D).

The USAF Air Staff, is currently using *CM/1* in the stand alone mode to help brainstorm high level Air Force issues. The Air Staff has limited its use of *CM/1* to the single user version; in this capacity, one person simply tracks the group's problem solving/decision making efforts. The Defense Information Systems Agency is using the *CM/1* single user version in much the same fashion. Headquarters, United States Marine Corps in Washington, DC, completes the list of known DoD *CM/1* users. The Marines appear to be the only other DoD organization, in addition to this ACSC research project, using the network version of *CM/1* for interactive brainstorming.[35] While they have just begun this effort (December 1994), their experience should be an interesting one to follow in the future and a possible source of information for follow-on research. Although the author also conducted research on *CM/1's* stand alone capability, numerous users had already demonstrated its usefulness in this manner. The author's ultimate goal was to show the usefulness of the software on a computer network; group problem solving and brainstorming of ideas in cyberspace.

The reader should now have a rudimentary understanding of how a group might use IBIS methodology to solve a problem. In addition, one should also now have a basic knowledge of how *CM/1* software tracks this process. The next portion of this research further familiarizes the reader with the use of *CM/1*. Historical fact and illustration demonstrate how a World War II Army Air task group staff might have used *CM/1* software and the IBIS process had these tools and ideas existed in 1942. Expansion of the problem's solution is purposely kept at a rudimentary level. The example used should be

familiar to those individuals who have studied air war theory. The historical facts of the following scenario are discussed extensively by Air Force field grade officers at ACSC.

WWII Strategic Bombing Campaign Example. On 24 August 1942, President Franklin D. Roosevelt ordered a task group of army airmen to estimate future United States aircraft requirements for employment in WWII.[36] These airmen also began brainstorming a proposed Allied strategic bombing campaign of Nazi Germany. Although kept at a basic level for this paper, the overall issue facing the airmen would certainly be an example of a wicked problem. The pictorial map view at Appendix B and textual tree diagram at Appendix C illustrate how these army air decision-makers might have compiled their ideas using *CM/1*. *CM/1* users are able to generate both forms of printouts, map drawings and text views, for all the issues they input. The first portion of Appendix B (the upper section of the chart) depicts the period August 1942 through the US decision to discontinue the strategic bombing of crude oil targets in December 1943 due to heavy US bomber losses.[37] The second portion of the example (lower section of Appendix B) demonstrates how intelligence developments, showing the vulnerabilities of the German railway marshaling yards and the proven extended ranges of US fighter aircraft, changed the planners' decision in 1944.[38] The new decision was to resume long-range strategic bombing of oil fields and marshaling yards. While the facts are historically correct, the author in no way means to imply the limited number of issues in this example tell the whole story behind air planners' decisions on the strategic bombing of German crude oil. However, the author does mean to imply *CM/1* is sophisticated, yet friendly, enough that the planners could have used issue-based problem solving to brainstorm 'all' facets of the

WWII Allied strategic bombing campaign. With all the preceding in mind, the reader is encouraged to study the *CM/1*-generated map view (Appendix B) and hierarchical text description (Appendix C) to understand how army airmen could have used *CM/1* to brainstorm the oil targeting problem and decide on a course of action. Of particular interest to most readers should be the ease with which map views and text descriptions are compiled; thus offering the organization a historical record of the thought process involved behind all decisions. How many times have you walked into a new unit and asked why something was done a particular way? If you did not hear, "We've always done it that way!," you probably only heard part of the original rationale, and that was undoubtedly second- or third-hand at best. After weeks of discussion and the wrenching feeling that someone already invented most of this wheel long before you arrived on station, you find out one of the most important facts influencing the previous decision has changed 180 degrees. If you had the paper or electronic version of the original thought process and related decisions you could easily reexamine all previous issues quickly and comprehensively to determine the best course of action.

Description of Approach in Using *CM/1* at ACSC

Student Research Group. In the stand alone mode, employing the single user version, groups can use *CM/1* in two ways. First, a group can problem solve together using a single computer running *CM/1* software. This implementation is similar to a group using the issue-based problem solving process together on a blackboard. *CM/1* employment in this fashion is valuable even for simplex problems, but no more so than the traditional chalk and eraser method. Inputs to brainstorming are still made using the

traditional face-to-face combined group approach and subject to the same brainstorming inhibitors described in *Literature Review*, Chapter II: production blocking, evaluation apprehension, and free riding. As mentioned previously, this stand alone method is the manner in which *CM/1* has been successfully used at ACSC, AFIC, and DISA. While the software works well on simplex problems, more complex problems better utilize *CM/1's* full brainstorming capabilities. Another method, and one of the main focal points of this research, involves nominal, or individual brainstorming by group members using *CM/1* separately and later combining their individual inputs on a single computer. These combined inputs are then further discussed and refined by the group. *CM/1* is still used stand alone, but in this instance group members are allowed to nominally problem solve during part of the brainstorming process.

To test this functionality, the author needed a volunteer group with a vested interest in brainstorming ideas to produce quality decisions. The *Non-Lethal Offensive/Defensive Operations* subgroup of the *CONOPS 2010* student ACSC Research Project Group, 95-010F, volunteered to learn the basic functionality of *CM/1* and then use it to brainstorm ideas for their research project. The author spent less than 1 hour training the leader of the subgroup, Major Scott Ley, on *CM/1* use and installation of the software on his ACSC-issued 486 laptop computer. He was fairly computer literate. After some practice on his own and two additional, but relatively short meetings (10-15 minutes each), Major Ley was ready to train the other five members of his group so they could begin brainstorming. Appendix E shows a portion of the first level *CM/1* map view of their original brainstorming product. The author developed and then issued a *CM/1*

critique (see Appendix F) to each of the six team members to report their experience with the software. The author reports the results of those critiques and the group's overall experience using *CM/1* in *Data Descriptions and Analysis*, Chapter IV.

Install *CM/1* on the ACSC Computer Network. The next step in determining whether *CM/1* would be of full use to ACSC was to test its functionality on the school's computer network. A prerequisite to testing *CM/1* was successfully installing it on the ACSC computer network. This involved working with ACSC Network Operations, headed by Major Pat Stroman and assisted by Captain Ken Montgomery. Major Stroman and his staff also provided the specifics on the ACSC network architecture (Appendix G). The author explained the type configuration required and left the computer disks, *CM/1 Installation Guide*, and a *CM/1* software critique with Major Stroman. ACSC Network Operations provided outstanding support to the author throughout the different phases of this project. The author reports the results of ACSC Network Operations' installation and comments in *Data Descriptions and Analysis*, Chapter IV.

Initial Tests of *CM/1* Software on the ACSC Network. Before asking a group to problem solve using *CM/1*'s interactive network capabilities, the author wanted to perform some basic tests of *CM/1*'s overall functionality. The author has 6 years of experience writing software applications and over a year of experience in software testing. The purpose of these tests was to discover any problems which might negatively affect an ACSC faculty volunteer group's initial use of *CM/1*, thus adversely affecting their motivation. While these tests were far from all-inclusive, the author estimated they would offer a rudimentary glimpse into the software's sophistication and user friendliness. The

author performed some of the following tests alone and some with his advisor, Lieutenant Colonel Pat Nutz. The specific tests performed were as follows:

(1) response time between one user's screen inputs and the same input being displayed on another user's screen,

(2) the result of two or more users simultaneously accessing the same node (i.e., *Issue*, *Position*, *Argument*, *Decision*, etc.),

(3) *CM/1*'s forgiveness factor for operator error (i.e., recovery from accidentally deleting items, response to an illegal operator input, etc.),

(4) security of the system (i.e., password protection, user group procedures, read/write protection, etc.),

(5) the hypertext capability of linking other software applications (i.e., *Toolbook, Word, Power Point,* etc.) from within *CM/1* by executing an icon in the map view, and

(6) color code functionality showing the user either has or has not read a particular node.

The author reports the results of these tests in *Data Description and Analysis*, Chapter IV.

Faculty Group on Network. Based on the literature review, the author anticipated *CM/1*'s most valuable use would be in network electronic brainstorming. To test this functionality he identified a small working group, four volunteer faculty members, who were willing to brainstorm a relatively simplex, but still a real world, ACSC organizational problem. All four faculty members shared a single office at ACSC. Their problem dealt with finding a method to ensure curriculum books arrive in time for their

associated courses. This issue has been a recurring problem at ACSC. The group's objective was to recommended a viable solution to their superiors. Since the group did not really have a suspense from ACSC to find a solution, the author established a time limit. Therefore, the reader should not consider the group's final solution as necessarily binding. To facilitate the test, the author first added the four team members and himself as a usergroup to the ACSC computer network. Second, all four members' computer workstations, were set up on the ACSC network. Third, the author and ACSC Network Operations personnel configured each member's access to *CM/1* to allow them to work in the same *'Home Window,'* or area in cyberspace. Next, the author spent 45 minutes explaining the IBIS process and demonstrating basic, hands-on use of the *CM/1* software (i.e., logging on, creating map and list views, creating and manipulating nodes, etc.). This group also received the benefit of learning what problems the student research group encountered using *CM/1* (explained in *Data Description and Analysis*, Chapter IV). The author also explained the intended game plan for the next two meetings and emphasized some basic brainstorming rules (i.e., no idea is too crazy, never delete another member's idea, have fun with the tool, etc.). Lastly, as a result of his own network testing, the author warned the group of some potential pitfalls they might encounter while using *CM/1* on the network.

At this point the group was ready to begin brainstorming. The group held an initial combined group electronic brainstorming session lasting 30 minutes. Using *CM/1* in the network mode, all four members simultaneously worked in the same common electronic work area in cyberspace; they used *CM/1* as a virtual whiteboard. At this meeting the

group established several positions, regarding the book problem, from which to further individually brainstorm. Additional individual brainstorming was to take place using the nominal group approach. The author attended the initial meeting and answered technical questions on *CM/1* and basic questions about the IBIS process. At the conclusion of this meeting, the group agreed to each do nominal brainstorming during their free time over the next 8 days. They were to build on the original issue, as well as their fellow team members' future inputs. The reader can view the result of their initial electronic face-to-face combined group brainstorming session in the map view at Appendix H. The group only generated a few ideas, but this preliminary map served as a good jumping off point for further development of the issue. Each of the four group members was given a *CM/1* critique (see critique questions in Appendix F) to complete and asked to return it to the author after their final meeting. At the end of the 8 days, the group held its second, and last, meeting where it reviewed all the information and made its decision. The group took approximately 15 minutes to arrive at a decision during this final meeting. The results of the faculty group's experience and comments are outlined in *Data Description and Analysis*, Chapter IV.

Summary

This chapter discussed the author's methodology in further educating the reader on the use of *CM/1* and issue-based decision making. Further, the author presented his overall approach to testing the functionality of *CM/1* software at ACSC in several different respects: studying a student research group using the nominal brainstorming approach, installing *CM/1* on the ACSC computer network, initially testing *CM/1* on the

network, and studying a faculty group using *CM/1* for combined and nominal group electronic brainstorming on the ACSC network.

IV. Data Description and Analysis

Introduction

With all tests complete, the author was ready to report his findings. This chapter discusses the results obtained using the analysis methods described in *Methodology*, Chapter III. The author presents the results of all *CM/1* tests conducted: stand alone group brainstorming, network installation, network software check, and network group brainstorming.

CM/1 Test Results

Student Research Group (*CM/1* Stand Alone) Results. Overall, the six members of the research group expressed a positive experience using *CM/1* in their project. *CM/1* map views of their effort are at Appendix I and the text version output of these same maps is at Appendix J. The group used the same approach described earlier in *Methodology*, Chapter III. After they had brainstormed their initial issue using *CM/1*, the group physically dispersed to nominally brainstorm different non-lethal operations areas. Subsequently, each individual's inputs were then consolidated into one *CM/1* data file. The group then brainstormed this product to further develop and build on ideas until they settled on the final version at Appendices I and J. The group used the map views and text outputs they generated in *CM/1* to write-up their research project. In addition, because of the assistance *CM/1* outputs lend to understanding a group's basic logic flow, the student group elected to include map and text view outputs in their final research product.

The author synopsized the following information from the student research group's *CM/1 Software User Critiques* (see Appendix F for critique questions). Four students classified the tool as "easy" to learn, while two students classified it as "medium." Group members reported the time to learn the basics of the system varied from 15-30 minutes. The leader of the group estimated his actual computer usage time of *CM/1* at 40 hours. He was also responsible for consolidating inputs, printing map and text views, and other administrative functions for the group. The remaining five members reported 2, 3, 8, 8, and 10 hours of *CM/1* computer use. Rating user friendliness of the software, three members reported "medium," two reported "fairly," and one reported *CM/1* "extremely" easy to use. All group members reported *CM/1* and issue-based decision making added value to their particular brainstorming/problem solving process. Group members identified the following positive areas where the software added to their process:

(1) added a framework for their group effort,

(2) helped get issues out in the open for discussion,

(3) consolidated all their ideas into one package,

(4) facilitated easier direction of their problem,

(5) allowed them to brainstorm separately and then easily consolidate ideas together for further analysis, and

(6) provided graphic representations and text as a permanent record of their effort.

In addition to what is mentioned above, the group listed the following as *CM/1's* strengths:

(1) ideas within the text outputs are appropriately indented and numbered to easily follow the group's thought process,

(2) the user can easily edit the text view output using any word processing program,

(3) the software allows users to easily link ideas which creates a logical flow for issues, and

(4) the tool, overall, is extremely easy to use.

The research group listed the following as *CM/1's* greatest weaknesses as well as where they experienced problems:

(1) if the user decides he would like to change the type of node he created (e.g., *Position* to an *Issue* node), there is no automatic function to handle this; the user must delete the original node and retype all the information into the new node,

(2) as mentioned previously, without a *PostScript* printer the printing process for map views becomes somewhat cumbersome, especially with complex issues, and

(3) *CM/1* does not allow the easy export of sub-levels of an issue contained in a map view. (**Note**: *CM/1* software allows building sub-levels to explore new issues and help avoid cluttering too much information in one map view. A sub-level is actually a new map view which is accessed through a single map view node at the next higher level.) Because the group was consolidating six individuals' ideas and then redistributing the consolidated product, the software forced the group to restrict all its inputs to one level. This resulted in one 'huge' map view which was a bit awkward to move within.

In addition to the group's preceding comments, they were encouraged to think of any possible *CM/1* enhancements. The group suggested the following enhancements:

(1) allow the user to split the screen to simultaneously view both the map and related text within the visible nodes, and

(2) enhance the *Arrange* function to make the most efficient use of space by repositioning more nodes within a single map view.

***CM/1* Network Installation Results.** **(Note:** The author would like to warn non-computer-type readers in advance for this short section. Unless the reader plans to install *CM/1* on a network someday, the author encourages him to skim through this section. Much of the section is unavoidably written in computer terms for network operations personnel.) Overall, *CM/1* installation on the ACSC network went fairly smooth. The author would like to commend ACSC Network Operations for an outstanding and timely performance.

The author and ACSC Network Operations personnel experienced two initial problems which were solved relatively quickly. First, the installers discovered what they thought were *CM/1* network version disks were actually stand alone version disks. Group Decision Support Systems, Incorporated, (GDSS), a value-added reseller who works with AFIC, quickly and courteously remedied this situation by sending the correct software to ACSC. Once the software was loaded, the installers experienced a problem accessing *CM/1* on the network. A short telephone conversation with a member of GDSS's team, Mr Jamie Sweat, revealed the stand alone version serial numbers were stored in error in an internal software file. These serial numbers protect the company to some extent from

illegal software pirating. Upon correcting these numbers to reflect the network version software, the problem was fixed and *CM/1* was up and running on the ACSC network. Mr Sweat and all GDSS personnel the author dealt with over the duration of this project offered and delivered professional and friendly assistance. In addition to those problems outlined above, ACSC Network Operations reported a minor error in the *CM/1* installation software. The install process misidentifies the target directory for the software by including an extra backslash in the directory name. Lastly, ACSC Network Operations reported they would like to see the *CM/1* network installation process somewhat simplified. They recommend eliminating the requirement for the installer to edit the required ***.ini*** file. They feel automating this step within the installation program will avoid potential installer errors.

Initial *CM/1* Network Software Test Results. Overall, *CM/1* showed it was a friendly and capable aid to brainstorming and problem solving. The following are the results of the author's network tests:

(1) ***Response Time*** - During 2 days of tests, the response time between one user's screen input and that same input appearing on another user's screen varied from 3-5 seconds the first day to 5-10 seconds the second test day. The author believes this difference may be attributed to overall network use; the number of users on ACSC's network at any given time. The author feels this is a reasonable delay time which should not adversely affect *CM/1* network users.

(2) ***Simultaneous Node Access*** - The author discovered a potentially annoying problem in this area. If two or more users are accessing the same map view node

simultaneously, the first user to exit the node via the *Update* function, has his input saved. The other user(s) still working in the node experience a loss of all recent inputs in that node. For instance, if you are typing in a three-paragraph explanation to a *Position* node and another user types in a three-word explanation and updates the node before you finish, you will see your explanation vanish and the three-word explanation appear in its place. This situation exists for every type of *CM/1* node.

(3) ***Forgiveness Factor*** - *CM/1* allows the user to recover from mistakes much the same way other software applications allow recovery. An ***undo*** function allows the user to restore work as it was prior to his last operation. In other words, if a user accidentally deletes a node, or even an entire map view, he can recover the node or map by using the ***undo*** function. However, if he performs any other operation (i.e., creating another node, updating a node, etc.) and then realizes he has made a mistake, it is too late to recover. Also, unlike most application programs (i.e., *Word, Power Point*, etc.), *CM/1* makes saves to its data base after each user input. Most other application software requires the user to execute a save function or set an automatic save function which periodically engages to save a user's data. On the positive side, *CM/1's* constant data saving precludes losing information (i.e., network crashes, personal computer problems, power outages, user errors). On the negative side, if the user has started a new session and decides he does not like what changes he has made, he is stuck with what he is looking at in the map view. However, this is not an insurmountable problem. Even a beginning user can learn to quickly and easily make copies of entire map views if he feels the preceding may be a problem; of course the user can only copy single-level maps as

mentioned previously. *CM/1* provides descriptive and friendly error messages on screen when the user is attempting to perform an illegal function (e.g., trying to link logically incompatible nodes together; *Argument* node to a *Reference* node). Overall, *CM/1's* forgiveness factor is more than reasonable.

(4) ***System Security*** - The author found no problems with *CM/1's* provisions for ensuring a secure system. Password, user group procedures, and read/write permission controls all worked as advertised. The author conducted no tests on whether the *CM/1* system could secure classified data and makes **no claims**, positive or negative, in this area.

(5) ***Linking Other Software Applications*** - This impressive feature in *CM/1* allows hypertext functionality and worked as designed; the author linked *Word, Power Point,* and *Toolbook* applications to *CM/1* maps. The author cautions users to ensure all group members can link to referenced drives. As the author realized while testing, the rest of the user group does not have access to your ***c:*** drive (internal hard drive).

(6) ***Color Coding*** - This feature also worked as advertised and appears quite useful for network *CM/1* use. Briefly, nodes appear in different colors depending on whether a user has or has not yet read a node since the last time it was updated.

Faculty Group (*CM/1* Network) Results. All four faculty members stated overall, *CM/1* added value to their brainstorming/problem solving effort. A *CM/1* map view of their final solution is at Appendix K, while the *CM/1* text description of the same solution is at Appendix L. The group used their pre-planned approach which was previously described in *Methodology*, Chapter III, and held only two face-to-face meetings. At the first meeting they spent a few minutes getting acquainted with using

CM/1 and asking this author technical questions about the *CM/1* software. During the last 15 minutes of the meeting the group discussed and input their idea of what the problem statement was and some basic positions from which to start nominal brainstorming. The author observed the following during the group's initial *CM/1* network brainstorming session:

(1) ***Energy, Excitement, and Exploration*** - This highly motivated group spent a few minutes together on the system exploring some of the system's functionality (i.e., sending mail, creating and moving nodes, exploring the menu options, etc.).

(2) ***Competition to Input Data*** - The group displayed normal face-to-face combined group brainstorming behavior. There was no one individual in charge, so members competed with one another to have their ideas heard and accepted as input. Because any member could make an input at any time, there was a little confusion as members suddenly saw nodes and links appear and then move around on their screens. In a few instances there was some duplication of ideas input to *CM/1*.

As planned, the face-to-face group dispersed and performed nominal brainstorming on their own for the next 8 days. Group members worked in *CM/1* at different times and in some cases at the same time. While some members preferred making inputs early in the morning before class hours began, others preferred to work in *CM/1* between classes, at lunch, or after normal duty hours.

During the second and final meeting, which lasted only 15 minutes, the process was smooth and productive. Because all members had reviewed all inputs to their *CM/1* problem prior to the meeting, they were all prepared to make their decision. The group

made only cosmetic changes to their previous *CM/1* inputs before making an unanimous decision on what their recommendation would be to their superiors on the ACSC book problem. For those interested, their final decision is in both their *CM/1* map (Appendix K) and text (Appendix L) listings.

The author has consolidated the following information from the faculty members' *CM/1 Software User Critiques*. Members reported the time required to learn the basics of *CM/1* at between 10 minutes and 1 hour. Two group members stated *CM/1* was of "medium" difficulty to learn, while two members felt *CM/1* was "easy" to learn. All four members reported their actual computer usage time of *CM/1* at 2 hours. Three users classified *CM/1* as "fairly" user friendly, while one said *CM/1* was "extremely" user friendly. All four group members mentioned *CM/1* and issue-based decision making enhanced their brainstorming/problem solving effort. One member's opinion was that *CM/1* eliminated the need for a secretary and facilitator at meetings. Another group member felt *CM/1* helped avoid stifling anyone's creativity. Group members expressed praise for *CM/1* on its ability to maintain a historical accounting of ideas and the rapidity of including new ideas and thoughts into the creative brainstorming process. In addition to what is mentioned above, the group listed the following as *CM/1 's* strengths:

(1) puts everyone's ideas into one, easily transportable medium,

(2) acts as one continuous electronic record, which could become cumbersome if tracking a complex problem on paper, and

(3) allows networking of ideas over time and distance.

In addition, the group listed the following as *CM/1's* weaknesses or areas where they experienced problems:

(1) too easy to take credit for or delete others' ideas (**Note**: *CM/1* only records the name of the last user to update a particular node),

(2) arranging nodes (map icons) on one user's screen unavoidably moves them on another's screen; this caused some confusion,

(3) two or more users can access a node simultaneously, but only one user's inputs are saved, and

(4) although one can reposition his view, the screen view at any one time is limited due to the standard ACSC computer and monitor settings.

In addition to suggestions listed above, the faculty offered the following ideas on how to enhance *CM/1's* capabilities:

(1) only allow the originator of a node, link, or map the capability of deleting it,

(2) provide tracking of who has made inputs to nodes instead of just listing the last person to make an update,

(3) include a zoom capability to maximize or minimize the amount the user sees on his screen depending on his own preference,

(4) supply more on-line user help in the help menu, and

(5) provide some type of weighting factor and voting method within the *decision* node (e.g., the boss might be given a larger weighting factor associated with his ideas than his subordinate's ideas).

Summary

This chapter discussed the results of the four main tests the author conducted on *CM/1* software at ACSC. Those tests included examining *CM/1* functionality and use by a student research group in the stand alone mode, network software installation, initial network software tests, and faculty group use in a network configuration.

V. Findings and Conclusions

Introduction

Having completed his research tests and analysis, the author was ready to sum up his effort. This chapter discusses the author's opinions, conclusions, and recommendations. First, the author examines his initial hypotheses in light of the research findings. Second, the author lists his conclusions regarding *CM/1* software and issue-based decision making. Here, he offers a number of suggestions for enhancing the software tool. Third, the author recommends a number of groups and organizations that would benefit by using *CM/1* or a similar electronic brainstorming tool. Fourth, the author presents some ideas for possible future research. Lastly, the author delivers his concluding remarks.

Research Hypotheses

Hypothesis I: Electronic brainstorming software, specifically *CM/1*, performs with current ACSC computing capability; individual personal computers, working both stand alone and as part of a network.

The author's research confirmed *CM/1* software performs on ACSC computer equipment, both stand alone and in a network configuration. Users working with the single user version, stand alone mode, as well as users configured to run on the ACSC computer network were able to use all *CM/1* functions as advertised by Corporate Memory Systems, Incorporated.

Hypothesis II: *CM/1* brings a positive, value-added capability to ACSC faculty and students; enhancing ACSC as both an organization and higher learning institution.

All users participating in the author's tests reported *CM/1* added value to their brainstorming/problem solving process. The faculty network test reasonably indicated ACSC can use *CM/1* to help solve organizational and curriculum problems in cyberspace. This electronic decision-making capability has the potential to both improve the quality of group decision making and lessen the amount of time required to make such high quality decisions at ACSC. Using *CM/1* to conduct brainstorming during their own research, the student research group showed the value and ease of using the tool in an educational setting.

Conclusions

Overall, the author believes *CM/1* adds value to any problem solving/brainstorming process at ACSC or any other professional organization. The school should, at a minimum, find a way to put all 15 *CM/1* software site licenses to good use around ACSC.

In this author's opinion, redesigning the following areas in the *CM/1* software would make it an even more versatile tool; they are factors ACSC should at least consider to ensure the software is a good 'fit' for the school before deciding to purchase any more site licenses:

(1) **Allow printing on a less expensive, more common printer.** *CM/1* should be redesigned to either print map views directly on a laser or dot-matrix printer, or put the map views out in a format that is easily brought into another application program (i.e., *Word*, *Power Point*, etc.) for manipulation before printing. The current short-cut method

used by the author throughout his research takes unnecessary extra time and does not produce as high a quality printout as that of a direct printing function.

(2) **Allow import and export of multi-level map views.** One of the most advantageous features of *CM/1* is the ability to break sub-problem areas down by taking them into subsequent sub-levels. This ability to create sub-levels allows users to keep from cluttering up one map view screen with too much information. Without the ability to import and export sub-levels the user loses this added capability.

(3) **Allow only one user access to a node at one time.** The current potential to wipe out another user's data is a formula for possible frustration and confusion. Only one user should be allowed in a particular node at one time; other users should be locked out. If this item is redesigned, the author suggests displaying a message to the user locked out telling him who is using the node and when they first started accessing it. This information would allow the person waiting for access the option of calling the person using the node to discuss the possibility of releasing it (e.g., someone may have accessed the node, but then started working on something else in the office). Another option might be to allow the user to create a type of holding node to store his idea. Later, when the node is released, he would have a record of his idea to transfer in from the holding node.

(4) **Allow anonymous inputs by group members.** As shown through previous research discussed in *Literature Review*, Chapter II, offering group members anonymity increases brainstorming productivity. Evaluation apprehension is significantly reduced when group members are not worried about rejection or ridicule by the rest of the group.

The following suggestions are other areas the author feels would enhance the software, but are bearable in the current version of *CM/1*:

(1) **Include the ability to change a node type.** Currently, the user must delete the old node and retype all the information in the new node.

(2) **Only allow the group leader and the originator of a node icon or map view permission to delete it.** Since all ideas are actively solicited in brainstorming, no group member should have the right to delete another member's ideas. This precaution would preclude the temptation of anyone deleting what they feel is an inferior idea.

(3) **Only give permission to create a *Decision* node to selected users.** In most organizations only certain people have the authority to make decisions anyway. The authority to make decisions could vary from issue to issue; *CM/1* could control this right much the same way it controls who has read/write permissions.

(4) **Include a *Zoom* function to make better use of screen space.** Users may prefer to work with a smaller or larger total screen view.

(5) **Create a tracking feature which holds a historical record of who has been in each node and when.** Provided group members are not working anonymously, tracking this data could help team leaders and managers. This information could be useful in determining who showed more interest in what area of the problem and act as a more accurate yardstick in measuring actual member participation.

(6) **Add a voting method, possibly with weighting factors for users, to *Decision* nodes.** All group members are not created equal. The boss probably has a larger say in the decisions made than his subordinates. Under this scheme, if equal status is

desired, the *CM/1* systems administrator could set all members' weights to one; if member status is not equal, the system administrator could set the appropriate weights. The *Group Systems* software offered some impressive capabilities in this area.

(7) **Create a function to allow a split screen, where the user can see a map view on one side and the text descriptions of the same map on the other side.** This feature would be a quick and convenient method for users to review both a selected on-screen map view and the associated text. Otherwise, under current software capabilities, the user must click on, or highlight, each node to read the associated text inputs one at a time.

Recommendations

Even with the limitations the author mentioned, *CM/1* is a valuable software tool and ACSC may seriously want to consider purchasing more site licenses. At a bare minimum, the senior leadership and selected other faculty should take advantage of the current 15 site licenses and begin enhancing their own decision making abilities in cyberspace. The following suggestions are the author's recommended possible uses of *CM/1*, or any similar software product, at ACSC for both students and faculty:

(1) **Lesson development** - Faculty use of *CM/1* on the ACSC network is an ideal way to create new and update existing lesson plans within and even between curriculum departments. A department is busiest during the time it is presenting its block of instruction to students. *CM/1* offers a quick method of getting into an existing graphic map and/or text record of the lesson plan's development and adding brainstorming ideas of how to improve it for the next class. Faculty members could add suggestions at their

convenience. Later, the whole department could review these suggestions after their block is completed and they have more time to soak in all implications of suggested changes.

(2) **Curriculum integration** - If all lesson plans had associated *CM/1* map and text views stored on the network, curriculum departments could easily see where common overlaps occur in the ACSC curriculum. Not only would the logical flow of the lesson plan be apparent, but the rationale for putting the specific material in a particular lesson plan would be included.

(3) **Unit history development and record** - ACSC faculty could access and work on any relevant portion of the unit history at any time. In addition, they could review updates by fellow faculty members faster because they wouldn't have to wait for the next physical meeting or marked-up paper copy to come across their desk. This electronic version of the history would act as a solid starting point in the next year's unit history development.

(4) **Student brainstorming in curriculum scenarios** - There are many instances where ACSC students are asked to form groups to brainstorm solutions to airpower scenarios. As an example, students currently perform strategic and operational nodal analysis through two ACSC *Toolbook* software applications, *STRATEX* and *OPEX*, respectively. A good deal of the students' time in these hypertext applications is spent brainstorming *centers of gravity*. If *CM/1* were available to students on the ACSC network, they could easily use it to brainstorm and then take their results into the previously mentioned nodal analysis programs. ACSC faculty personnel could even

update these *Toolbook* programs to allow a direct jump from *STRATEX* or *OPEX* into *CM/1*.

(5) **Faculty committee problems or tiger teams** - The author has already alluded to *CM/1's* value in this area; he feels this is where *CM/1*, or any similar issue-based decision making software tool, offers the most utility to an organization. As previous statistically sound research, as well as this author's non-scientific research indicate, group members using *CM/1* on a network can produce superior results to traditional methods of problem solving. Group members benefit by physically meeting less frequently, gaining access to one another's inputs faster, and producing higher quality and quantity of brainstorming ideas.

(6) **Distance learning through problem solving** - Using *CM/1* over *Internet* would allow brainstorming between ACSC and other organizations. Specifically, the non-resident ACSC program might find this type of application valuable. What better way to include a higher volume of Air Force, or even sister service officers in ACSC's in-resident curriculum? As an example, ACSC in-resident officers could brainstorm in-resident curriculum exercises (i.e., *STRATEX*, *OPEX*, etc.) with non-resident correspondence or seminar officers. The networking potential with outside organizations is unlimited; within Air University's academic circle or even over *Internet*.

(7) **Expanded *CM/1* use in the stand alone mode** - Even without using *CM/1* on the network, the software tool has shown its ability to add value to any group brainstorming process. In addition to the stand alone methods Lieutenant Colonel Nutz and this author have used, there are many more uses for the tool at ACSC. For instance, a

trained *CM/1* user could track initial research group meetings. At the end of the research brainstorming meeting, the *CM/1* tracker could hand the group both a pictorial map and text view printout of their session. Further, ACSC faculty could employ this method during any of their meetings. The *CM/1* tracker could replace the secretary or recorder and produce instant meeting minutes.

Most of the above recommendations for ACSC are also applicable to any military or DoD organization with appropriate networking capability. In particular, organizations where personnel are required to attend a large number of group problem solving meetings would benefit from *CM/1* or similar issue-based decision making software. Other educational institutions (i.e., School of Advanced Airpower Studies, Air Force Institute of Technology, etc.) could benefit in the same ways shown at ACSC.

As mentioned earlier, and as a final reminder to the reader, Corporate Memory Systems, Incorporated, recently changed the name of their *CM/1* software package to *QuestMap*. They are expected to release subsequent software versions under this new name.

Future Research

The author conducted some preliminary tests at ACSC focusing on small groups and relatively simplex issues for brainstorming/problem solving. The results indicated no reason to believe *CM/1* will not function at ACSC for large groups and/or in the study of more wicked problems. However, the following areas are reasonable candidates for future follow-on research: tests on larger groups using *CM/1* on the network, tests with other organizations connected to the Air University local area network, tests over *Internet's*

World Wide Web, group brainstorming of more wicked/complex problems, and tests of similar existing or emerging electronic brainstorming/problem solving software (e.g., *Group Systems V* or *Group Systems for Windows*) on the ACSC computer network.

Concluding Remarks

Electronic brainstorming not only produces superior results to traditional methods, but it also makes sense in today's fiscally constrained military. With a shrinking force, the US military must find better ways to do more with less. Electronic brainstorming satisfies, and in most cases exceeds the purposes of many of the meetings we now attend. The potential savings in travel costs alone make electronic brainstorming (perhaps in concert with video teleconferencing) a viable alternative for physically separated working groups. While the parochial view of meetings will linger on for those unwilling to embrace change, tomorrow's leaders have already begun meeting to solve complex problems in cyberspace.

As military professionals, our job is to be ready to fight and win. Our **O-O-D-A Loop** must perform better and faster than our opponent's.[39] Electronic brainstorming offers us the ability to maintain that edge.

Summary

This chapter summarized the significant results of the author's research. The chapter began with a discussion of the author's original hypotheses statements in relation to his research findings. Next, the author stated his conclusions and recommendations. And finally, the author closed with his suggestions for possible future research and some concluding remarks.

[1] Gary A. Vincent, "In the Loop: Superiority in Command and Control," *Airpower Journal* 6, no. 2 (Summer 1992): 17.
[2] Srikumar S. Rao, "Meetings Go Better Electronically," *Financial World* 167, no. 7 (14 March 1995): 72-73.
[3] Thomas Halper, *Foreign Policy Crisis* (Columbus: Charles E. Merrill Publishing Company, 1971), 30-33, 40-41.
[4] Ramon J. Aldag and Sally R. Fuller, "Beyond Fiasco: A Reappraisal of the Groupthink Phenomenon and a New Model of Group Decision Processes," *Psychology Bulletin* 113, no. 3 (May 1993): 541.
[5] Greg Pastrick, "Brainstorming Software, A Free Flow of Ideas," *PC Magazine* 10, no. 8 (30 April 1991): 330.
[6] Robert G. Walker, "Virtually Interactive Brainstorming," *Industrial Engineering* 26, no. 9 (September 1994): 20-21.
[7] Department of the Air Force, "The Squadron Officer Course," *Air University Quarterly Review* 6, no. 3 (Fall 1953): 104.
[8] Aldag and Fuller, 542-543.
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[10] Ibid., 543.
[11] Alan R. Dennis and Joseph S. Valacich, "Computer Brainstorms: More Heads Are Better Than One," *Journal of Applied Psychology* 78, no. 4 (August 1993): 531-532.
[12] Corporate Memory Systems, Inc., *The IBIS Manual, A Short Course in IBIS Methodology*. Company Handout. Austin TX: Corporate Memory Systems, Inc., 1992: 1.
[13] Ibid., 1-3.
[14] Ibid., 3.
[15] Ibid., 4-5.
[16] Joseph S. Valacich, Alan R. Dennis, and Terry Connolly, "Idea Generation in Computer-Based Groups: A New Ending to an Old Story," *Organizational Behavior and Human Decision Making* 57, no. 3 (March 1994): 448-463.
[17] Pastrick, 333-334.
[18] Ibid., 334-338.
[19] Ibid., 338-339.
[20] Karen A. Brophy, "Idegen++ Helps PC Users Spark Creative Thinking," *Infoworld* 14, no. 28 (13 July 1992): 93.
[21] Allen Bergles, Ventana Corp., Tucson AZ, telephone interview, 22 March 1995.
[22] Ventana Corp., "Group Systems for Windows, The Power to Achieve," company brochure, Tucson AZ, no date.
[23] Corporate Memory Systems, Inc., *CM/1 Users Guide, Version 1.1 (Second Printing)*. Austin TX: Corporate Memory Systems, Inc., February 1994: 2-1 - 2-7.
[24] James C. Sweat, Principal, Group Decision Support Systems, Inc., Washington DC, telephone facsimile message, 16 March 1995.
[25] Donald D. Spencer, *Computer Dictionary* (Ormond Beach FL: Camelot Publishing Company, 1993), 299.
[26] Ibid.
[27] Regina White, Group Decision Support Systems, Inc., Washington DC, telephone facsimile message, 15 April 1994.
[28] "The Squadron Officer Course," 104.
[29] Corporate Memory Systems, Inc., *The IBIS Manual*, 1.
[30] Ibid., 1-3.
[31] Corporate Memory Systems, Inc., *CM/1 Users Guide*.
[32] Corporate Memory Systems, Inc., *The IBIS Manual*, 1.
[33] Corporate Memory Systems, Inc., *CM/1 Users Guide*.
[34] Corporate Memory Systems, Inc., *CM/1 Installation Guide, Version 2.0 (First Printing)*. Austin TX: Corporate Memory Systems, Inc., September 1994.

[35] James C. Sweat, Principal, Group Decision Support Systems, Inc., Washington DC, telephone interview, 16 March 1995.
[36] Maj Gen Haywood S. Hansell, Jr., *The Air Plan That Defeated Hitler*, (Atlanta GA: Higgins-McArthur/Logino & Porter, Inc., 1972), 102.
[37] Ibid., 219.
[38] Department of the Air Force, *The United States Strategic Bombing Surveys*, (Maxwell AFB AL: Air University Press, October 1987), 18, 31, 39.
[39] Vincent, 17.

Appendix A: Electronic Brainstorming Software

Brainstormer.[1] ***Brainstormer***, Version 2.21, by **Soft Path Systems**, while relatively simplistic and cheap, $75 per site license, allows users to focus their random thoughts by freeword association to produce viable ideas and options. Specifically, the software guides one through the first steps of problem solving; problem definition and goal setting. Although not elegant or sophisticated, *Brainstormer* requires less than 1.44 megabytes of storage space. *Brainstormer* works the user through three modes: interest, theme, and probe. Groups can generate many ideas, but the software does not lead them through a discovery process, nor does it carry them through to a problem solution. All associations created throughout the process are displayed and printed in a text format only (i.e., all words, no pictures). *Brainstormer* is a stand alone program; the group makes inputs through only one computer. Thus, it does not act as a virtual whiteboard where multiple computer network users all make inputs, in many cases simultaneously. One may think of a virtual whiteboard as a common working space for computer users in cyberspace. Using a virtual whiteboard, all participants can update the same data and see all new inputs real-time, as they occur. Either a nominal group user working alone or, as mentioned previously, a combined group of users working face-to-face employ a single computer to make inputs.

IdeaFisher.[2] ***IdeaFisher***, Version 3.1, by **Fisher Idea Systems, Incorporated**, is considerably more sophisticated and requires 7 megabytes of storage space. It is also more expensive, $595 a site license. *IdeaFisher's* vast database allows

the program, through free association based on the user's inputs, to function similarly to the way our own human creative thought processes work. By prompting and questioning, the software leads the user(s) through all steps of the problem solving process, soliciting and encouraging brainstorming inputs along the way. *IdeaFisher*, unlike *Brainstormer*, also includes a full range of editing and file management capabilities (i.e., linking other applications, exporting files, generating formatted reports). All capabilities however, are limited to text displays and printouts. *IdeaFisher* is also a stand alone program; one or more users make inputs to an application program on a single computer.

The Idea Generator Plus.[3] ***The Idea Generator Plus***, Version 3.1, by **Experience in Software, Incorporated**, could be considered in the medium range of sophistication. The software is priced at $195 per site license and requires less than 1.44 megabytes of storage space. Based on a more narrative approach to brainstorming, *The Idea Generator Plus* takes the user through a series of exercises to zero in on the problem and better focus goals. Main menus lead the user through a process: a *Problem Statement* exercise, seven idea development exercises during *Idea Generation*, a prioritization of ideas phase during *Evaluation*, and an opportunity to produce a summary of your brainstorming session in the *Reports* section. The software only displays text by way of screen and hard copy output. *The Idea Generator Plus* also only operates stand alone.

Idegen++.[4] ***Idegen++***, by **FinnTrade**, is perhaps a bit more sophisticated than *The Idea Generator Plus*, but described in an amazingly similar manner. Although their names also look quite similar, each is produced by different California companies.

Idegen++ sells for $495 a site license. Karen Brophy, who reviewed this software, does not list the program's size. The process starts with an *Idea* module which helps the user clarify the problem and begin listing possible solutions. Within this module, the user can execute three subfunctions: *General Principles* allows one to define goals and identify who needs to be involved in the problem solving process, *Modification Checklist* inspires the user to tackle the problem from new angles, and *Distant Models* provides key words to facilitate the user's creative sense in developing possible solutions. After collecting a sufficient number of possible solutions, the user enters the *Evaluation* module to select the best solution. Lastly, the user can enter the *Sort and/or Print* modules to complete his session. Output is only available to the user in text format and the software, like the three previous applications, only operates stand alone.

Group Systems V* and *Group Systems for Windows*.**[5] ***Group Systems V, Version 1.1 and, the recently developed *Windows* version of this software, ***Group Systems for Windows***, Version 1.0, by **Ventana Corporation**, are extremely sophisticated network electronic brainstorming and electronic meeting support software packages. While the basic software was produced at least 5 years ago, the *Windows* version is less than a year old. The author presents the following information on these electronic meeting support software tools. *Group Systems V* and *Group Systems for Windows* both support face-to-face combined group and nominal group electronic brainstorming. The software also supports numerous other functions to further aid group members to organize and track their own ideas in addition to working with others. *Group Systems V* and *Group Systems for Windows* were designed to operate most effectively in a network environment.

While *Group Systems V* and *Group Systems for Windows* function admirably in a stand alone mode, using them in this capacity would be like asking Picasso to paint your house; he would do a fantastic job painting the trim and gutters, but what a misuse of a valuable resource. The software was originally designed to work on a *DOS* system, however the company released a basic *Windows* version in the fall of 1994 and expects to release its advanced *Windows* version in the near future. The *Windows* version, as already mentioned above, is called *Group Systems for Windows*.

The *DOS* version of *Group Systems V*, with its basic and advanced tools, is priced at $1,200 to $1,300 per user license (General Services Administration rate), with a 20-user (users in this case are considered 'simultaneous' users) minimum purchase. This package includes 60 'office participant' slots, of which any 20 of these 60 participants can use the software simultaneously. This *DOS* based package also includes a 2-day training course for six users, a 1-year maintenance contract, and free subsequent software upgrades.

The *Windows* version, *Group Systems for Windows*, with its basic tools, is priced at $582 per user license (again, General Services Administration rate), with a 10-user minimum purchase. Ventana Corporation plans to release the advanced tools *Windows* version in the fall of 1995. The basic tools package includes 30 'office participant' slots, of which any 10 of the 30 participants may use the software simultaneously; this is the same three-to-one ratio as the *DOS* version between total office participants and simultaneous participants. The *Windows* package also includes a 2-day training class for

one in every ten purchased simultaneous users, a 1-year maintenance contract, and free subsequent version upgrades of the software.

Group Systems V and *Group Systems for Windows* claim to assist problem solvers achieve their objectives in as little as one-tenth the time of traditional approaches. Both systems offer group members the option of making anonymous inputs during brainstorming or choosing to associate their names with their ideas. The basic and advanced tools in the upcoming *Group Systems for Windows* version contain the following functions and capabilities:[6]

(1) **Agenda**, the heart of the entire system, is where group users create, share, and analyze ideas. Subfunctions include *Electronic Brainstorming, Categorizer, Vote, Commentor,* and *Group Outliner*.

(2) **People** provides information, even graphic portraits, on group members.

(3) **Event Monitor** informs members of new **Agenda** activities.

(4) **Personal Log** keeps track of the individual member's activities during meetings.

(5) **Briefcase** holds commonly used software applications, including a calculator, calendar, and clock.

(6) **Opinion Meter** employs one of three different polling methods to quickly solicit other group members' opinions.

(7) **Handouts** makes other files (i.e., word processing, spreadsheets, etc.) available to other group members.

(8) **Whiteboard** is a common, free-form drawing area in cyberspace available to all group users.

(9) **Survey** enables group members to send out quick surveys or questionnaires over the local area network.

(10) **Enterprise Modeler** allows group members to apply reengineering principles in evaluating organizational processes.

This author, along with his research advisor, received a demonstration of the capabilities of *Group Systems for Windows*, basic version, software from Ms Brenda Wells, Office of the Secretary of the Air Force, Financial Management Budget Management Automation - South (SAF/FMBMA-S), Maxwell Air Force Base, Gunter Annex, Alabama. Ms Wells is currently using the software to help develop a training program for the Automated Budget Integrated Data Environment System (ABIDES). Working with groups of budget experts, she facilitates face-to-face electronic network brainstorming sessions. (**Note**: Ventana Corporation did not list the price of this upcoming advanced tools *Windows* version.)

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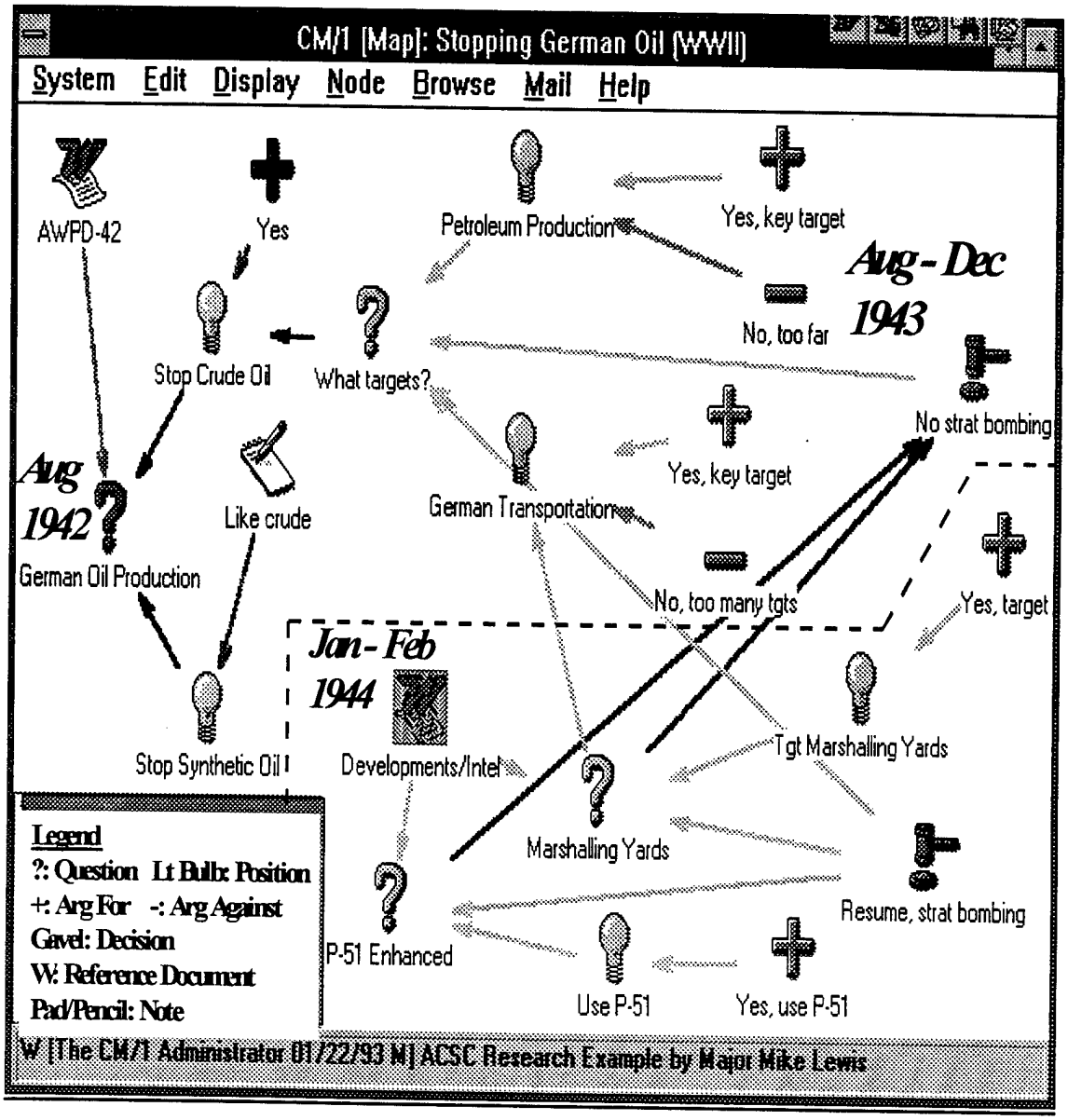
[1] Greg Pastrick, "Brainstorming Software, A Free Flow of Ideas," *PC Magazine* 10, no. 8 (30 April 1991): 333-334.
[2] Ibid., 334-338.
[3] Ibid., 338-339.
[4] Karen A. Brophy, "Idegen++ Helps PC Users Spark Creative Thinking," *Infoworld* 14, no. 28 (13 July 1992): 93.
[5] Allen Bergles, Ventana Corp., Tucson AZ, telephone interview, 22 March 1995.
[6] Ventana Corp., "Group Systems for Windows, The Power to Achieve," company brochure, Tucson AZ, no date.

Appendix B: WWII Strategic Bombing Campaign Map View



Appendix C: WWII Strategic Bombing Campaign Text View

Stopping German Oil (WWII) (Example by Major Mike Lewis, ACSC '95)

1 *Question* : **German Oil Production**
German crude oil production is allowing it to keep its air force, submarines, and ground forces mobilized; POL also runs their industry which supports military and civilians. German oil is a key Center of Gravity in its ability to wage war. Crude oil is used to provide power for industry and fuel for tanks, trucks, and submarines. Synthetic oil and petroleum products, produced from coal, provide aviation fuel for the German Luftwaffe, as well as vital POL for their industrial base.

1.1 *Reference* (Related To Question 1): **AWPD-42 (Air War Plans Division - 42)**
This would be in an electronic file the reader had access to. The plan was adapted and refined from the AWPD-1 of 1941. AWPD-42 was a response to President Roosevelt's request for a plan on 24 August 1942 ("The Air Plan That Defeated Hitler", pp 102). Planning for strategic bombing by Army Air Corps resources and force projections necessary for fighting Germany in WWII were made in this document. Particularly, targeting was discussed and the details on oil as a target elaborated.

1.2 *Idea* (Responds To Question 1): **Stop Crude Oil**
We can stop Germany from getting refined crude oil to its military and industry.

1.2.1 *Pro* (Supports Idea 1.2): **Yes**
We can stop German crude oil from getting to German military and industry. We have strategic bombers to attack the German/European landmass and hit essential targets. We can figure out the targets and we believe "the bomber always gets through." Peacetime exercises show bombers are self-defending and impossible to stop; drawback in practice (until 1943) appears to be a high casualty rate of our bomber assets during our strategic daylight precision bombing, but missions do get through.

1.3 *Idea* (Responds To Question 1): **Stop Synthetic Oil**
We can stop synthetic oil production which is processed into aviation fuel.

1.3.1 *Note* (About Idea 1.3): **Like crude**
Use similar approach as that used for stopping German crude oil. This target is not further developed in this example....

2 *Question* (Expands On Idea 1.2): **What targets?**
Specifically, what would you target to stop refined oil from getting to German military/industry?

2.1 *Idea* (Responds To Question 2): **Petroleum Production**
Petroleum production in both Germany proper and German occupied territory, Ploesti Oil Refineries in Romania, etc.

2.1.1 *Pro* (Supports Idea 2.1): **Yes, key target**
German refined oil originates from crude oil refineries within Europe. Romania and Hungary provided 1/4 of Germany's total liquid fuel consumption in 1943.

2.1.2 *Con* (Objects To Idea 2.1): **No, too far**
Allies can't attack oil fields without massive losses of aircraft and men. Bombers have the range, but no current pursuit aircraft have the same range to go along for defense. We've already

experienced high bomber and aircrew losses through 1943 (i.e., Ploesti oil field raids and Schweinfurt ballbearing factory raids.). And we've tried physical enhancements(more guns, armor protection, personnel flak jackets) to the bombers as well as enhanced formation flying (box, increased numbers, etc.), but still heavy losses.

2.2 *Decision* (Resolves Question 2): **No strat bombing**
Losses to bomber force and personnel are too high at this time to continue daylight strategic bombing of targets too far outside the range of our escort aircraft; in particular the crude oil refineries. Also, not going to target transportation to get at refined oil because it doesn't appear there are key targets we could reasonably hit and significantly affect the enemy's supply for very long.

2.3 *Idea* (Responds To Question 2): **German Transportation**
Attack German transportation system consisting of railway lines, waterways, and highways - inside and outside of Germany Proper.

2.3.1 *Pro* (Supports Idea 2.3): **Yes, key target**
We have ability to hit German transportation; railways, waterways, and highways to stop transport of refined oil products to German military/industry. (Not just oil, but all transport) RR - 70%, Waterways - 21-26%, Highways < 3% (stats from USSBS).

2.3.2 *Con* (Objects To Idea 2.3): **No, too many tgts**
Allies would have to hit too many targets to sufficiently stop refined oil from reaching German military/industry. No key points appear to exist that Allies could sufficiently damage (i.e., RR stations, bridges, tracks, harbors, piers, etc.; highway intersections, bridges, etc.) that the Germans could not quickly repair to significantly slow down oil to German military/industry.

3 *Question* (Expands On Decision 2.2) (Expands On Idea 2.3): **Marshaling Yards**
(This information was added after original decision not to target German transportation)... Target marshaling yards. Marshaling yards are the main hubs of the rail system; routes changed, cars changed, etc.

3.1 *Idea* (Responds To Question 3): **Tgt Marshaling Yards**
Intelligence has discovered that marshaling yards are the hub of the entire rail transportation system in Germany. Everything by rail passes through them.

3.1.1 *Pro* (Supports Idea 3.1): **Yes, target**
Remember, rail provides 70% of the German's total transportation needs. Time has shown the railway marshaling yards are centers of gravity, COGs, within the German railway system and they are in reasonably low enough numbers to make them a worthwhile target. In addition to stopping refined oil transport, taking out the marshaling yards will cripple 'all' rail transport. This will result in stopping civilian/military goods from being shipped, the German military unable to transport many of its personnel, and the reduction in transport of coal to industry. In particular, this reduction in coal to refineries that produce aviation fuel would be a significant blow to the Luftwaffe. Crippling of transport could result in the strategic paralysis of the entire German industrial base and military.

3.2 *Reference* (Related To Question 3): **Developments/Intel**
This document would hold facts on long-range pursuit development and other details. In addition, the results of intelligence gathering would show there were vulnerable points (Centers of Gravity) within the German railway system (i.e., the marshaling yards).

3.3 ***Decision*** (Resolves Question **3**): **Resume, strat bombing**
Based on the new evidence, resume daylight precision bombing with new extended range pursuit aircraft as escorts (P-51 and P-38).

4 ***Question*** (Expands On Decision 2.2): **P-51 Enhanced**
(This branch of the process was added as new information became available in late 1943)... In late 1943 the P-51(escort/fighter aircraft) was enhanced with additional fuel capacity (more internal tankage). Its range was effectively extended to that of our bomber aircraft. The P-38's (also an escort) range was also extended. Both are capable pursuit aircraft, but the P-51 is the better fighter for aerial dogfighting.

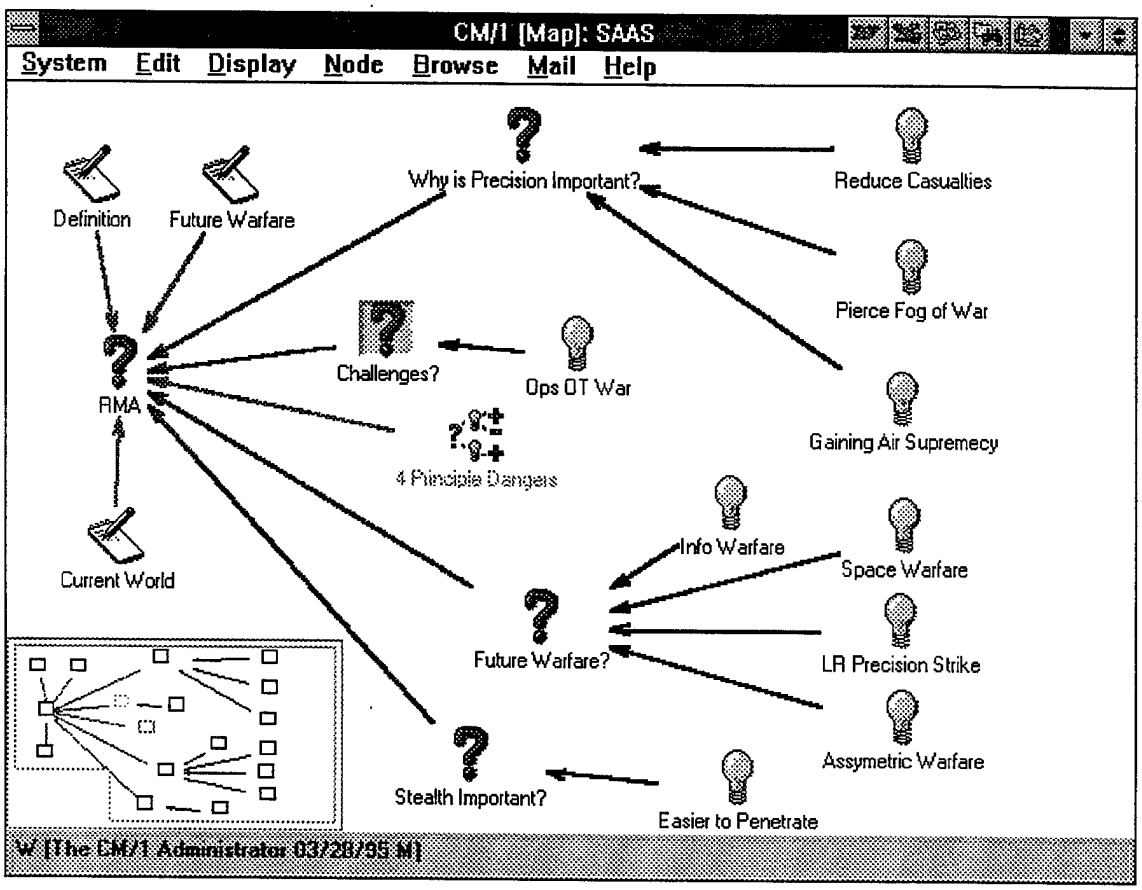
4.1 ***Reference*** (Related To Question **4**): **Developments/Intel**
This document would hold facts on long-range pursuit development and other details. In addition, the results of intelligence gathering would show there were vulnerable points (Centers of Gravity) within the German railway system (i.e., the marshaling yards).

4.2 ***Decision*** (Resolves Question **4**): **Resume, strat bombing**
Based on the new evidence, resume daylight precision bombing with new extended range pursuit aircraft as escorts (P-51 and P-38).

4.3 ***Idea*** (Responds To Question **4**): **Use P-51**
Use P-51 as escort for bombers and resume precision daylight bombing of oil fields in Rumania and Hungary.

4.3.1 ***Pro*** (Supports Idea **4.3**): **Yes, use P-51**
We now have long range escort to defend bombers and Luftwaffe fighters are less of a threat. German pilot proficiency has been reduced (attrition and less training for new pilots). In addition, Allied medium range bombing and war consumption have reduced the amount of aviation fuel available for German Luftwaffe.
Added benefit: Strategic bombing continues to bring deteriorating Luftwaffe fighter force up for aerial dogfights. Continued attrition of the German Luftwaffe fits the overall plan for air superiority prior to the Normandy invasion.

Appendix D: SAAS Brainstorming RMA Map and Text Views



SAAS Brainstorm (Tracked by Major Mike Lewis, ACSC '95)

8 Dec 94 Session at School of Advanced Airpower Studies

1 *Question* : **RMA**
Revolution in Military Affairs, MTR (Soviets)

1.1 *Note* (About Question **1**): **Future Warfare**

1.2 *Note* (About Question **1**): **Definition**
Get Col Miller's notes

1.3 *Map View* (About Question **1**): **4 Principal Dangers**
from notes

1.4 *Note* (About Question **1**): **Current World**
"All possible question(issues) for further breakup"

1.4 *Note* (About Question 1): **Current World**
"All possible question(issues) for further breakup"
Break up of the former Soviet Union
Megatrends - globalization(greater increased economic and political integration), space exploration, information revolution, proliferation(by 2003 could have 25+ countries w/ nukes, chemical & biological weapons) - also delivery vehicles (for sale on the open market) - advanced conventional weaponry - active/passive defense systems.
Disintegrating World (teenage 3rd world, migration, refugees, ethnic tensions and clashes)
Warfare today - "Joint"... (issue - Seamless capabilities) , Coalition(somewhere to go and someone to fight with), Parallel vs. Serial(strategic paralysis), 2 MRC planning, OOTW execution

2 *Question* (Expands On Question 1): **Why is Precision Important?**
Reduce casualties by orders of magnitude

2.1 *Idea* (Responds To Question 2): **Reduce Casualties**

2.2 *Idea* (Responds To Question 2): **Pierce Fog of War**

2.3 *Idea* (Responds To Question 2): **Gaining Air Supremacy**

3 *Question* (Expands On Question 1): **Challenges?**
- to develop
Sensor-to-shooter architecture
Virtual Joint organizations
Adaptive force packaging
Peer warfare
Technology integration

3.1 *Idea* (Responds To Question 3): **Ops OT War**
public health, disaster relief, tech training, police operations

4 *Question* (Expands On Question 1): **Future Warfare?**

4.1 *Idea* (Responds To Question 4): **Info Warfare**

4.2 *Idea* (Responds To Question 4): **Space Warfare**

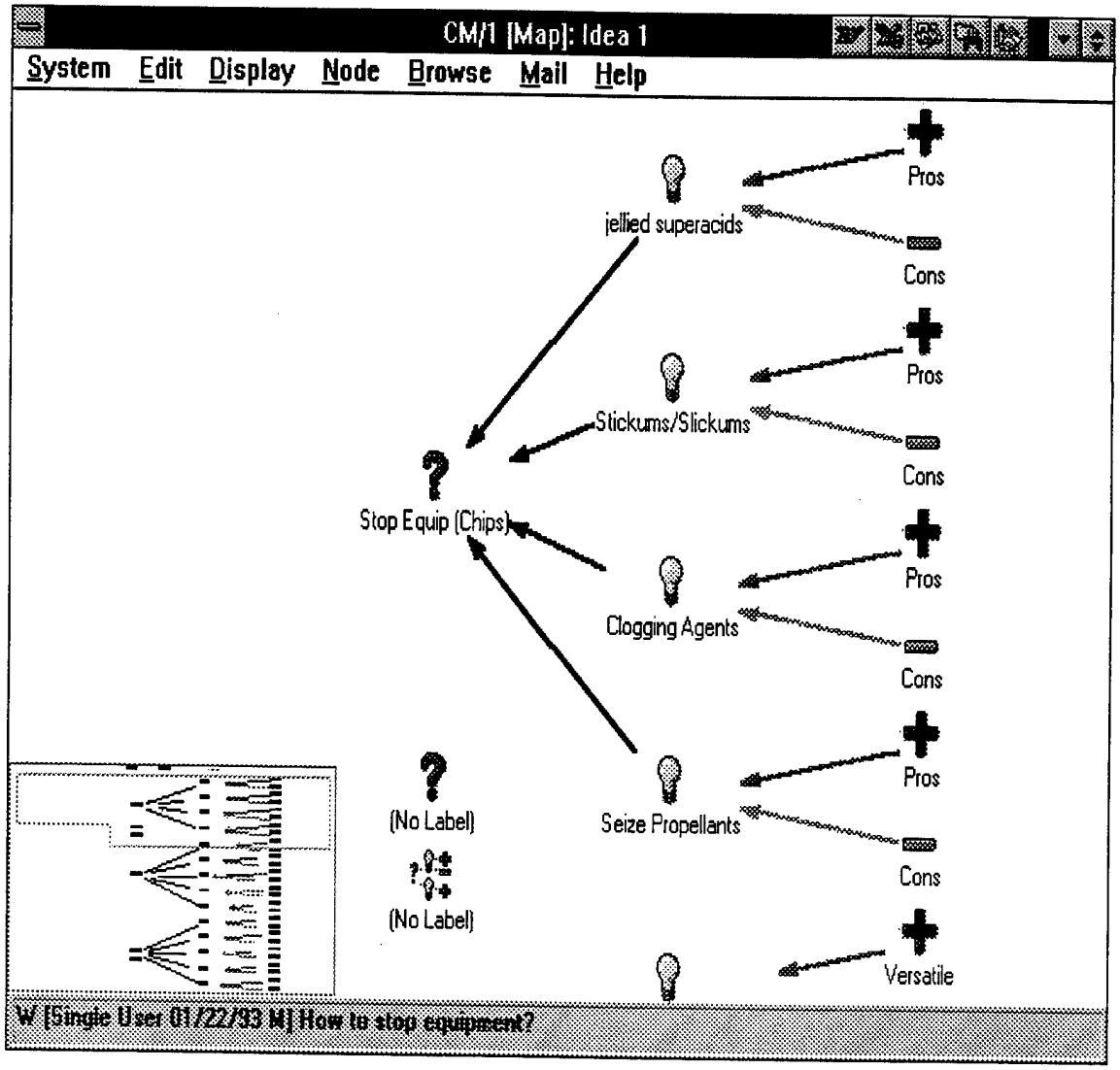
4.3 *Idea* (Responds To Question 4): **LR Precision Strike**

4.4 *Idea* (Responds To Question 4): **Asymmetric Warfare**

5 *Question* (Expands On Question 1): **Stealth Important?**

5.1 *Idea* (Responds To Question 5): **Easier to Penetrate**
Easier to get at enemy

Appendix E: Non-Lethal Initial Map View



Appendix F: CM/1 Software User Critique

CM/1 Software User Critique

Thank-you for taking the time to answer a few questions about CM/1. Your thorough inputs are valued and may help decide whether DoD money is spent on this tool. Therefore, be honest and tell me what you really thought of the software as you applied it to your unique problem. If you would like your responses to remain anonymous, please **do not** put your name on this critique. If you run out of room on a question, please turn this critique over and write on the back. Thanks, Major Mike Lewis, ACSC

1. Did you use CM/1 as a single user (loaded on your PC) or did you use it as part of a usergroup on a network (virtual whiteboard)?

2. If part of a network usergroup... How many people were in your group? What was the maximum number of users working simultaneously on a single problem (using CM/1 as a virtual white board)? How many different geographical locations were your users in?

3. Briefly describe the issue you were working on using CM/1?

4. How long did it take you to learn the basics of CM/1 and get started?
How easy was CM/1 to learn? (very easy, easy, medium, hard, or very hard)?

5. Estimate your total computer usage of CM/1 (actual time spent in CM/1 program).

6. Overall, how user friendly would you rate CM/1? (extremely, fairly, medium, not very, or very unfriendly)?

7. Did you feel CM/1, and issue-based decision-making in general, added to your particular problem solving process?
Compare CM/1 (issue-based) problem solving to other methods you've used in the past.

8. List the greatest strengths of CM/1.

9. List the greatest weaknesses of CM/1.

10. List any problems you encountered with CM/1. Please indicate whether these were problems with the software or the issue-based problem solving process.

11. List any suggested improvements you'd like to see to the software. (Note: Don't limit yourself on this question because you don't believe something's feasible, focus on anything you feel would enhance the tool.)

Appendix G: ACSC Network Specifications

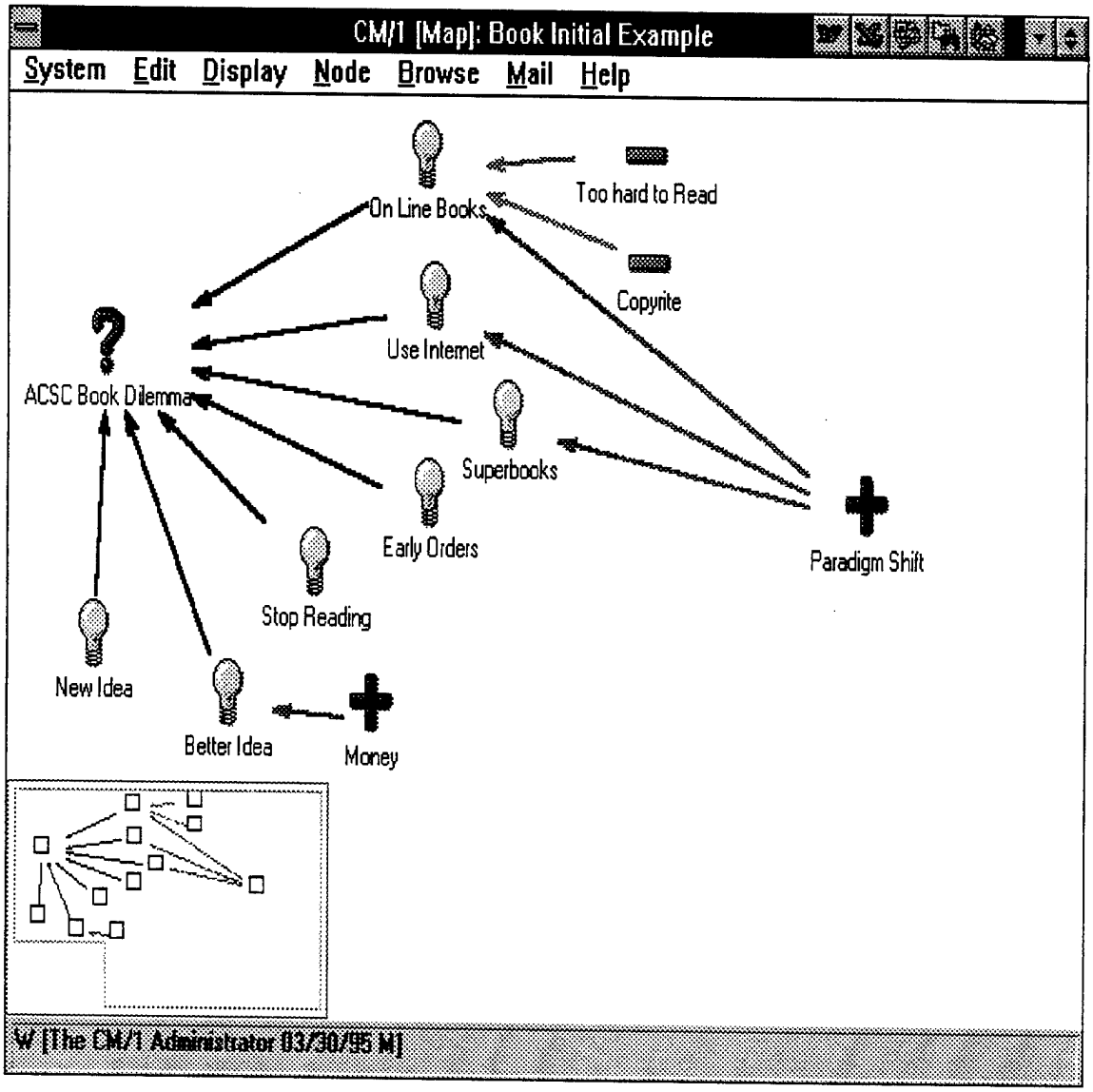
(All information provided by ACSC Network Operations)

ACSC Network: Major Pat Stroman — Chief of Network Operations
Capt Ken Montgomery — Chief of Presentation Systems Support

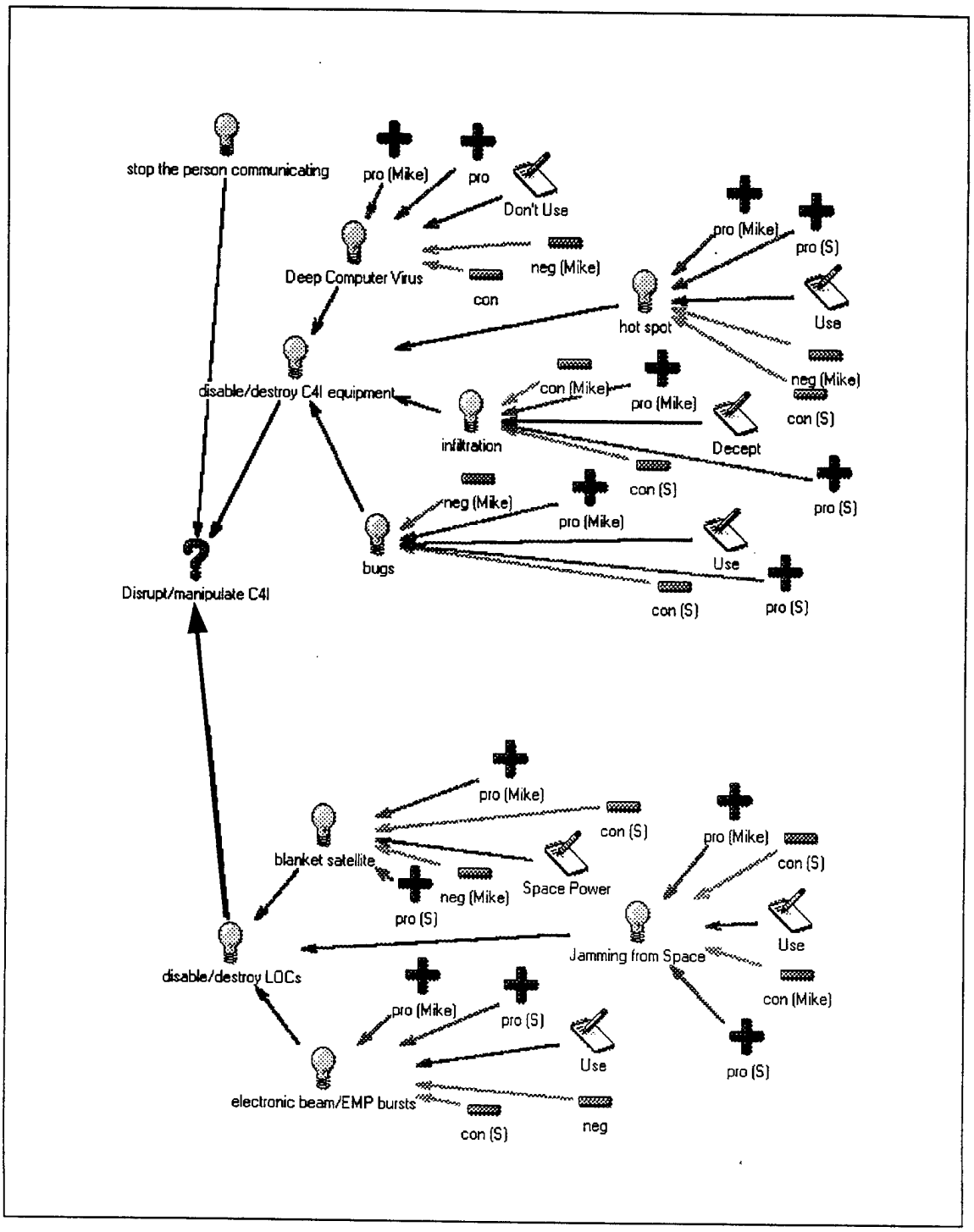
Network Architecture: ACSC's overall LAN architecture is a collapsed backbone. ACSC's LAN consists of 10BaseT ethernet segments fed into one of eight Cabletron MMAC8 hubs. The hubs are connected via a Fiber ring (FDDI). Each of ACSC's 44 seminar rooms contain an MMAC3 which allows all students in that room to share a single 10BaseT connection to the hosting MMAC8. All Faculty PC's are connected directly to the MMAC8s. The 8 servers which house the NOS are connected directly to the FDDI ring via an ethernet switch. In addition to the 10BaseT network, ACSC has in place a large 10Base5 (Thicknet) backbone which is connected to the rest of the LAN, at one of the MMAC8 hubs. The link to the outside world is controlled by a Cisco 3000 router. This router is actually attached to the 10Base5 network and then to the AU Fiber ring. Currently, many of the Student "Seminar Computers" (There are 44 of these 386 class PCs used for presentations etc.) are still connected to the 10Base5 backbone.

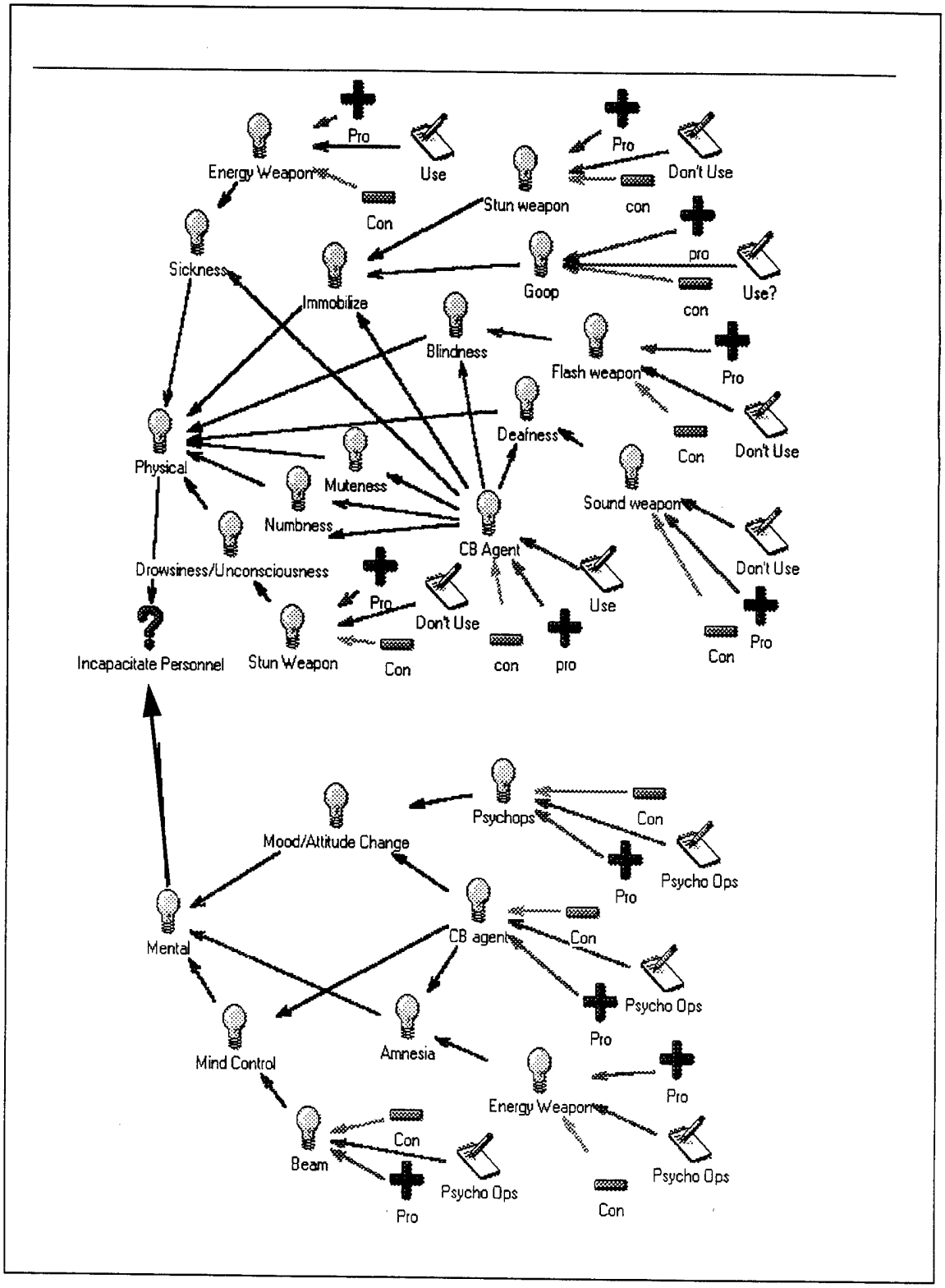
Network Operating System: Banyan Vines (ver 5.54(6))

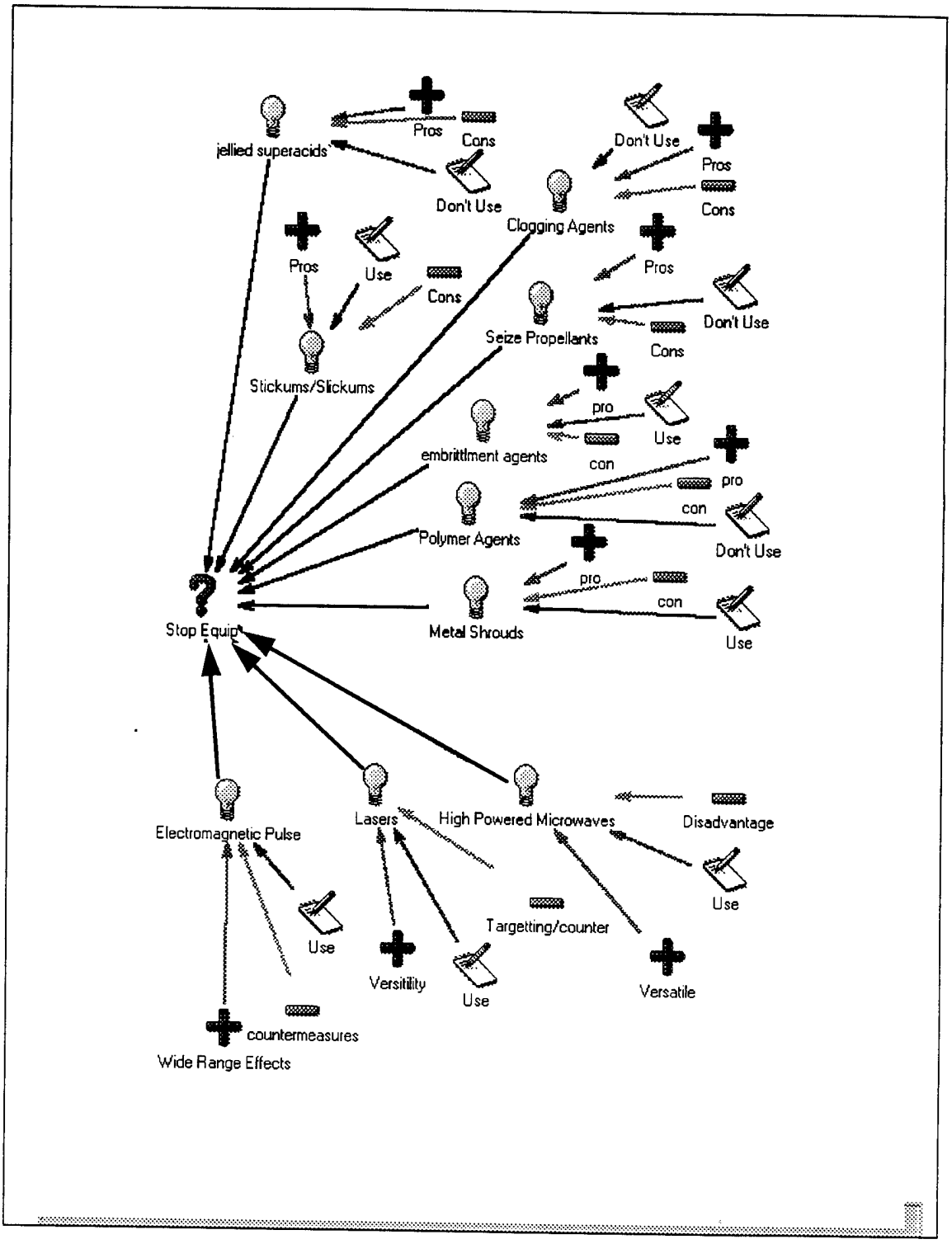
Annex H: Book Problem Initial Map View



Appendix I: Non-Lethal Final Map Views




Energy Weapon
Pro
Use
Con
Stun weapon
Pro
Don't Use
con
Sickness
Immobilize
Goop
pro
Use?
con
Blindness
Flash weapon
Pro
Don't Use
Con
Deafness
Physical
Muteness
Numbness
Sound weapon
Don't Use
Pro
Con
CB Agent
Drowsiness/Unconsciousness
Pro
Don't Use
Use
Incapacitate Personnel
Stun Weapon
Con
con
pro
Psychops
Con
Psycho Ops
Pro
Mood/Attitude Change
Mental
CB agent
Con
Psycho Ops
Pro
Mind Control
Amnesia
Energy Weapon
Pro
Con
Beam
Psycho Ops
Pro
Psycho Ops
Con


jellied superacids
Pros
Cons
Don't Use
Clogging Agents
Don't Use
Pros
Cons
Pros
Use
Cons
Stickums/Slickums
Seize Propellants
Pros
Don't Use
Cons
pro
Use
con
embrittlment agents
pro
con
Don't Use
Polymer Agents
pro
con
Use
Metal Shrouds
Stop Equip
Electromagnetic Pulse
Use
countermeasures
Wide Range Effects
Lasers
Versitility
Use
High Powered Microwaves
Disadvantage
Use
Targetting/counter
Versatile

Appendix J: Non-Lethal Final Text View

Nonlethal (This example is provided courtesy of the CONOPS 2010, Non-Lethal Operations Subgroup: Air Force Majors Scott Ley, Amy Bouchard, Ken Gladfelter, James Cody, Mike Fernandez, and Larry Soybel.)

CONOPS 2010 Nonlethal Offensive/Defensive Brainstorming Effort

1 *Question* : **Disrupt/manipulate C4I**
prevent a group from communicating

1.1 *Idea* : **stop the person communicating**
Same as those things used to incapacitate a person

1.2 *Idea* : **disable/destroy C4I equipment**
Directly effect the equipment being used by the person communicating

1.2.1 *Idea* : **Deep Computer Virus**
A deep computer virus that is triggered remotely

1.2.1.1 *Argument* : **pro (Mike)**
- allows use of surprise
- speed (very fast)
- not risky to friendly personnel
- inexpensive
- no strategic lift required

1.2.1.2 *Argument* : **pro**
- allows you to corrupt/tear-down a computer system without alerting the adversary until it starts to tear down the system.
- can be very fast
- clandestine
- no harm to friendly personnel
- takes time to correct
-does not permanently damage the equipment

1.2.1.3 *Note* : **Don't Use**
We decided to not use deep computer viruses as part of our concepts because they had little or no aerospace involvement.

1.2.1.4 *Argument* : **neg (Mike)**
- requires inside intel from enemy to gain access
- can be used against you (reverse virus)

1.2.1.5 *Argument* : **con**
- need complicity by the US computer industry or need a humint asset in the adversaries country that can insert the virus upon command
- possibly can be used against you
- difficult to turn-on remotely
- the easiest way to accomplish gives least control - set it to go off at a specified time and date in the future.

1.2.2 *Idea* : **hot spot**
put a point of energy (microwave, laser, ?) on an antenna/radio/repeater which fuses/shorts out the internal workings of the item making it

temporarily/permanently no useable. Delivery should be from an airborne platform - preferable an unmanned autonomous vehicle/RPV/drone. Power source for laser might be external from the shooter. Requires through air transmission of energy

1.2.2.1 ***Argument*** : **pro (Mike)**

- prevents enemy from communicating
- if accomplished by satellite, it's easy to penetrate enemy system utilizing surprise and shock
- no risk to operators
- once satellite is in place, is quick and easy to use

1.2.2.2 ***Argument*** : **pro (S)**

S- selective in nature - used against point targets. You hit only those parts of the communication system you want to hit.

S - best if used in a low surface to air threat environment

S-effective method of cutting off/isolating a particular individual or area of a city or nation from external and internal communications.

S- long/indefinite ability to interdict communications. The UAV has long endurance - not limited by the human.

S-provides some level of anonymity

1.2.2.3 ***Note*** : **Use**

The most effective delivery method for lasers and microwaves in/over the battlefield is from aerospace platforms. Aerospace platforms provide a greater line of sight capability and the ability to exploit three dimensional space that ground operations fail to do,

1.2.2.4 ***Argument*** : **neg (Mike)**

- permanent damage to unit
- if accomplished by aircraft, subjects pilots to risk

1.2.2.5 ***Argument*** : **con (S)**

S - susceptible to SAMs and AAA

S - needs to be relatively close to the target to prevent dissipation of the energy through the atmosphere

S - antennas are inexpensive to buy and replace

S - attraction is based upon frequencies used, thus our communications devices are as susceptible as our adversaries if we are operating on the same characteristics and in the same area covered by the flight path of the air vehicle.

S - due to the size of the air vehicle, at this time an energy source of sufficient capability and small size and weight that will fit on the shooter is not likely. the need for an external power source is necessary to allow long term operation on any one mission .

S- at present it takes a little bit of time to focus on a specific target. In a target rich environment, it will take even longer.

1.2.3 ***Idea*** : **infiltration**

clandestinely insert yourself into the enemies C4I system without detection. Once inserted, use disinformation to stabilize a situation or undermine an adversary. Examples: Appear as a leader, operate as a AOC/SOC/etc.

1.2.3.1 ***Argument*** : **con (Mike)**

1.2.3.2 ***Argument*** : **pro (Mike)**

- very effective means of deception and psyops
- confuses both fielded forces and population; no one will know when the real leader is on the tube or radio, and which set of orders to follow, i.e. surrender, the war is over, etc.
- impacts enemy's OODA loop in the observation phase initially and screws

their decisions
- low risk to our personnel
- cheap to use
- no strategic lift required

1.2.3.3 ***Note*** : **Decept**

Aerospace platforms will play a major role in successfully infiltrating an enemy's system. Aerospace platforms provide a view of the battlefield or adversaries country that is essential for line of sight infiltration and overpowering a communication node and inserting your own. Since this falls into the deception/psychological operations area, we will not address it.

1.2.3.4 ***Argument*** : **con (S)**

S - Ineffective against first wave or small groups(guerrillas, terrorists) with limited reliance on digital C2 systems. The bigger the size of the net and physical separation the easier it is to infiltrate.

S - requires the use of other techniques to incapacitate a key person or group operating the link you infiltrate for long term effectiveness.

S - limited use required to prevent defeat. Do not want to use this all the time. Once an adversary becomes aware of our ability to infiltrate, they will set up procedures to require face to face meetings or personnel authentication versus machine to machine authentication.

S - requires great knowledge of adversaries communication routine.

S - takes a period of time to learn the routine. The more chaos/confusion occurring around the group/city/nation the easier it is to be operate.

1.2.3.5 ***Argument*** : **pro (S)**

S - allows you to get inside your adversaries decision cycle. Depending on where you inject yourself into the cycle, you can feed information up and down the chain that will have a positive affect on your ability to influence the leadership and fielded force to do your will.

S - can be done remotely through relays, the last being an aerospace platform.

S - effective against second and third wave groups because of their reliance on digital message traffic and data based C2 systems. Limited VERBAL direction.

1.2.4 ***Idea*** : **bugs**

Use micro-robotic insects to infiltrate, seek and destroy communication lines and equipment. Seeker searches for communication wavelengths. Delivery through drones, rpvs and autonomous air vehicles. Like a mining operation. The delivery vehicle searches for specific target emanations. Upon localizing the target, it jettisons the bugs. They have limited life and self-destruct as a last act or after mission accomplished.

1.2.4.1 ***Argument*** : **neg (Mike)**

- need a way to turn them off or self-destruct after awhile for war termination they won't continue to go after systems

1.2.4.2 ***Argument*** : **pro (Mike)**

- uses surprise
- enemy won't know what hit them
- enemy can't defend against them
- no risk to friendly forces
- cheaper to use RPVs
- programmable
- can mass produce

1.2.4.3 *Note* : **Use**

This is a nonlethal weapon that is ideally suited for delivery by aerospace delivery platforms. Through the use of SOF aircraft or UAVs and RPVs they can be inserted anywhere.

1.2.4.4 *Argument* : **pro (S)**

S - very clandestine
S - Hard to find and track
S - can turn off selected nodes.
S - hard for the adversary to determine where the short is or cut line is
S - programmable

1.2.4.5 *Argument* : **con (S)**

S - not instantaneous - requires a period of minutes or hours to complete mission.
S - can be used against us by our adversary
S - less effective against buried communication lines and fiber optics

1.3 *Idea* : **disable/destroy LOCs**

1.3.1 *Idea* : **blanket satellite**

put a satellite in close proximity to an enemies satellite (i.e. have it fly information). When you want to turn off the signal open a blanket in space under the receivers or transponders

1.3.1.1 *Argument* : **pro (Mike)**

- once satellite is in place, it is there for a long time and becomes very cost effective
- uses surprise
- jams all enemy comm
- precise
- no collateral damage
- no risk to friendly forces
- no strategic lift required

1.3.1.2 *Argument* : **con (S)**

S - normally easy to defeat
S - multiple satellites in one area would require coalition with other satellite owners to prevent use by adversary
S - more expensive than other methods
S - having a unit in relative close position so that it can move into position quickly.
S - would require a constellation of satellites to be effective

1.3.1.3 *Note* : **Space Power**

Strong applicability with space power efforts

1.3.1.4 *Argument* : **neg (Mike)**

- won't work against low tech enemy or guerrilla warfare

1.3.1.5 *Argument* : **pro (S)**

S - can turn on and off at your direction
S - does not cause permanent damage
S - useable against multiple satellites over time
S - hard to detect once in formation with the target satellite due to close proximity
S - turns off all SATCOM through that satellite

1.3.2 *Idea* : **Jamming from Space**

From a space based asset, be able to put sufficient energy on a building/city/state/nation to continuously disrupt all communications through the air medium

1.3.2.1 *Argument* : **pro (Mike)**

- see blanket satellite

1.3.2.2 *Argument* : **con (S)**

S - not very selective - covers a broad area with its beam

S - only effective against airborne waves. Ineffective against buried cables and landlines (fiber, wire)

S - requires a large power source to reach the earth from a geosynchronous orbit

S -

1.3.2.3 *Note* : **Use**

This option is applicable to all aerospace platforms (space based or air breathing). The aerospace environment provides the optimum and greatest level of targeting options.

1.3.2.4 *Argument* : **con (Mike)**

- see blanket satellite

1.3.2.5 *Argument* : **pro (S)**

S - No personnel in harms way

S - each satellite can cover a large area of the globe

S - Do not need to turn-off - limited only by the length of your power source

S -

1.3.3 *Idea* : **electronic beam/EMP bursts**

They ability to interfere with communications to total destruction of the ability to pass electronic signals.

1.3.3.1 *Argument* : **pro (Mike)**

- fast; once a satellite is in place, it is then immediately available to use
- capability can be used as a deterrent; can demonstrate capability to stop enemy intentions
- can use surprise to big advantage; enemy doesn't see it coming and can't defend against
- precise weapon
- no collateral damage
- no risk to friendly personnel
- doesn't require strategic lift

1.3.3.2 *Argument* : **pro (S)**

S - temporarily disrupts all electronic devices and communications. Some devices are permanently damaged depending on the distance from the center of the EMP source and susceptibility to EMP affects

S - limited/controlled area of coverage

S -

1.3.3.3 *Note* : **Use**

The aerospace medium provides the greatest range of delivery options and allows you to attack any target at any time (each location over the target has a different level of risk to the detection and destruction of the platform by the enemy).

1.3.3.4 *Argument* : **neg**

1.3.3.5 *Argument* : **con (S)**

- Not as effective against EMP harden systems. But is very expensive to harden equipment
- prevents all radio communication with the party attacked until their equipment can be repaired/replaced
- we are as susceptible as our adversary to the use of this weapon
- from a beam perspective you can be more selective, but you now need an ability to pinpoint and loiter over an area for a long time

2 *Question* : **Incapacitate Personnel**

2.1 *Idea* : **Physical**

Physical inability to act/perform

2.1.1 *Idea* : **Sickness**

Incapacitating attack on digestive system (nausea, etc.); Flu-like symptoms; dizziness (lose balance); too sick too move-hurts too much, must sit still

2.1.1.1 *Idea* : **Energy Weapon**

Microwave, sound wave, etc. to cause bowel spasms, etc.

2.1.1.1.1 *Argument* : **Pro**

effective, technology probably exists

2.1.1.1.2 *Note* : **Use**

Due to its indiscriminate nature, the aerospace delivery platform would be used to deliver mines. These mines would be used to setup a barrier through which personnel could not move without being physically debilitated

2.1.1.1.3 *Argument* : **Con**

questionable precision, UCD,

2.1.1.2 *Idea* : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.1.2.1 *Note* : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.1.2.2 *Argument* : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.1.2.3 *Argument* : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.2 *Idea* : **Immobilize**

Immobilize through temporary paralysis or physical restraint

2.1.2.1 *Idea* : **Stun weapon**

2.1.2.1.1 *Argument* : **Pro**

effective, doable, immediate, relatively precise flexible range, i.e. one room or entire city.

2.1.2.1.2 *Note* : **Don't Use**

Current drawback are too great. As further research is done in this area, it needs to concentrate on making the weapon only effect the people selected. Not suited for an urban setting with both combatant and noncombatants intermixed. Needs to be used in an open battlefield away from noncombatants

2.1.2.1.3 *Argument* : **con**

unintended collateral damage, i.e. lethal results; fall off ladder, car

crashes stop surgery etc. Mistaken for lethal attack leading to lethal response.

2.1.2.2 ***Idea*** : **Goop**

2.1.2.2.1 ***Argument*** : **pro**

variable timing of effect (time to activate, duration of effect); technology exists; relatively precise application;

2.1.2.2.2 ***Note*** : **Use?**

Not addressed in detail. Can be delivered the same way as slickum, stickums and CB against point targets. Since many of these goops work based upon reacting with air, the paintball used to carry goop could break in the gun thus making the gun unusable. Paintball breakage and storage life must be investigated before final use can be determined.

2.1.2.2.3 ***Argument*** : **con**

counter may already exist. need target to be uncovered for direct application; collateral lethal damage, i.e. smother, unable to stop, operate equipment.

2.1.2.3 ***Idea*** : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.2.3.1 ***Note*** : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.2.3.2 ***Argument*** : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.2.3.3 ***Argument*** : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.3 ***Idea*** : **Blindness**

Temporarily Blind

2.1.3.1 ***Idea*** : **Flash weapon**

2.1.3.1.1 ***Argument*** : **Pro**

Effective, technology exists, concomitant psychological damage

2.1.3.1.2 ***Note*** : **Don't Use**

Do not use due to the great potential for inflicting permanent damage on the targeted individuals.

2.1.3.1.3 ***Argument*** : **Con**

UCD, possible permanent blindness, hard to determine duration of effect, can be defeated with eye protection (sun glasses, visors)

2.1.3.2 ***Idea*** : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.3.2.1 *Note* : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.3.2.2 *Argument* : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.3.2.3 *Argument* : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.4 *Idea* : **Deafness**

Temporarily unable to hear

2.1.4.1 *Idea* : **Sound weapon**

2.1.4.1.1 *Note* : **Don't Use**

Do not use due to the potential for permanent damage to the targets hearing. Further research is required in this area. It is an indiscriminate weapon due to it being an area weapon.

2.1.4.1.2 *Argument* : **Pro**

immediate effect, concomitant psychological effect, technology exists

2.1.4.1.3 *Argument* : **Con**

Communication still possible, UCD, hard to target just specific individuals, possible permanent deafness, undetermined duration of effect

2.1.4.2 *Idea* : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.4.2.1 *Note* : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.4.2.2 *Argument* : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.4.2.3 *Argument* : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral

damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.5 *Idea* : **Muteness**

Temporarily unable to speak

2.1.5.1 *Idea* : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.5.1.1 *Note* : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.5.1.2 *Argument* : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.5.1.3 *Argument* : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.6 *Idea* : **Numbness**

Make extremities numb so they can't walk, type, operate equipment, etc.

2.1.6.1 *Idea* : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.6.1.1 *Note* : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.6.1.2 *Argument* : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.6.1.3 *Argument* : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.7 *Idea* : **Drowsiness/Unconsciousness**

Too sleepy to act/work/fight; unconscious

2.1.7.1 *Idea* : **CB Agent**

Temporarily paralyze/disable/incapacitate/shock/distract via dust, gas, microbe, etc.

2.1.7.1.1 *Note* : **Use**

The delivery of CB agents will not be discussed in detail. Their packaging and delivery requirements are similar to those used to deliver slickums and stickums or embrittlement agents. For area targets, you would use spray devices. For point targets, the material can be encapsulated in "paintballs" and delivered at subsonic speeds for a gun of some type.

2.1.7.1.2 *Argument* : **pro**

technology probably exists, relatively inexpensive, effective, relatively easy to apply. Can target both area and point targets. CBs can cause a great number of temporary debilitating effects against humans. Many chemical agents do not have any lasting affect on humans especially the riot control agents.

2.1.7.1.3 *Argument* : **con**

probable international treaty violation; hard to contain once applied (hard to target just specific individuals); may cause a lethal response (conventional or NBC); unintended collateral damage (UCD); possible existence of antidote; possible misdiagnosis/mistreatment by enemy medical personnel--UCD.

2.1.7.2 *Idea* : **Stun Weapon**

Shock wave that knocks people out

2.1.7.2.1 *Argument* : **Pro**

effective, immediate effect, technology exists. Easily delivered from aerospace vehicles.

2.1.7.2.2 *Note* : **Don't Use**

At this time do not use. Put too many friendly forces in harms way and great potential for causing long term effects or death to targeted humans. If in the future the technological deficiencies can be overcome, the aerospace environment provides the optimum delivery environment.

2.1.7.2.3 *Argument* : **Con**

UCD, undetermined duration of effect, Presently, the technology is not available to target an individual or multiple humans simultaneously (providing each target the appropriate level of impact to knock them out without causing long term effects or death). Once you knock them out, you must put troops on the ground to disarm and take control of the people. This would require extensive use of helicopters or V-22 type aircraft. (More people in harms way)

2.2 *Idea* : **Mental**

2.2.1 *Idea* : **Mood/Attitude Change**

Make individuals depressed, non aggressive, irritable, etc.; lose will to fight

2.2.1.1 *Idea* : **Psychops**

Persuade through leaflets, radio broadcasts, etc. ; deceive opponent through clones, impostors, holograms (national leaders, deity figures, etc.) -- give false orders, speeches, etc. to sway public opinion, etc.

2.2.1.1.1 *Argument* : **Con**

Questionable effectiveness against motivated, loyal opponent

2.2.1.1.2 *Note* : **Psycho Ops**

We will not cover this area. It is part of the Psychological Operations and Deception sub group in the CONOPS 2010 project.

2.2.1.1.3 *Argument* : **Pro**

technology exists, some methods have been used successfully before, relatively inexpensive

2.2.1.2 *Idea* : **CB agent**

gas, dust, microbe, etc. to alter mood/attitude etc.; cause hallucinations

2.2.1.2.1 *Argument* : **Con**

Same as other CB agents

2.2.1.2.2 *Note* : **Psycho Ops**

These agents can be delivered the same as the CB agents associated with physical immobilization. We will not cover them due to their alignment under the Psychological Operations and Deception topic also being addressed in the CONOPS 2010 project.

2.2.1.2.3 *Argument* : **Pro**

Same as other CB agents

2.2.2 *Idea* : **Amnesia**

Temporary amnesia so individuals forget who they are, where they are, why they are fighting, what they are supposed to be doing, etc.

2.2.2.1 *Idea* : **CB agent**

gas, dust, microbe, etc. to alter mood/attitude etc.; cause hallucinations

2.2.2.1.1 *Argument* : **Con**

Same as other CB agents

2.2.2.1.2 *Note* : **Psycho Ops**

These agents can be delivered the same as the CB agents associated with physical immobilization. We will not cover them due to their alignment under the Psychological Operations and Deception topic also being addressed in the CONOPS 2010 project.

2.2.2.1.3 *Argument* : **Pro**

Same as other CB agents

2.2.2.2 *Idea* : **Energy Weapon**

Energy wave (sound, microwave, etc.) to cause amnesia

2.2.2.2.1 *Argument* : **Pro**

immediate effect, easy to employ (target doesn't necessarily have to be in the clear)

2.2.2.2.2 *Note* : **Psycho Ops**

We will not cover because it is a subset of the Psychological Operations and Deception group in CONOPS 2010

2.2.2.2.3 *Argument* : **Con**

Difficult to localize effect, UCD, may cause permanent memory loss, technology may not exist yet

2.2.3 *Idea* : **Mind Control**

Hypnotize, subliminal suggestion, etc. to get personnel to do what we want them to do

2.2.3.1 *Idea* : **CB agent**

gas, dust, microbe, etc. to alter mood/attitude etc.; cause hallucinations

2.2.3.1.1 *Argument* : **Con**

Same as other CB agents

2.2.3.1.2 *Note* : **Psycho Ops**

These agents can be delivered the same as the CB agents associated with physical immobilization. We will not cover them due to their

alignment under the Psychological Operations and Deception topic also being addressed in the CONOPS 2010 project.

2.2.3.1.3 ***Argument*** : **Pro**

Same as other CB agents

2.2.3.2 ***Idea*** : **Beam**

Mind controlling /altering beam, possibly from satellite

2.2.3.2.1 ***Argument*** : **Con**

Technology doesn't exist yet, expensive, targeted individuals must be exposed to beam (must be outside)

2.2.3.2.2 ***Note*** : **Psycho Ops**

We will not cover because it is associated with the Psychological Ops and Deception group in 2010

2.2.3.2.3 ***Argument*** : **Pro**

Precise targeting, immediate effect, extremely effective (able to get opponent to do exactly what we want)

3 ***Question*** : **Stop Equip**

-Examines chemical agents such as metal embrittlement, polymers, jellied superacids, stickums, slickums,

-Considers means such as metal shrouds to stop equipment ;movement

-Caustic Chemicals that eat through metal, plastic , rubber

-Clogging Agents that prevent movement of tanks

-Seizing agents that cause render missile propellant ineffective

3.1 ***Idea*** : **jellied superacids`**

-Potentially a million times more potent than hydrochloric acid, might be shot at weapons to destroy their optics or employed to destroy key weaponry silently. (Janet Morris, Enter non-lethal weaponry. Spectrum, Sep 1991).

-Similar to liquid embrittlement

3.1.1 ***Pro*** : **Pros**

-Cost effective

-Technology Exists

-Makes equipment unusable

-Effective against a wide array of equipment

3.1.2 ***Con*** : **Cons**

-Collateral Damage!!!!

-Countermeasures

-Potentially environmentally unsafe

-If it damages equipment to this extent-is it really non-lethal? What are effects on people?

-How do you deliver it without getting the acid on other than the intended target?

3.1.3 ***Note*** : **Don't Use**

Collateral Damage to personnel, equipment and environment is too great for use.

3.2 ***Idea*** : **Clogging Agents**

-Agents used to stop tanks and APC's by causing soil or some rubber agent to clog and seize tracks

-Filter clogging agents

-Jell Fuel or other petroleum based products

-Liquefy petroleum based rubbers (tires, seals, etc.)

3.2.1 ***Note*** : **Don't Use**

Due to its indiscriminate manner, do not use until a counter measure or greater discrimination between what it will effect and not effect.

3.2.2 ***Pro*** : **Pros**

-Prevents tanks, APC's from moving without destroying people or causing collateral

damage
-Could affect anything that is dependent of petroleum products

3.2.3 ***Con*** : **Cons**

-Need countermeasure for friendly equipment
-Employment limited to areas where we are not operating if countermeasure is not available
-Environment

3.3 ***Idea*** : **Seize Propellants**

-Develop the ability to deploy agents that cause rocket propellant to seize on SAM's, Air-to-Air, Air-to-Ground and Artillery
-Cause combustion engines to seize or overheat
-Cause flight controls or other moving surfaces to seize
-Jams moving parts

3.3.1 ***Pro*** : **Pros**

-Renders the enemy ineffective in terms of munitions capability
-Effective against a varied array of equipment
-Not harmful to environment
-Seize guns or other weapons delivery platforms

3.3.2 ***Note*** : **Don't Use**

Same reasons as clogging agents

3.3.3 ***Con*** : **Cons**

-Extremely difficult to target
-Must have a countermeasure or could affect friendly equipment
-Environmentally questionable if affects civilians
-Potentially a lot of collateral damage-civilian populace could be affected
-How to deliver it

3.4 ***Idea*** : **Stickums/Slickums**

-Anti-traction technology (A-TT) embraces entire spectrum of superlubricants. Exists today. Obvious targets - runways, streets, rail roads, and walkways.
(Evancoe, National Defense, p. 28))
- Goop Gun-sticky foam. Turns to taffy when exposed to air. Sticks until sprayed with solvent. (Int'l. "Soon phasers on stun" Newsweek)
- "Instant banana skin" a powder that is spread on the street and then sprinkled. More slippery than ice. Opposite effects would be instant-
aneous glue made of an adhesive substance which makes the streets so sticky that everything sticks to it. (DTIC, p. 6)

3.4.1 ***Pro*** : **Pros**

-Immobilizes transportation infrastructure without collateral damage
-Airfields become ineffective for producing sorties
-Rail lines become ineffective
-Roads and infrastructure not permanently damaged
-no irritating or toxic effects. (DTIC, p. 6)
-Great for slowing mobility
-Runways become useless

3.4.2 ***Note*** : **Use**

The aerospace delivery platform provide the optimum method of delivering slickums and stickums.

3.4.3 ***Con*** : **Cons**

-Because A-TT is susceptible to temperature and weather extremes, it must be formulated for specific targets and environments if it is to retain its slippery characteristics. (Evancoe)
-A large quantity of the agent may be required for large scale application. (Evancoe)
-How to affect enemy capabilities without affecting our capability to move

-Research and technology time needed
-Delivery a problem
-We're still trying to figure out the clean-up (David Boyd, Nat'l Inst of Justice-New Scientist-War over wpns that can't kill)
-Must have countermeasure to ensure we aren't caught with a problem we cant' handle
-Environmentally could cause a problem

3.5 *Idea* : embrittlement agents

Liquid embrittlement agents: chemically changes the structure of metals, useful in sabotaging planes, ships, cars, trains, railroads (Bulletin of Atomic Scientist, March-April 94)

3.5.1 *Pro* : pro

-no intentional loss of life
-permanent loss of military capability
-can be used selectively on critical metal structures such as aircraft, ships, bridges, vehicles, tanks, tank tracks, railroad tracks
-LME agents are clear so they are not easily detectable by the enemy, they have little or no perceptible residue whether they are sprayed or applied with a instrument similar to felt tip markers (National Defense, Oct 93, p.25)
-little or no collateral damage

3.5.2 *Note* : Use

Delivered in the same method as slickum, stickums and Cbs against point targets. The greatest difference, would be that the paintball would encase a sponge that would prevent the liquid from spreading everywhere. This would localize effect to the part of the target aimed at and prevent collateral damage. We will not cover these agents in detail due to similarity with slickums and stickums which are covered.

3.5.3 *Con* : con

-costly to enemy in terms of rebuilding infrastructure, equipment
-need to develop countermeasure
-may violate the Biological Weapons convention/ Chemical Weapons Convention & Geneva Protocol(Bulletin of Atomic Scientist, Sep-Oct 94)
-Unknown peripheral effects to humans

3.6 *Idea* : Polymer Agents

-Biological agents used to degrade fuel, lubricants, electrical insulation(New Scientist)
-Super-sticky or super slick agents
-Microbes that turn jet fuel or petroleum products into jelly like unusable substances (Aviation Week & Space Technology, Aug 92)
-Can be used to clog jet intakes by releasing it into the air mixing it with a dye to form tinted clouds that will warn pilots from flying into that area thereby protecting troops on the ground from air attack(New Scientist)

3.6.1 *Pro* : pro

-Can severely impact enemy system essential by ruining the petroleum products necessary to fuel war machines
-Slickums/Stickums stop enemy equipment and personnel without loss of life
--Prevent enemy from being able to use roads and runways limiting their capabilities without permanently damaging the roads and runways
-Can be deployed as a mist from aircraft or aerial munitions(National Defense, Dec 93, p.28)

3.6.2 *Con* : con

-Need countermeasure for friendly troops
-Potential bioenvironmental impact
-Unknown collateral damage to humans
-May violate Biological Weapons Convention/ Geneva Protocol

-Effectiveness of Polymer Agents are extremely dependent on weather conditions therefore limiting the effective employment of Polymer Agents
-Amount of agent needed to be effective may limit the ability to deploy polymer agents

3.6.3 ***Note*** : **Don't Use**

Same as clogging and polymer agents.

3.7 ***Idea*** : **Metal Shrouds**

-Stop equipment /personnel movement

3.7.1 ***Pro*** : **pro**

-Stops people and equipment in their tracks
-Minimal collateral damage
-Easily deployed from aircraft or field artillery
--Large soda bottle size canisters for deployment pop open and fall on target (Newsweek, 7 Feb 94)

3.7.2 ***Con*** : **con**

-Requires precise targeting to be effective
-Can be easily countered if enemy has equipment capability to remove shrouds
-Effectiveness may be short term

3.7.3 ***Note*** : **Use**

The AC-130 or any other aircraft that can house a 105mm or launch a rocket capable of housing and delivering the shroud in the same manner as an artillery shell is capable is a viable delivery platform. The use of the aerospace platform allows the best view of the target and greatest potential for properly covering the vehicle due to its natural downward angle of attack.

3.8 ***Idea*** : **High Powered Microwaves**

Systems that emit microwave energy to a selected target such as communications & computer data storage equipment.
Pulsing action internally excites the components rapidly generating intense heat which fuses or melts electronic components destroying the circuit (National Defense, Dec 93, p. 27)

3.8.1 ***Argument*** : **Disadvantage**

- Not effective against shielded electronic systems
-Power source necessary to employ the weapon are large systems need to be miniaturized(National Defense, Dec 93, p.27)
-Possible collateral damage and loss of life if personnel are in the area when the weapons are employed

3.8.2 ***Note*** : **Use**

Same rationale that used for as lasers and electromagnetic pulse.

3.8.3 ***Argument*** : **Versatile**

-Technology currently exists can be deployed through the use of 155mm artillery shells(Defense Electronics, Feb 93, p.45)
-Capable of disabling all types of electrical equipment
-Can be deployed as a bomb
-Isotropic radiators can be exploded above indirect targets in cities or mountains where conventional line of sight lasers are ineffective(National Defense, Dec 93, p.27)
-Capable of penetrating aircraft, missile systems, disable flight controls, engines, navigation systems, communication, weapons control systems (National Defense, Dec 93, p.27)
-Ultra-wide band, high power microwaves can be used to disable any vehicle(trucks, aircraft, tanks, missiles) that are dependent on electronic circuits to operate

3.9 ***Idea*** : **Lasers**

-Low collateral damage munitions that have a variety of capabilities to include the ability to destroy or disable sensors used to collect information or direct weapons

-Have the capability to destroy missile capability (New Scientist 3 Aug92, p.28)
-Pulsed Chemical Lasers project "hot high pressure plasma in the air in front of a target surface, creating a blast wave that will result in variable but controlled effects on material or personnel (Defense Electronic, Feb93, p.44)
-Laser Dye Rods can be contained in 40mm artillery shell contained in plastic casing on impact causes an exceptionally intense flash which blinds electro optical sensors and personnel(Defense Electronic , Feb 93, p.44)
Defensive Use of Lasers(Aviation Week & Space Technology, 7 Dec p. 51)
-Anti-missile Laser has the ability to shoot down tactical ballistic missile and acts as a long range reconnaissance sensor
--Can be used against both air and ground targets
range 150km-200km

3.9.1 ***Argument*** : **Targeting/counter**

-Required detailed intel data and precise targeting capability to avoid collateral damage
-Technology needs improvement to develop laser beams that can travel horizontally without dissipating excessive energy to remain effective particularly for the role of anti-missile lasers
-Enemy may easily develop countermeasures to protect equipment
-Possible injury or death to personnel
-Development must yield weapons that are small, yet powerful that can also be specifically targeted

3.9.2 ***Argument*** : **Versatility**

-Can melt down electrical systems
-Capable of destroying or disabling sensors use to collect information or direct weapons therefore making enemy aircraft, tanks, field artillery, C4I virtually ineffective
-Easily used against both air and ground targets and employed by either air and ground

3.9.3 ***Note*** : **Use**

Aerospace platforms have the ability to see and reach any target over the battlefield to include targets that are very deep out of range of artillery. Operating from a platform above the target with the maneuverability that the aerospace environment offers to the commander great leverage and flexibility. The laser can target anything it can see. This field of view is much greater than that of a delivery platform operating from the ground.

3.10 ***Idea*** : **Electromagnetic Pulse**

-EMP produced by creating a magnetic field in a coil and then squeezing it by the detonation of conventional explosives (Aviation Week & Space Technology, 22 Feb 93)
-Produces an upset of electronic devices by scrambling digital memories or causing the device to destroy itself by diverting current to sensitive components (Aviation Week & Space Technology, 24 May 93, p.61)
-Disable electrical and electronic systems
-Pulse can be generated from the ground or a cruise missile to disable enemy weapons

3.10.1 ***Note*** : **Use**

Aerospace delivery platforms, like UAVS, RPVs, and cruise missiles, provide a loiter capability and the ability to search out and affect selected targets. Whereas bombs and artillery shells have very little maneuverability in the target area. They can not go around. they are going to go off.

3.10.2 ***Argument*** : **countermeasures**

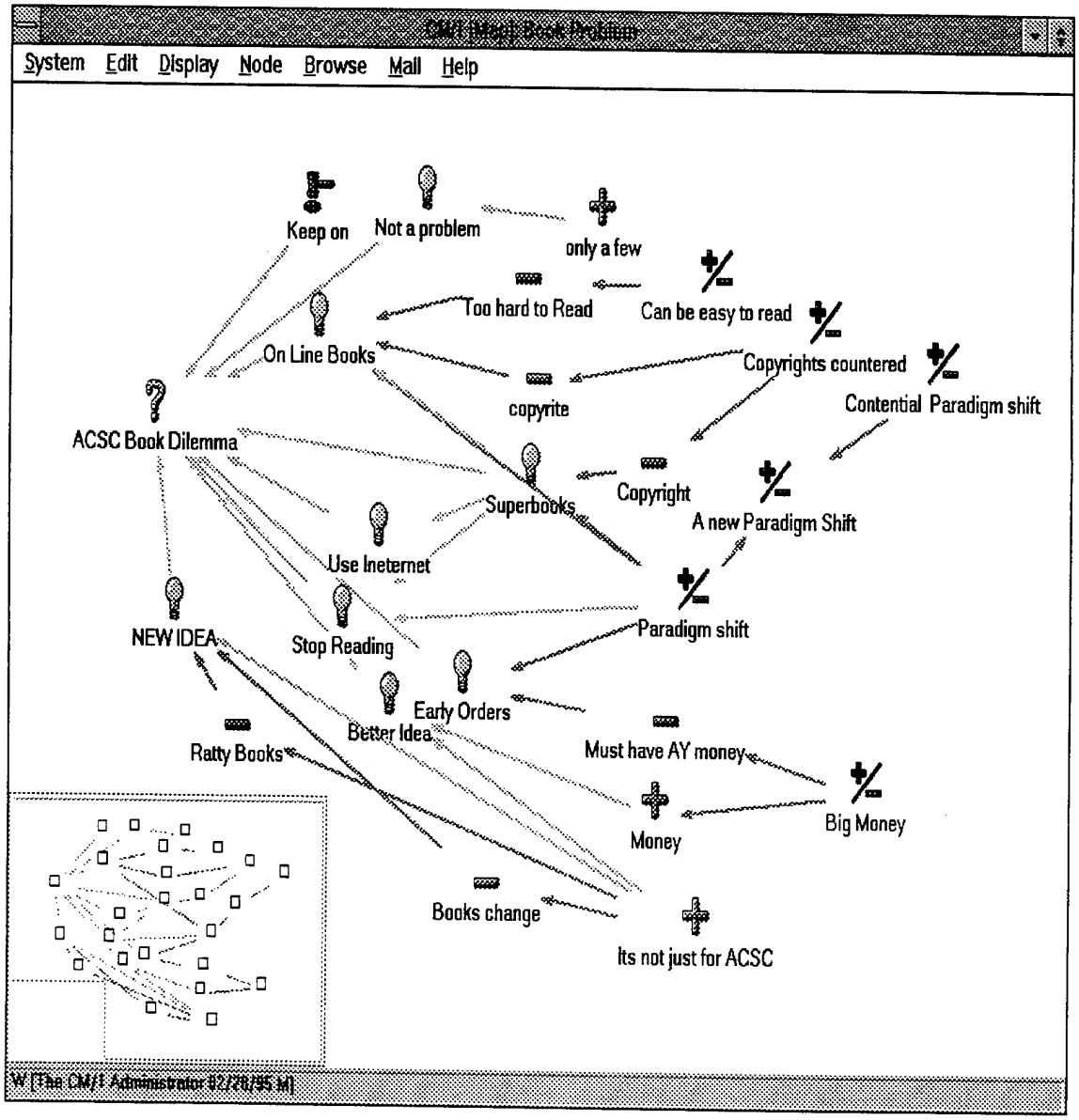
-Need to have capability to produce a highly directional EMP to maximize effectiveness and minimize any collateral damage(Aviation Week & Space Technology, 24 May 93, p. 61)

-Need better ability to target and focus the EMP to accurately target the output depositing the pulse at the right range and on the correct target
-Requires extreme accuracy
-Countermeasures do exist with radiation hardened electronic devices
-Might not prove to be effective against first wave nations with limited dependency on electronic

3.10.3 ***Argument*** : **Wide Range Effects**

-Disables vehicles, missiles, machines, aircraft electronics, computers without destroying forces
-Current technology is being explored so it could be fielded relatively quickly
-Can create a huge impact on oppositions capability with minimal damage
-Debilitates enemy capability without destroying buildings and infrastructure other than electronic devices

Appendix K: Book Problem Final Map View



Appendix L: Book Problem Final Text View

Book Problem (Inputs for this example courtesy of ACSC/DEC personnel: Commander Homer Coffman, and Majors Chuck Sutherland, Bob Goss, and Rick Carroll)

1 ***Question*** : **ACSC Book Dilemma**

1. The books are not here in the required quantity in time for the classes . . .
2. Some publishers don't want to reprint books that are out of print . . .
3. Students complain about having to read too many books . . .
4. Books are expensive . . .

(The CM/1 Administrator)

1.1 ***Idea*** (Responds To Question **1**): **Not a problem**
We are doing ok right now. We are developing standard procedures as we go along. After all this is only the second year of execution!!!
(chuck)

1.1.1 ***Argument*** (Supports Idea **1.1**): **only a few**
only a few books fail to get in on time or not at all
(chuck)

1.2 ***Decision*** (Resolves Question **1**): **Keep on**
Let's keep on doing what we are doing right now. We are getting better at this. We need another year before we make some kind of drastic change to the concept of reading based instruction.
(chuck)

1.3 ***Idea*** (Responds To Question **1**): **On Line Books**
Use electronic books on the Internet
(chuck)

1.3.1 ***Con*** (Objects To Idea **1.3**): **Too hard to Read**
Lots of pages to read from screen. Difficult on eyes
(rick)

1.3.1.1 ***Argument*** (Objects To Con **1.3.1**): **Can be easy to read**
If high resolution monitors and high performance video cards were used the screens would be very easy to use.
(chuck)

1.3.2 ***Con*** (Objects To Idea **1.3**): **copyright**
Could run into problems with copyright
(chuck)

1.3.2.1 ***Argument*** (Objects To Con **1.3.2**): **Copyrights countered**
We don't need to copy the books, just do educational reviews and synopsis of the material. But even if some copyright fees had to be paid--it would be cheaper than the amount being spent on buying books that only 10% of the book is read.
(chuck)

1.3.3 ***Idea*** (Specializes Idea **1.3**): **Superbooks**
Use faculty to make super-books. Extract important information in several books and put them into pamphlets to be published by AU Press.
(chuck)

1.3.3.1 ***Argument*** (Objects To Idea **1.3.3**): **Copyright**
COPYRIGHT COULD BE VERY EXPENSIVE
(bob)

1.3.3.1.1 *Argument* (Objects To Argument **1.3.3.1**): **Copyrights countered**
We don't need to copy the books, just do educational reviews and synopsis of the material. But even if some copyright fees had to be paid--it would be cheaper than the amount being spent on buying books that only 10% of the book is read.
(chuck)

1.3.3.2 *Argument* (Objects To Idea **1.3.3**): **Paradigm shift**
(homer)

1.3.4 *Argument* (Objects To Idea **1.3**): **Paradigm shift**
(homer)

1.4 *Idea* (Responds To Question **1**): **Superbooks**
Use faculty to make super-books. Extract important information in several books and put them into pamphlets to be published by AU Press.
(chuck)

1.4.1 *Argument* (Objects To Idea **1.4**): **Copyright**
COPYRIGHT COULD BE VERY EXPENSIVE
(bob)

1.4.1.1 *Argument* (Objects To Argument **1.4.1**): **Copyrights countered**
We don't need to copy the books, just do educational reviews and synopsis of the material. But even if some copyright fees had to be paid--it would be cheaper than the amount being spent on buying books that only 10% of the book is read.
(chuck)

1.4.2 *Argument* (Objects To Idea **1.4**): **Paradigm shift**
(homer)

1.5 *Idea* (Responds To Question **1**): **Use Internet**
God's only tool
(homer)

1.5.1 *Idea* (Specializes Idea **1.5**): **Superbooks**
Use faculty to make super-books. Extract important information in several books and put them into pamphlets to be published by AU Press.
(chuck)

1.5.1.1 *Argument* (Objects To Idea **1.5.1**): **Copyright**
COPYRIGHT COULD BE VERY EXPENSIVE
(bob)

1.5.1.1.1 *Argument* (Objects To Argument **1.5.1.1**): **Copyrights countered**
We don't need to copy the books, just do educational reviews and synopsis of the material. But even if some copyright fees had to be paid--it would be cheaper than the amount being spent on buying books that only 10% of the book is read.
(chuck)

1.5.1.2 *Argument* (Objects To Idea **1.5.1**): **Paradigm shift**
(homer)

1.6 *Idea* (Responds To Question **1**): **NEW IDEA**
Issue books to the students and get them back at the end of the year
(bob)

1.6.1 *Con* (Objects To Idea **1.6**): **Ratty Books**
The books would be almost useless after the third time they were used. Wear and tear, and highlighting the books would trash the books.
(chuck)

1.6.1.1 *Argument* (Objects To Con **1.6.1**): **It's not just for ACSC**
The books are designed to establish a professional military reading library for field grade officers. Many will be encouraged to continuing their studies long after they've left ACSC
(chuck)

1.6.2 *Con* (Objects To Idea **1.6**): **Books change**
The book list is different each year because:
1. New books come out
2. Old books are rediscovered each year
3. Some books fall from favor

(chuck)

1.6.2.1 *Argument* (Objects To Con **1.6.2**): **It's not just for ACSC**
The books are designed to establish a professional military reading library for field grade officers. Many will encouraged to continuing their studies long after they've left ACSC
(chuck)

1.6.3 *Argument* (Supports Idea **1.6**): **Its not just for ACSC**
The books are designed to establish a professional military reading library for field grade officers. Many will be encouraged to continuing their studies long after they've left ACSC
(chuck)

1.7 *Idea* (Responds To Question **1**): **Stop Reading**
The concept is to not read so many books.
(homer)

1.7.1 *Idea* (Specializes Idea **1.7**): **Superbooks**
Use faculty to make super-books. Extract important information in several books and put them into pamphlets to be published by AU Press.
(chuck)

1.7.1.1 *Argument* (Objects To Idea **1.7.1**): **Copyright**
COPYRIGHT COULD BE VERY EXPENSIVE
(bob)

1.7.1.1.1 *Argument* (Objects To Argument **1.7.1.1**): **Copyrights countered**
We don't need to copy the books, just do educational reviews and synopsis of the material. But even if some copyright fees had to be paid--it would be cheaper than the amount being spent on buying books that only 10% of the book is read.
(chuck)

1.7.1.2 *Argument* (Objects To Idea **1.7.1**): **Paradigm shift**
(homer)

1.8 *Idea* (Responds To Question **1**): **Early Orders**
Order the books earlier than we have been
(chuck)

1.8.1 *Argument* (Objects To Idea **1.8**): **Paradigm shift**
(homer)

1.8.2 *Argument* (Objects To Idea **1.8**): **Must have AY money**
Release of money is important.
(bob)

1.8.2.1 *Argument* (Objects To Argument **1.8.2**): **Big Money**
ACSC has been doing a pretty good job of getting the money. If the money well dries up--we won't get any books at all. We should not limit our thinking to current budgets or the fear that the money might go away!
(chuck)

1.9 *Idea* (Responds To Question 1): **Better Idea**
Stop using Books
PUT EVERYTHING ON TOOLBOOKS
(chuck)

1.9.1 *Argument* (Supports Idea **1.9**): **Money**
If Congress deletes this funding we can still teach with the books
Books will be here in quantity, and instructors will know which ones are here in advance
(bob)

1.9.1.1 *Argument* (Objects To Argument **1.9.1**): **Big Money**
ACSC has been doing a pretty good job of getting the money. If the money well dries up--we won't get any books at all. We should not limit our thinking to current budgets or the fear that the money might go away!
(chuck)

1.9.2 *Argument* (Supports Idea **1.9**): **Its not just for ACSC**
The books are designed to establish a professional military reading library for field grade officers. Many will be encouraged to continuing their studies long after they've left ACSC
(chuck)

2 *Argument* : **A new Paradigm Shift**
(rick)

2.1 *Argument* (Objects To Argument **2**): **Continental Paradigm shift**
The intent of instruction at ACSC, or anywhere for that matter, it to either transfer knowledge or stimulate independent thought. The knowledge transfer that occurs when concepts from select books published by great thinkers is injected optically into the minds of the nation's brightest has the ability to generate a transfer of independent thought. This paradigmacal shift marks the arrival in the second Revolution in Optical Affairs (ROA) or the possibility the advent of the first Military Optical Revolution (MOR). The first of course was the collapse of the canopy just before the great flood which revealed the celestial bodies to the human eyes--the literal thousand points of light. The MOR or the second ROA leaves many questions unanswered, or in others words we still want the MOR evolution to continue. This would naturally be called the Military Optical Revolution Evolution (MORE). An obvious counter is the Lexiconal Evolution of the Statistical Systems (LESS) which drives the intent of acquiring present knowledge then application of said knowledge against future problems. Which leaves us with the real shift of Paradigms in questions:
When is MORE better than LESS. Certainly their is room for either but not at the same time. You can not have MORE and LESS working on the same challenge with our current vision. Only by the way we perceive things can we truly see that we can not only have MORE and do LESS but we can also do MORE with LESS.
(chuck)

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Vita

Major Michael Lewis was Chief, Space Systems Test Division, Space and Warning Systems Center, Peterson AFB, Colorado, prior to attending ACSC. In this capacity, he also served as a Deputy Commander in the Cheyenne Mountain Space Control Center. In addition, he has served as a Master Flight Commander and Communication Skills Curriculum Manager at SOS. After commissioning, Major Lewis maintained software for and flew as battlestaff support on the SAC Airborne Command Post. He has almost 6 years of enlisted Air Force service and attained the rank of Staff Sergeant before accepting an AFROTC scholarship. Major Lewis was commissioned through AFROTC in 1984.

Major Lewis' advanced degrees include: MPA, Public Administration, University of Oklahoma (1987) and MS, Systems Management, School of Logistics and Acquisition Management, Air Force Institute of Technology (1992). He is also a member of Pi Alpha Alpha, the national honor society for public administration, and Sigma Iota Epsilon, the national honorary and professional management fraternity.

He is a distinguished graduate of NCO Leadership School, SOS, and Advanced Communications Officer Training School. At SOS he was awarded the Commandant's Trophy as the number one graduate in a class of 798 officers (Class 87-B).

Major Lewis is currently a student in the ACSC Class of 1995. Upon graduation, he will attend the School of Advanced Airpower Studies (SAAS), Class of 1996.