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THESIS

DESIGNING A GRAPHICAL USER
INTERFACE FOR A
BILATERAL NEGOTIATION SUPPORT SYSTEM

by

Ralph Sabene

March, 1992

Thesis Advisor:

Tung X. Bui

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Designing a Graphical User
Interface for a
Bilateral Negotiation Support System

by

Ralph Sabene
Lieutenant Commander, United States Naval Reserve
B.S., Arizona State University, 1978

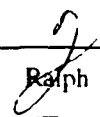
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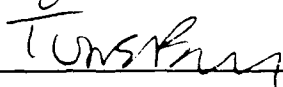
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NAVAL POSTGRADUATE SCHOOL
March 1992


Author:


Ralph Sabene

Approved by:


Tung X. Bui, Thesis Advisor


Balasubramaniam Ramesh, Second Reader


David R. Whipple, Chairman
Department of Administrative Sciences

ABSTRACT

Graphical User Interfaces (GUI) are quickly becoming the standard operating environment for most software programs and operating systems. Ease of use, rapid learning and the ability to retain complex task sequences and operations are some of the advantages attributed to this type of interface. When properly implemented the GUI can provide a natural interaction between the user and the computer. Initial acceptance and continued use of any program can be greatly enhanced by proper design of this interface. It is expected that this trend toward visual representation of a task's objects and actions will be more fully developed and expanded in future years. This thesis explored the principles of interface design with particular attention given to the specific characteristics associated with GUI design. Unique design concepts associated with Negotiation Support Systems were also considered. These design techniques and principles were then applied in the analysis and design of the graphical user interface for a Bilateral Negotiation Support System based on multiple attribute utility theory. The program was written in Microsoft Visual Basic for use under the Microsoft Windows 3.0 operating environment.

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I. INTRODUCTION

A. PURPOSE OF THESIS

The purpose of this thesis is to design and implement a Graphical User Interface (GUI) based program for a Bilateral Negotiation Support System (NSS) (Bui & Sivasankaran, 1991). The program is written to operate on a Microsoft Windows/DOS operating system microcomputer. It is expected that graphical user interfaces, when properly implemented, can provide a user friendly and natural interaction between the user and the decision support system program. Initial acceptance and continued use of any program can be greatly enhanced by proper design of the interface.

B. BACKGROUND

1. Bilateral Negotiation Support Systems (NSS)

The framework upon which the Bilateral NSS is based was originally formulated in a publication on Group Decision Support Systems (Bui, 1987) and a publication on Bilateral Negotiation Support Systems (Bui, 1991). The first character-based, menu-driven Bilateral NSS program based on this design was written in the Pascal language in 1987 and subsequently translated to the C language in 1991.

The Bilateral NSS is a multiple attribute, joint utility negotiation model. In its present form it supports a two party negotiation strategy. A negotiation session can consist of up to ten issues of contention. Within an issue, each party can assign relative

utilities within the range of values defined by the party's initial offers. Also, relative weightings can be assigned to each issue by the parties involved. Once party variables (weights, utilities and initial offers) are entered for both parties, negotiation results are calculated and displayed in tabular and graphical formats.

2. Graphical User Interfaces (GUI)

Over the past ten years, the Graphical User Interface has become the standard operating environment for most software programs. The beginnings of GUI design can be traced to research started in the 1970's at the Xerox Palo Alto Research Center. The result of this initial research was the introduction of a computer with a GUI interface called the Xerox Star 8010 workstation. It had a cursor-based interface using high resolution graphics and icons. (Norton, 1990)

The next evolution in GUI design was begun by the Apple Computer Corporation. Apple designed and introduced the Lisa Computer in 1983 after visits to the Xerox Palo Alto Research Center by key corporate personnel. Although not commercially successful, it was the precursor for the successful introduction of the Macintosh Computer in 1984. Most people today credit the Apple Macintosh as starting the "GUI revolution."

Realizing the potential importance of the GUI design, Microsoft Corporation began work on their own GUI and introduced the Windows GUI environment in 1985. Several revisions of this GUI followed until the commercially successful release of Windows 3.0 in 1990. At the time of this writing, Microsoft is releasing an updated version of Windows 3.0 - Windows 3.1. It is expected that the GUI-based Bilateral NSS

developed for this thesis will run faster with Windows 3.1. This current version, along with the Microsoft Disk Operating System (DOS), is the environment under which the Bilateral NSS was developed.

C. LITERATURE REVIEW AND METHODOLOGY

The initial thrust in researching for this thesis was in gaining a basic perspective on designing the user interface for NSS. Several publications on general interface design were reviewed (Lim & Benbasat, 1991). These publications discussed a broad spectrum of design techniques on graphical interfaces as well as the character-based interfaces such as menus and command line entry. With a basic understanding of interface design, the next step was getting information on GUI design for the IBM-PC/Windows platform. The primary publication used was the Common User Access Advanced Interface Design Guide (IBM, 1989). This document provides a set of interface standards for all Windows programmers to follow.

After gaining an initial feel for interface design techniques through the literature review, an overall design strategy for the program was initiated. An initial prototype of the various screens was developed and presented to various potential users for feedback. Several iterations of this process resulted in a final prototype that successfully met general interface design principles. Implementation consisted of coding and testing each screen module before the final integration and testing for the entire program.

D. SCOPE AND DIRECTION

The main focus of this thesis is presenting the design considerations for developing a GUI-based program. Examples and techniques unique to this environment will be presented and explored. Where appropriate, character-based versus GUI-based interface design considerations will be contrasted.

The second chapter will open with a broad overview of general interface design principles. Five main categories of interfaces will be discussed and compared with particular attention focused on the graphical user interface. The third chapter will discuss the actual design and implementation of a Bilateral NSS. Design features and considerations for the individual modules of the Bilateral NSS will be presented. The final chapter will summarize the findings and make recommendations for future research.

The framework and model for the Bilateral NSS described in this thesis is reproduced in Appendix A. Appendix B excerpts the end user manual guidelines set forth in DOD standard 7935A. The Bilateral NSS user's manual is provided in Appendix C.

II. INTERFACE DESIGN OF NEGOTIATION SUPPORT SYSTEMS

A. GENERAL INTERFACE DESIGN PRINCIPLES AND ISSUES

Successful computer programs begin with an intelligently designed user interface. Without a good interface there is little incentive for the user to continue to use your program. "... if the computer industry is successfully to extend its user base it must urgently attend to developing user-friendly interfaces" (Coombs, 1981). It is therefore incumbent upon the program designer to become thoroughly familiar with two important aspects of good software design: understanding the needs of the intended users of the program and the generally accepted guidelines of proper interface design.

This chapter begins with a review of interface design techniques. The strengths and weaknesses of the various designs will be examined as well as the rationale for choosing the graphical user interface over other possible alternatives. The last part of this chapter will deal with the actual design considerations involved in the programming of the Bilateral NSS.

1. Types of Interfaces

In his book on designing the user interface, Shneiderman identifies five categories of user interfaces (Shneiderman, 1987). They are:

- **Menu Selection** - In this method the user is presented with a list of items and must choose one by highlighting his choice or pressing the appropriate key. This style is appropriate for novice and intermediate users. It is easy to learn, provides for structured decision making and supports error handling. Disadvantages include the

danger of creating too many layers of menus and slowing the speed of use for frequent users of the program.

- Form Fill-in - This method displays a group of fields for user fill-in. The fields are normally navigated by use of the cursor or tab keys. This style is appropriate when data entry is the main form of interaction. It simplifies data entry, requires modest training and permits the use of form management tools.
- Command Language - This method relies on the user learning a group of commands that are often complex and cryptic in nature. This style is appropriate for experts and frequent users of the program. It allows the user to quickly initiate commands with short and highly complicated syntax. Disadvantages include poor error handling and substantial user training.
- Natural Language - This method allows users to enter words or phrases in a natural language format. Its chief advantage is that it can relieve the user from having to learn an obscure command syntax. Disadvantages include the requirement for frequent "clarification dialogs" and the possibility of being slower and more cumbersome.
- Direct Manipulation (Graphical User Interface) - This method involves the visual representation of objects and actions of interest to the user. The user is allowed to select from a visible set of objects and act upon those objects by means of various cursor motion devices such as mice, trackballs and keyboards. It is relatively easy to learn and retain for both novices and experts. Disadvantages normally include more difficulty in programming and the requirement for additional pointing devices and higher quality displays.

As can be seen from the above list, there are a variety of interface design methods at the disposal of the computer programmer. Choice of a method depends on the complexity of the program and the experience level of the programmer. Each one requires the programmer to correctly analyze both the user's requirements and the necessary functionality of the program. In a Danish textbook on interface design (Nielson, 1989), five guidelines for the process of user interface design were presented.

They are:

- Know the user
- Involve users during the design
- Coordinate the total user interface
- Empirical measurements
- Iterative design to remove usability problems

As can be seen in the above guidelines, the user is a key element in almost all aspects of interface design. The programmer must avail himself of every opportunity to get user input and feedback during all stages of program development. The final guideline is especially critical. Even with user involvement during the early stages of system design, until the user is able to interact with your program, the success of your design is highly tentative at best. When practicable, a design philosophy based on rapid prototyping will yield more success than the "waterfall" method of system design (Page-Jones, 1988).

2. Graphical User Interface

Until the unveiling of the Apple MacIntosh in 1984, almost all interface design followed the general guidelines enumerated in the first four of Shneiderman's methods. Although still used for certain applications, the direct manipulation or graphical user interface has supplanted the earlier design methods as today's design of choice. Indeed, today's software applications need graphical user interfaces to sell (Zachary, 1990).

Currently, there are a wide variety of GUIs running on almost all available hardware/software platforms. Some examples are:

- Microsoft Windows 3.0 on IBM compatible systems
- GeoWorks Ensemble on IBM compatible systems
- IBM Presentation Manager for OS/2
- Motif for Unix-based systems
- NextStep for the Next computer

In a tutorial on graphical interface design (Marcus, 1990), the author stresses the importance of visually communicating a program's data and functions. Proper use of graphic design principles and an effective use of "visible language" contributes to improved visual communication. The author defines visible language as "...all the graphical techniques used to communicate the message or content." Some aspects of visible language are:

- Layout: formats, proportions and 2-D and 3-D organization
- Typography: selection of typefaces and typesetting
- Color and texture: color, texture and light that convey pictorial reality
- Imagery: signs, icons and symbols
- Animation: a dynamic or kinetic display that is especially important for video related imagery
- Sequencing: the overall approach to visual storytelling
- Sound: abstract, vocal, concrete or musical cues

- Visual Identity: the additional, unique rules that lend overall consistency to a user interface

Careful manipulation of this visible language and judicious adherence to the following set of design principles will help to ensure a successful well thought out graphical design. The three principles and amplifying concepts within each principle are detailed below.

a. Principles of Graphic Design

(1) Organize

Provide the user with a clear and consistent conceptual structure.

Four important concepts associated with this principle are:

- Consistency - observe the same conventions and rules for all elements of the GUI.
- Screen Layout - standardize the screen layout and group related items.
- Relationships - link related elements and disassociate unrelated elements.
- Navigability - provide an initial focus for the user; direct attention to important items; and assist in navigation throughout the material.

(2) Economize

Maximize the effectiveness of a minimal set of cues. Four concepts associated with this principle are:

- Simplicity - include only those elements that are essential for communication.
- Clarity - design all components so that their meaning is not ambiguous.

- Distinctiveness - distinguish important properties of essential elements.
- Emphasis - make the most important elements salient, de-emphasize non-critical elements and minimize clutter so that important information is not hidden.

(3) *Communicate*

Match the presentation to the capabilities of the user. Six concepts associated with this principle are:

- Legibility - design characters, symbols and graphic elements to be easily noticeable and distinguishable.
- Readability - make the display easy to interpret as well as inviting and attractive.
- Typography - use a small number of typefaces. Generally, you should use a maximum of three typefaces in a maximum of three point sizes.
- Symbolism - carefully design icons, charts, maps and other imagery to properly convey the desired contents.
- Multiple Views - provide multiple perspectives on the display of complex structures and processes.
- Color/Texture - use a consistent color code for screen displays and a maximum of five plus or minus two colors in each display.

b. Hardware Elements

Common to all GUIs are several hardware elements. They are:

- High resolution graphics displays
- Pointing devices such as mice, trackballs and pens
- Keyboards

c. Software Elements

In addition to common pieces of hardware, there are software elements common to most GUIs. They are:

- Windows
- Pull-down menus
- Dialog boxes
- Icons
- Buttons and scroll bars
- Cursors

Careful examination of the Microsoft Windows 3.0 interface will reveal a general adherence to the principles and elements enumerated above. To accomplish this, the Microsoft Windows 3.0 system was designed using GUI standards detailed in an IBM document called the Common User Access Advanced Interface Design Guide (IBM, 1989). Common User Access (CUA) is a portion of IBM's System Application Architecture (SAA) that defines an overall set of interface standards. Conformance to the CUA ensures consistency of the interface across platforms as well as software applications on a single platform.

B. GUI DESIGN FOR NEGOTIATION SUPPORT SYSTEMS

The GUI guidelines presented in the previous section are in principle applicable to all software interfaces. For NSS software, there are, however, some additional design concepts that should be considered.

Bui (1987) argues that the following topics should be taken into consideration when designing for a group decision environment:

First, a Group Decision Support System (GDSS) should provide both formal and informal man-machine-man interfaces to enhance information exchange within group members. Second, the GDSS should be designed in such a way that (i) it becomes favorable media for solving group problems, and (ii) it ensures that decision makers do not waste unnecessary resources in interpersonal exchange at the expense of a thorough discussion of the object of the group problem.

... a user interface of a DSS should (i) be transparent and consistent to make the system easy to learn, use and remember; (ii) be suitable for both novice and expert use; (iii) let the user have control of the system and feel competent in task performance; (iv) promote effective usage and better decision-making; (v) and be efficient in the use of system resources (Stohr and White, 1982; Shneiderman, 1986). Although these design principles should prevail in building GDSS, importance should be given more to the concept of ease-of-use and transparency.

... DSS users are often decision makers who deal with strategic and ill-structured problems. It is reasonable to expect that (i) the frequency of GDSS use is low and, (ii) familiarity with computers is insignificant to none. Under such a decision environment, a comprehensive, structured and controlled interface, such as sequences of hierarchical menus or carefully designed queries, seems to be most appropriate in order to satisfy the five design principles mentioned above.

In addition to Bui's arguments, Lim and Benbasat (1991) propose a conceptual framework for designing software interfaces for group decision support systems. They suggest four dimensions that need to be examined in group interface design:

- Concurrency – this dimension describes the type of collaboration between members of a work group. The *temporal* aspect of this dimension concerns itself with whether the collaboration is synchronous or asynchronous. The *spatial* aspect describes whether the collaborators are collocated or dispersed.
- Content – this dimension describes the type of message passed between members of a group. There are two categories – *task-oriented* or *social-emotional*. Computer-mediated communication tends to be richer in task-oriented than social-emotional messages.
- Path – this dimension describes the type of communication path. Some of these paths may be *collaborator – collaborator*, *collaborator – workstation – collaborator*, *collaborator – display*, etc.
- Channel – this dimension describes the characteristics of the medium through which communication occurs. Two issues are discussed – *technology support* and *mode*. The modes by which collaborators communicate may be classified by the degree of social presence conveyed. In a computer-mediated context, the textual and graphical/symbolic modes at the low end of the social presence spectrum are predominant.

The above mentioned design considerations are not totally unique concepts. Rather, they build upon the general design techniques enumerated in the previous section. They attempt to address some of the special characteristics inherent in a computer-mediated environment. When applied to the GUI design of the Bilateral NSS, they give the designer additional insight into the type of person that uses a NSS program and some of the environmental issues he may be exposed to.

The next section will take the design ideas presented in this chapter and attempt to apply them to the design of a Bilateral NSS. Although certain aspects of the above discussion are not applicable to the design of this particular Bilateral NSS, the general guiding principles and special considerations of this project will be explained.

III. DESIGN AND IMPLEMENTATION OF A BILATERAL NSS

This section presents the philosophy used in designing the Bilateral NSS. The first part of this section discusses the GUI specifications for the Bilateral NSS. The second section discusses the design considerations for the program as a whole. The last part breaks down the Bilateral NSS program into its functional parts and discusses the programming and design considerations used.

A. GUI SPECIFICATIONS

Based on the previous discussion of general graphic design principles and the framework proposed by Lim and Benbasat, the following specifications have been determined for the GUI interface:

1. Concurrency

a. Temporal

The system should be distributed in time. Both negotiating parties can access and use the Bilateral NSS at different points in time.

b. Spatial

The system should be distributed in space. Both negotiating parties can either use the Bilateral NSS in face-to-face mode or at two different physical locations.

2. Content

a. Task-oriented

The system should use a formal and comprehensive multiple attribute utility theory to define negotiators' tasks.

b. Social-emotional

N/A

3. Path

As a minimum, the Bilateral NSS should support the following communication paths:

- collaborator - collaborator
- collaborator - workstation - collaborator
- collaborator - display

4. Channel

The main thrust of the Bilateral NSS is its application of multiple attribute utility theory to the negotiation process. Therefore, the mode of operation can be at the low end of the social presence spectrum. Ideally then, the predominant sub-mode should be graphical/symbolic if we are to exploit the advantages of the graphical user interface.

Particular aspects of designing the visual representation presented to the user are discussed in the next section.

B. METHODOLOGY

The first step taken in designing this program was to look at the original program as it was implemented in the C language (Gilley, 1991). The screen layouts and menu structure were penciled out and the general flow between them were analyzed. After initially trying to design the program using the old system structure, it became apparent that trying to directly convert it over to a graphical interface would not be successful. Although the menu-driven structure was adequate for the character-based interface that it was originally written for, a direct conversion would not in any way use the graphical user interface to its fullest advantage.

The second step was to come up with an overall flowchart of the program. All the information needed to be input by the user and all the information needed to be presented to the user was written down. This data was then broken down into logical groupings. The next step was to figure out how best to present this data to the user in a clear and logical manner. After designing the initial prototype that included the general screen layouts and the interaction between them, it was presented to several potential users for feedback. Several iterations of this cycle eventually produced the final working version.

The initial design layout was developed by adhering as much as possible to the guidelines outlined in the Common User Access guide. This document details a standard set of guidelines to follow when designing graphical interfaces for Windows and OS/2 programs. Standard menu bar configurations, screen layouts and minimum screen controls are some of the many design considerations presented. Some of the screen design issues that were standardized across the entire program are (See Figure 1):

- Button position - all buttons are located on the bottom righthand side of the screen. If the width of the screen is sufficiently small, the buttons are equally spaced across the entire bottom. The *Help* button is always the rightmost button in the row.
- Button types - almost all screens have an *OK* and *Cancel* button. If both are available the *OK* button is always on the left.
- Colors - a similar color scheme is used for all screens. A limited number of colors were used when groups of data needed to be highlighted.
- Help system - a *Help* button is available on all screens. This button provides context-sensitive help for the current operation.

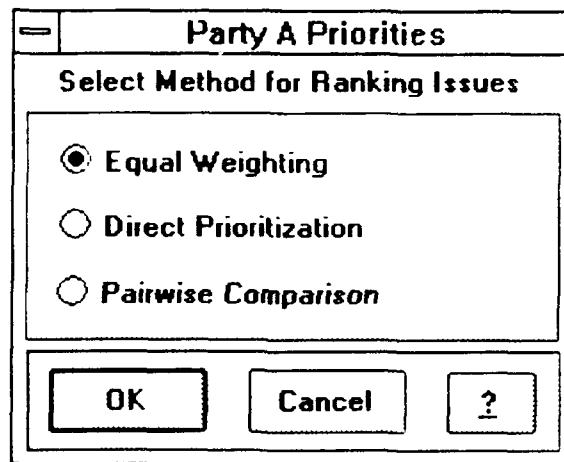


Figure 1
Sample Program Screen

C. INDIVIDUAL SCREEN DESIGN

The following sections discuss the design considerations used in developing the screen layouts for the various portions of the Bilateral NSS program.

1. Main Bilateral NSS Screen

Figure 2 shows the opening screen the user sees when starting the Bilateral NSS program. Window design components normally available on all Windows 3.0

application programs were used. These include the upper left Control Menu button, the upper righthand minimize and maximize buttons and the main Action Bar. The arrangement of the two Action Bar items are in compliance with the CUA guidelines. The background graphic of the shaking hands was included to visually convey the intent of the program.

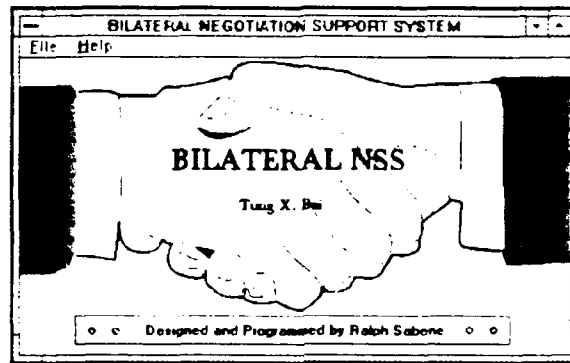


Figure 2
Bilateral NSS Opening Screen

2. File Menu Screens

The four screens that follow are associated with the commands listed under the File Menu on the Action Bar.

a. *Start New Session Screen*

Figure 3 shows the screen displayed when the user selects the *Start New Session* command under the File Menu. This command is selected to begin a new negotiation session. The user is prompted to enter the filename he wishes to store the data under. The standard set of control buttons are located along the bottom of the screen for consistency with all other screens. A *Cancel* button is provided to allow the

user to cancel the command if he decides to. As always, a *Help* button (denoted by the ? symbol) is the rightmost button.

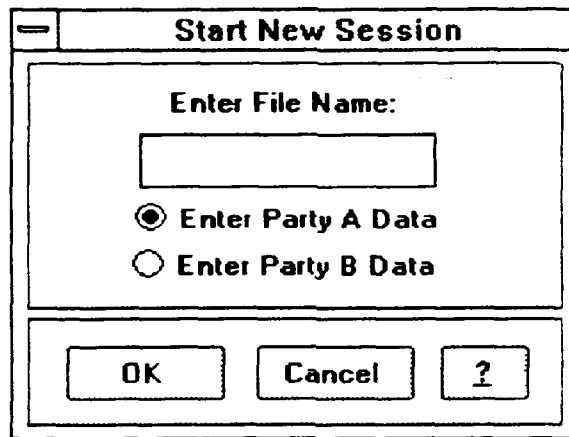


Figure 3
Start New Session Screen

b. Open Prior Session Screen

Figure 4 shows the screen displayed when the user selects the *Open Prior Session* command under the *File Menu*. The standard complement of control buttons is again located on the bottom of the screen in the same relative position as all other screens. This particular orientation of the file, directory and drive list boxes is the new standard for all applications written for Windows 3.0. This particular screen will look familiar to all users who run other Windows applications.

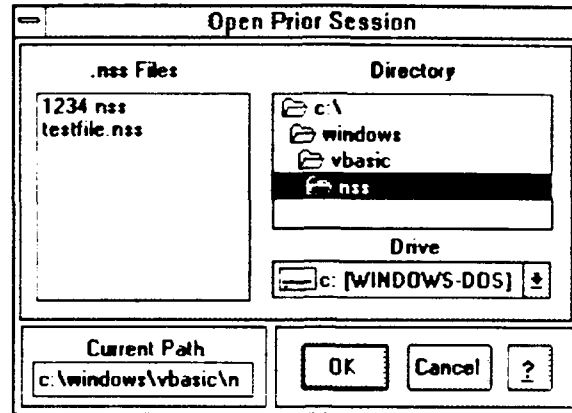


Figure 4
Open Prior Session Screen

c. *Save Current Session and Save Current Session As Screens*

Figures 5 and 6 show the screens the user sees when selecting the *Save Current Session* and *Save Current Session As* commands, respectively.

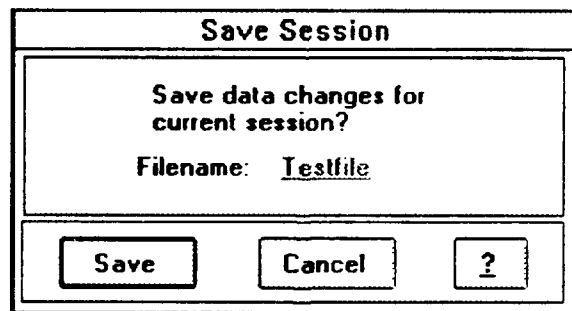


Figure 5
Save Current Session Screen

The button layouts are consistent with other program screens. The screen designs are very similar since they are used for the same basic purpose. For the *Save Current Session As* command, the user is provided with a text box to enter any eight

character filename. If non-allowable characters are entered, a message box indicating the error is displayed.

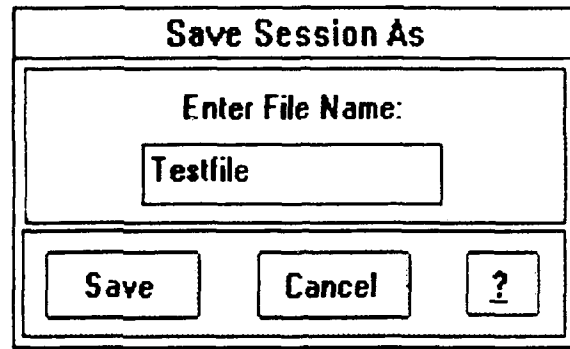


Figure 6
Save Current Session As

3. Help Menu Screens

The two screens that follow are associated with the commands that are listed under the Help Menu on the Action Bar.

a. Index Screen

Figure 7 shows the screen displayed when the user selects the *Index* command located under the Help Menu. This screen is the only one that was not designed using the same control layout considerations as the other screens. The use of *OK* and *Cancel* buttons was not appropriate since their meaning to the user would not have been clear in this situation. To get the user's attention, a set of program topics in the center of the screen are grouped together. The labeling of the *Get Help* and *Quit* buttons was used to clearly convey their intent if pressed.

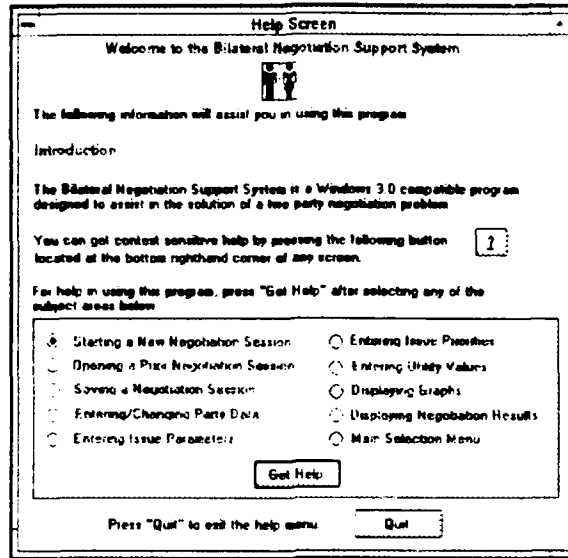


Figure 7
Help Index Screen

b. About... Screen

Figure 8 shows the screen displayed when the user selects the *About...* command located under the Help Menu. It is common practice to include this command under the Help Menu to indicate the program's current version, authors and any other information deemed appropriate.

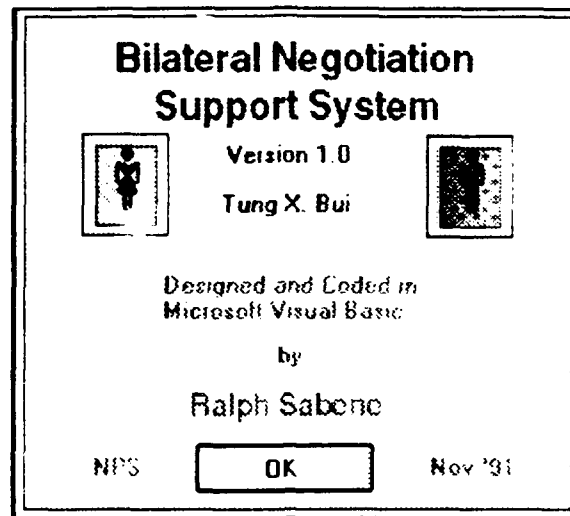


Figure 8
About... Screen

4. Main Selection Menu Screen

Figure 9 shows the screen displayed when the user starts the program by either opening a prior session or by starting a new session. The ordering of the menu items was chosen so that the first item a user would most likely go to was displayed at the top. Additionally, the default radio button is also the first item. The double column format was chosen as the most appropriate design to both limit redundancy and provide a symmetrical display. Button layouts are standard and the *Quit* button was used instead of the *Cancel* button since it would convey a clearer meaning to the action of leaving the Main Selection Menu.

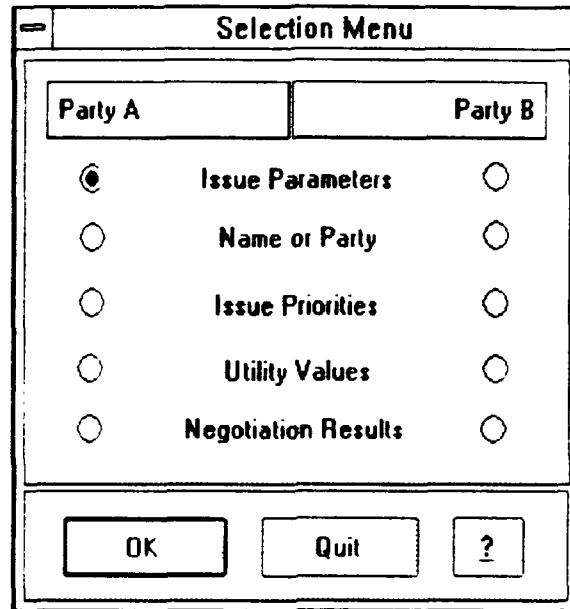


Figure 9
Main Selection Menu Screen

5. Issue Parameters Screen

Figure 10 shows the screen displayed when the user selects the *Issue Parameters* item from the Main Selection Menu. The lines were designed so that the user's cursor is automatically moved to the next available text box when he presses the *Enter* key. This helps to speed up user data entry. To enter an initial starting offer the user has two choices. He can directly enter the value in the text box provided or use the scroll bar located beside each text box. Two additional control buttons, *Add New Issue* and *Delete Issue*, are provided to give the user a positive means of initiating those actions.

| Issue Data | | | Party A | |
|------------------|------------|------------------------|---------|---|
| Issue Name | Unit Value | Initial Starting Offer | | |
| 1 Compensation | M\$ | 100 | • | • |
| 2 Duration | years | 20 | • | • |
| 3 Jurisdiction | percent | 100 | • | • |
| 4 Construction | years | 10 | • | • |
| 5 Defense | percent | 25 | • | • |
| 6 Nationals head | people | 200 | • | • |
| 7 A/L allowed | A/L | 200 | • | • |
| 8 Ships allowed | ships | 100 | • | • |

Figure 10
Issue Parameters Screen

6. Name or Party Screen

Figure 11 shows the screen displayed when the user selects the *Name or Party* item in the Main Selection Menu. This screen uses the standard button layout with two additional text boxes. If the user exceeds the 15-character limit for either text box, a message to that effect will be displayed.

| Party A Data Update Screen | |
|--|-----------------|
| Negotiator Name | Ambassador Hall |
| Negotiator Party | United States |
| <input type="button" value="OK"/> <input type="button" value="Cancel"/> <input type="button" value="?"/> | |

Figure 11
Name or Party Data Screen

7. Issue Priorities Selection Screen

Figure 12 shows the screen displayed when the user selects the Issue Priorities item from the Main Selection Menu. The screen is a standard option button screen with the normal three button layout.

The image shows a dialog box titled "Party A Priorities". Inside the dialog, the text "Select Method for Ranking Issues" is displayed. Below this text are three radio button options: "Equal Weighting" (which is selected), "Direct Prioritization", and "Pairwise Comparison". At the bottom of the dialog, there are three buttons: "OK", "Cancel", and "?".

Figure 12
Issue Priorities Screen

8. Issue Priorities (Direct Entry) Screen

Figure 13 shows the screen displayed when the user selects the *Direct Prioritization* option from the Issue Priorities Selection Menu. Values can be entered in the Weight column by direct entry in the text box or by using the scroll bars located beside each text box. The standard three button layout is used in this screen also.

| Issue Name | Weight | Issue Name | Weight |
|----------------|--------|------------------|--------|
| 1 Compensation | 10 | 2 Duration | 8 |
| 3 Jurisdiction | 7 | 4 Construction | 1 |
| 5 Defense | 7 | 6 Materials used | 4 |
| 7 A/C allowed | 8 | 8 Steps allowed | 8 |

Enter a weighting factor for each issue. Use the scroll bars to enter a value between 0 and 10.

OK Cancel ?

Figure 13
Issue Priorities (Direct Entry) Screen

9. Utility Values Screen

Figure 14 shows the screen displayed when the user selects the *Utility Values* item from the Main Selection Menu. The main design consideration in setting up this screen was how to make user entry of utility data as simple and intuitive as possible. To provide a graphical look to the display, seven columns of 11 radio buttons were used. The user simply has to click the desired button in each column to make his preference. The completed display presents the data in an x-y graph fashion. Since there are seven utility values associated with each issue a separate box was provided to allow the user to select which issue he would enter data for. The remaining buttons are in a standard layout.

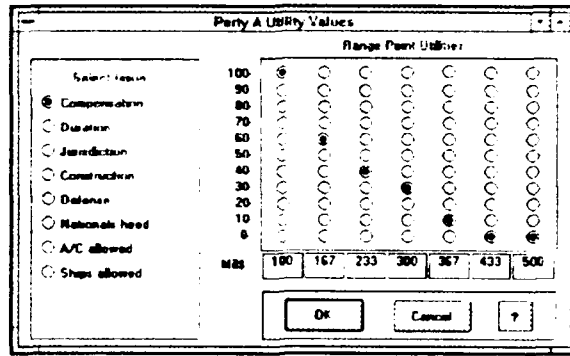


Figure 14
Utility Values Screen

10. Negotiation Results Screen

Figure 15 shows the screen displayed when the user selects the *Negotiation Results* item from the Main Selection Menu. Based upon the type of data presented, the tabular format was the most logical choice. The column total text boxes were separated from the rest of the data to give the user a clearer presentation. A distinctly different color was chosen for the Scratch Pad column that allows user modification to better indicate its unique nature. Descriptive names were chosen for the screen buttons to clearly indicate their purpose.

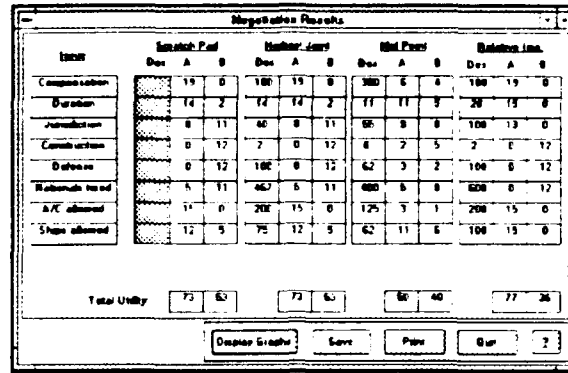


Figure 15
Negotiation Results Screen

11. Display Graphs Screen

Figure 16 shows the screen displayed when the user selects the *Display Graphs* button from the Negotiation Results screen. To augment the tabular data presented in the Negotiation Results screen, a graphical representation of the data was provided. The graph portion of the screen uses a three color layout to clearly present the data. The display grid is re-scaled for each issue to provide the maximum usable display area for each set of data. A standard option button selection scheme was chosen to select the desired issue for display. Two option buttons are also included to allow the user to toggle between weighted and unweighted data.

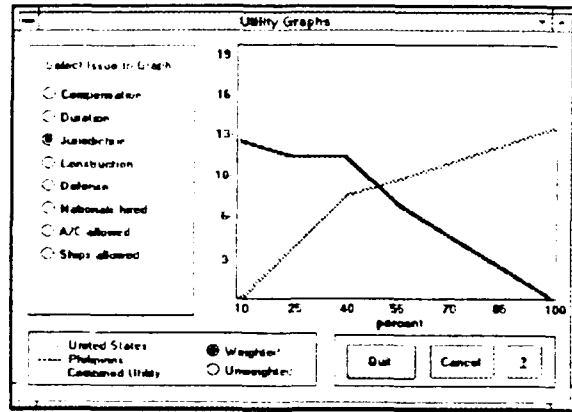


Figure 16
Display Graphs Screen

IV. SUMMARY AND SUGGESTIONS FOR FUTURE RESEARCH

A. SUMMARY

The goal of designing a graphical user interface for the Bilateral NSS was achieved. The GUI design followed the commonly accepted graphic design principles enumerated in this thesis. Additionally, the CUA standards outlined in IBM's System Application Architecture were followed to the maximum extent possible. It is believed that the GUI-based version of the Bilateral NSS will receive a favorable response in comparison to the original character-based program.

B. SUGGESTIONS FOR FUTURE RESEARCH

Several follow on studies are suggested as a result of this thesis. First, a study could be conducted to measure user preference between the GUI-based and character-based programs. Since the task sets of the programs are identical, a valid comparison could be made. Second, additional capabilities could be added to the original program to further enhance the negotiation process. This might include dynamic updating of graphs and tables with multiple views of the information on the screen. Third, the program could be integrated into a broader Group Decision Support System. The Bilateral NSS could be added as a module to such a system.

APPENDIX A

FUZZY PREFERENCES IN BILATERAL NEGOTIATION SUPPORT SYSTEMS

Tung Bui
Department of Administrative Sciences
U.S. Naval Postgraduate School
Monterey, Ca 93943

Taracad Sivasankaran
Department of Accounting & MIS
California State University
Northridge, Ca 91330

Abstract

This paper presents a bilateral Negotiation Support System (NSS) based on a multi-attribute utility model that adapts a fuzzy set methodology in determining user's preference functions. The system can concurrently handle negotiations that span across multiple mediating issues in a manner that increases the joint utility of both parties. The NSS is expected to impart a more interactive and realistic approach to capturing uncertainties while developing the utility functions using the standard approach. The potentiality of the proposed NSS lies in its ability to allow negotiators to evaluate potential treaties quickly, explore alternate arrangements that reveal to be more advantageous to both parties than those which are arrived at intuitively.

1. Introduction

Negotiations have always been an integral part of business, organizational management, and international affairs. With ever increasing competitiveness, negotiations require greater sophistication and faster resolution.

Today the information and knowledge of the parties involved are more technologically complex, making it more difficult to crisply define agreements leading to a compromise. Oftentimes, each party to the negotiation knows conceptually the multiple issues of the problem in fairly good detail, but this is not sufficient to define each other's preference/utility functions in a deterministic an interactive fashion. Current systems, however, can handle only deterministic inputs. In reality, utility functions are not deterministic and negotiators are willing to budge their positions in small variants during actual negotiations.

This paper proposes an extension to a Pareto-optimum model that maximizes the utilities of the two parties using the fuzzy set concept to capture the negotiators' preferences function. The paper is organized as follows. Section 2 addresses the problems in bilateral negotiations. Design issues for building bilateral Negotiation Support Systems (NSS) are discussed in section 3. Section 4 lays down the basic steps of an interactive multi-attribute model for negotiation involving multiple treaties between two parties. In section 5, we explain

the use of fuzzy sets in formulating negotiators' preferences as an improved means for the utility modeling. Section 6 illustrates the model using an example.

2. Background

Traditionally, bilateral negotiation is often viewed as a *distributive bargaining* in that it operates on the notion of a "fixed pie" which must be shared between the two parties. Both protagonists seek to maximize their own goals without concern for the other. Research has shown that distributive bargaining or the win-lose approach leads to capitalizing on power differentials, escalating hostilities, suboptimal agreements, and ultimately, an uncooperative relationship for future negotiations (e.g., Lewicki and Litterer, 1985).

An alternative approach is the *integrative bargaining* or win-win method. This seeks to resolve conflict with a set of procedures that permit both sides to maximize their objectives. Integrative bargaining generates solutions that yield high joint benefits, thus contributing to a more positive relationship (Fisher and Ury, 1981; Pruitt, 1981).

Real life negotiations are, however, characterized by a mixture of distributive and integrative elements. This phenomenon is known as *mixed-motive* paradigm. Hence, it is important to identify interest differentials quickly to help negotiators diagnose and reduce conflicts, thus moving towards integrative bargaining.

There are a number of problems associated with negotiation. In a bilateral negotiation, the protagonists assume that their interests are always in conflict with each other. Bazerman (1983) argues that this entrenched assumption inhibits the creativity and problem-solving necessary for the development of integrative solutions. Empirical studies have also

found that negotiators may not always be cognizant of their judgment criteria. Further, they may not be able to assess correctly the view of their counterparts (Kleinmuntz, 1990). Social and emotional factors have also been found to affect objectivity and rationality in negotiations. Kessler (1978) suggests that successful conflict resolution depends on successful use of techniques that could handle socio-emotional and cognitive bias issues inherent in conflict situations. As discussed later in this paper, we argue that by using a formal and comprehensive methodology for negotiations, the parties involved -- possibly the arbitrator as well -- could provide a structure for systematic information exchange and could lessen the personal biases of both parties. A computerized system that implements this methodology will be very useful in negotiations.

3. A Framework for Bilateral NSS

Figure 1 depicts a framework for designing a NSS for bilateral negotiation based on the Type VI of GDSS defined by Bui (1987). Each party can have his/her own DSS that contains models customized to his/her needs that individually describe the issues (DSS1 and DSS2). The Negotiation Module allows the negotiators to engage in a joint and open modeling effort. In practice, technical experts and advisors usually supply the bulk of information to the negotiators either before or during the negotiation process. Even if such information is accurate and complete, there is no reason why the negotiators themselves could not exercise their freedom of choice at the time of negotiation through joint concession, and experimentation of simpler models of their own. Nyhart and Samarasan (1987) contend that this can help the negotiators appreciate better the strengths and weaknesses of the other party's position and arguments. A joint and open modeling effort may be to the advantage of both parties.

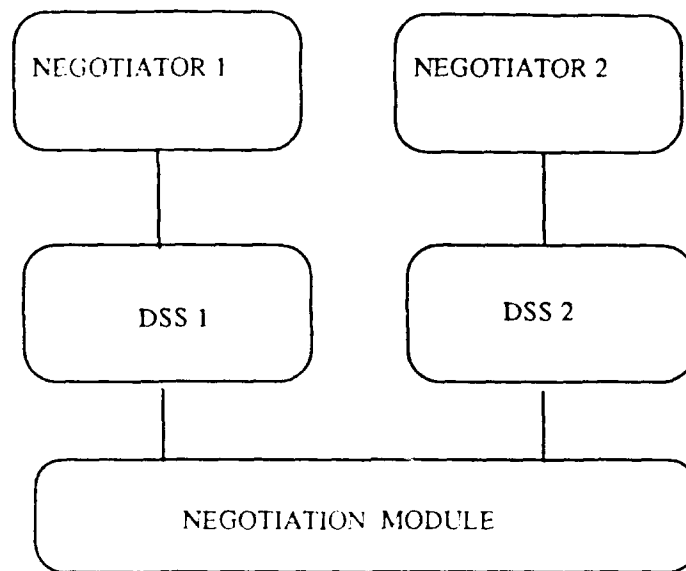


Figure 1. A Framework for Bilateral NSS

The NSS should provide a model-based interactive facilitation process that offers a comprehensive framework to allow the parties to concentrate on joint problem-solving rather than on convoluted arguments. The objectives of using a NSS are listed below:

1. Establish a consensual database as a foundation for negotiation,
2. Evaluate the impact of perceived uncertainty,
3. Provide communication links for bargaining and discussion,
4. Suggest restructuring for non-cooperative issues, and
5. Help search for agreements through Pareto-optimization.

Computer support can be used to assist the negotiators in interactive information elicitation and process them in an orderly manner. It can also update data as inputs are entered, and present the results of analysis both tabularly and pictorially. It should also act as a tool to let negotiators know that their compromises or concessions can be implemented

and will produce the desired and agreed-upon results.

4. An Interactive Procedure for Bilateral Negotiation

This section focuses on the negotiation module described in Figure 1. It describes a formal and comprehensive model for joint problem solving. The purpose of the model is to focus on asymmetries of interests between the two parties so that the terms of the final treaty are better for both (Barclay and Peterson, 1978). The whole algorithm is based on the Pareto principle applied to a bilateral negotiation situation. A treaty is Pareto optimum when it is no longer possible to increase the utility of one party without decreasing the utility of the other. A good treaty is one that yields to each party those issues which are more important to him/her. Thus the two parties should try to push the negotiation toward the Pareto optimum by capitalizing on asymmetries of interest, and sometimes by redefining the situation to reveal more asymmetries.

The essence of the procedure is described below:

Step 1. Identify the major treaties which the two parties would like to sign. For example, say the U.S. and a host country are negotiating on the extension of a military base treaty and establishing a bilateral trade treaty.

Step 2. For each of the treaties being considered, identify a common set of major issues about which the two parties disagree. The initial positions of the parties on each of the issues should be stated. Assume that for the military base treaty, the negotiators have identified the issues important to their nations as duration of the use of the military base by the U.S., civil jurisdiction of the host country over the military personnel, and U.S. economic compensation.

Step 3. Each party assigns a relative weight to each of the issues. It is important to understand the meaning of the relative weight in a bilateral negotiation context. The weights represent the relative importance of the difference between the parties' position. For example, if the U.S. gives a weight of 20 points to duration and 10 to economic compensation, the U.S. does not consider the first issue to be two times as important as the second issue. Rather, the 20/10 ratio implies that the U.S. considers the change from the host position to the U.S. position on the economic compensation issue to be twice as important as the change from the host position to the U.S. position on the duration issue. Assume that the weights for the three issues are (50,30,20) and (65,5,30) for the U.S. and the host country respectively.

Step 4. Define the range of values for all the issues as identified by both parties. For example, the U.S. may not be willing to sign a treaty unless it spans a minimum of 10 years, whereas the host country may want to restrict the duration to 5 years. It can be inferred that the negotiation will encompass the period between 5-10 years. A utility curve can be drawn for different values between the 5-10 year range.

Figure 2 shows the utility curves for duration, jurisdiction and compensation for the two countries. Note that these curves are unweighted in that they do not take into consideration the relative weights on the issues described in step 3.

Step 5. For each party, assign relative weights to utility curves. This is done by taking the product of the utility values (vertical axes of the graphs in Figure 2) and the respective relative weights of the issues.

Step 6. For each issue, compute the joint utility curve by adding the utility functions of the two countries.

Step 7. Determine the total utility for each nation across all the issues. Using the maximum utility principle, the value of an issue is the highest point on the joint utility curve. For the first iteration, the data shown in Figure 2 yield to a total utility of 65 for the host country and 30 for the U.S.

As the outcomes suggest, it is imperative to look for a better distribution of utility points. For this situation, as shown in Figure 3, the proposed NSS would check for non-cooperative issues and calls for restructuring. A cooperative situation is one in which the highest value of the joint utility curve is higher than the individual maximum utility values of both parties. Conversely, a non-cooperative situation is one in which the highest value of the joint utility curve corresponds to the highest for only one of the parties, leading to the standard zero-sum game scenario. In this circumstance, it is recommended to split the single non-cooperative issue into subsets of more asymmetrical issues for further search for higher Pareto optima. Note that there exists other aggregation to determine the total utility for both parties, e.g., mid-point analysis, equal utilities, etc.

The model as described in this section requires perfect information and is very sensitive to perturbations (e.g., falsification of weights or

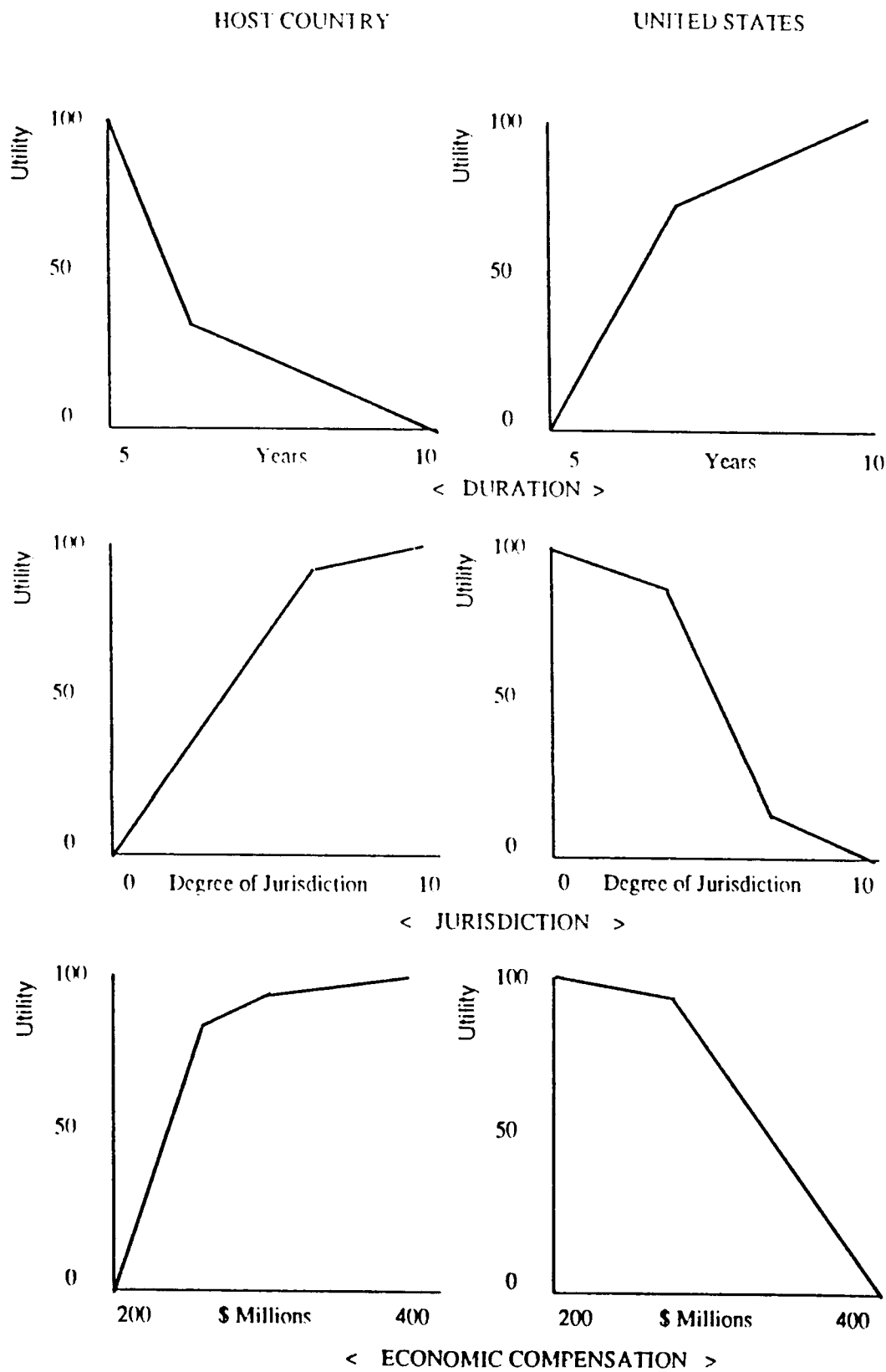


Figure 2. An Example of Multi-Attribute Utility Function (adapted from [1])

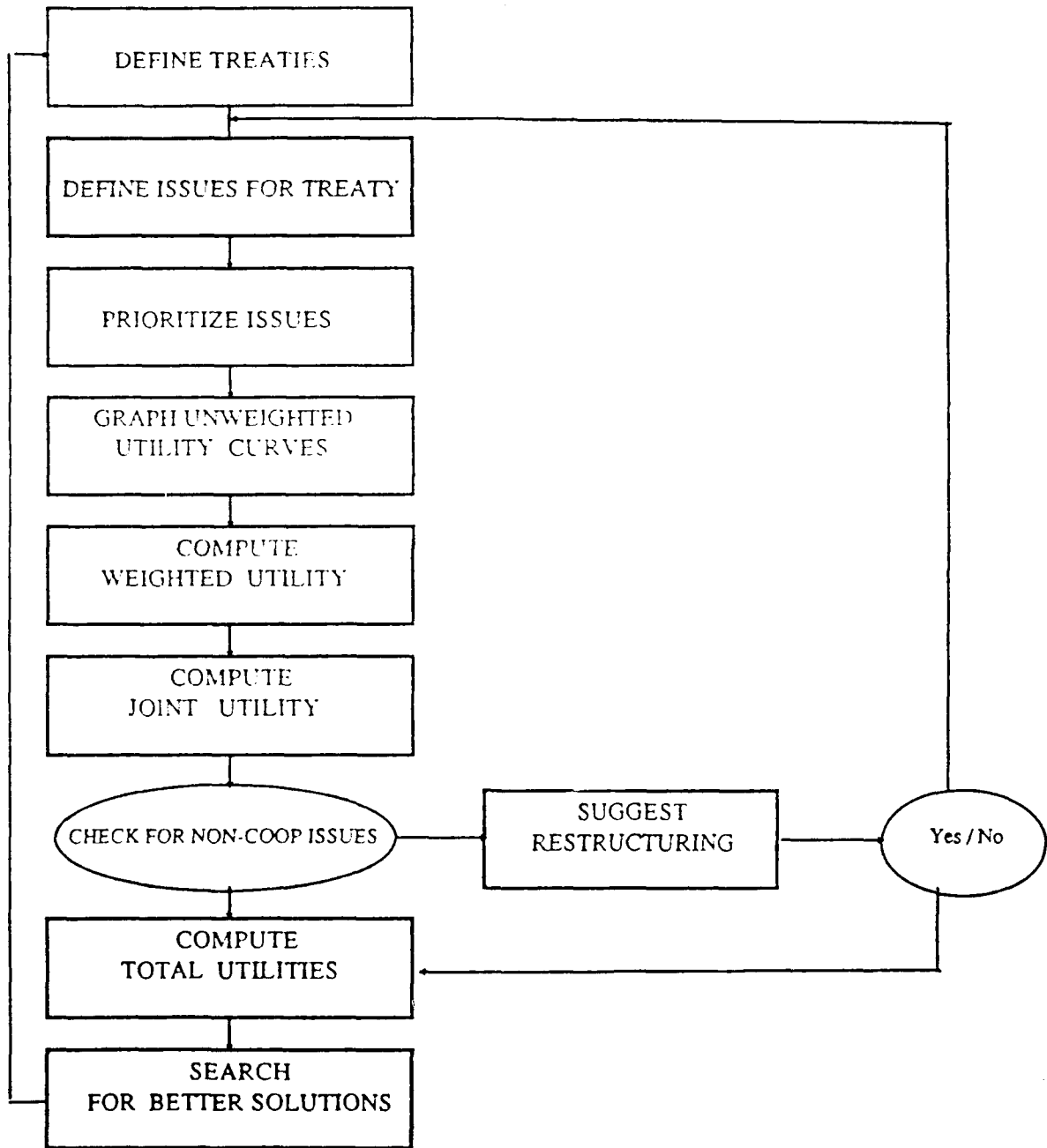


Figure 3. An Interactive Procedure for Bilateral Negotiation

unilateral disclosure of true preferences). For the sake of space, these issues are not discussed further, although they could be resolved by a careful and ordered preparation of the negotiation process.

5. Fuzziness in Preference Formulation

Experience has shown that it is difficult for the negotiators to define precisely their utility functions for the issues (Step 5). Negotiators might not understand the precise meaning of the utility scale (e.g., 0-100 in the example). Yet, they are forced to provide crisp inputs for the utilities. Human quantification is fuzzy at best, and a narrow range of acceptable values might exist around the crisp utility value suggested by the negotiator. Zimmermann (1987) asserts that under such circumstances, using fuzzy sets can capture the uncertainty or vagueness of the negotiators better.

A fuzzy set contains one or more pairs of numbers. The first of each pair represents a domain element. In this negotiation context, the domain element is the utility values [0,100] with respect to the issue range. The second element in the pair is the degree of membership of that element in the fuzzy set ranging from [0,1] (Norwich & Turksen, 1984). For example, the fuzzy set for a scale response 80 (on a 0-100 utility scale) would contain 80 with certainty (i.e., membership value=1) and the other proximate values (e.g., 70, 75, 85, 90) with lesser degrees of membership (e.g., 0.4, 0.8, 0.9, 0.75).

Through the use of fuzzy sets for each scale response to create the utility function, vagueness or complexity in the input information can be captured. Instead of eliciting the utilities of the negotiators with regard to the issues directly by asking them to provide a crisp definition of their utility curves, the fuzzy sets approach attempts to seize the uncertainty from the negotiators inputs and reconstruct their utility

functions. The utility value can be reconstructed by using the weighted sum.

6. An Example of Formulating Fuzzy Preference

In the NSS using fuzzy set technique, the preference elicitation is achieved as follows. For a specific value of a given issue, the user is prompted for a utility value. The utility value is assigned to be the domain element associated with a membership value of 1. If the user indicates that there exists other domain elements having positive membership values, the system prompts the user for membership values for proximate utilities (for example, values ranging 10 points around the initial domain value whenever possible). The set of utilities with their memberships for a given issue value is referred to as a fuzzy function.

Let us say after elicitation, the fuzzy function for a treaty of 10 year duration for the U.S. looks as follows: $f_{\text{duration}}(10 \text{ years}) = [(70,0.4), (75,0.8), (80,1), (85,0.9), (90,0.75)]$. We arrive at a single utility value for duration of 10 using the weighting scheme mentioned earlier, $(70*0.4 + 75*0.8 + 80*1 + 85*0.9 + 90*0.75) / (0.4 + 0.8 + 1 + 0.9 + 0.75) = 81$.

The procedure is then repeated for other possible values of the duration issue. The resulting set of utility points are then used to specify the utility function. The utility functions of other issues can also be done in a similar manner.

7. Summary

To use a formal multi-attribute negotiation model, negotiators are supposed to provide consistent and stable preference information. This information should not contradict with previous judgments. The interactive procedure proposed in this paper

seeks to allow the negotiators to strengthen their preference structure. This can be achieved through an interactive exploration of the fuzzy sets. We expect that true preferences will finally emerge from the learning process made possible by the system. The algorithm discussed in this paper is a specific treatment of preference information. Further research is required to explore better elicitation of preference information.

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APPENDIX B

DOD STANDARD 7935A END USER MANUAL GUIDELINES

The End User Manual is a vital reference source for the functional user of an application. It must contain an overview of the application package as well as an explanation of all of the instructions, formats and procedures by which the functional users can utilize the system.

1. OBJECTIVES

The manual should, as a minimum, meet the following objectives:

- 1.1 Acquaint new users of the application package with its features and purposes.
- 1.2 Show new users how to perform tasks utilizing the application package.
 - a. Provide a quick, easy reference for all users.
 - b. Describe the menu format of the application package to help the user to navigate through the system.
 - c. Help the user determine which online screens relate to forms used on-the-job for the business process.
 - d. Enable the user to use all entry/update/display screens related to tasks performed on-the-job.

2. MANUAL ORGANIZATION

The manual should contain major topics, such as:

- 2.1 General Information - The purpose of the End User Manual and of the system, reference materials, terms and abbreviations, and security.
- 2.2 An Overview of the System - The hardware and software required, contingencies and alternate modes of operation, and reporting problems.

- 2.3 Getting Started - How to gain access to the system, logon requirements, other user authorization requirements, special commands, and function keys.
- 2.4 Business Processes - How to use all transactions required in the performance of the tasks of the business process. How to find and retrieve information in the Database and/or manual files. Data backup, error messages, recovery from errors and malfunctions, and sample reports (hard copy and online).

The Department of Defence (DoD) provides guidelines for the development of documentation. As a branch of DoD, and because of the nature of the Information Engineering program at the U.S. Army Corps of Engineers (USACE), Application Development Projects should adhere to this documentation standard known as DoD-STD-7935A.

DoD-STD-7935A lists two types of User Manuals that may be produced during the life cycle of an Automated Information System (AIS):

- Users Manual
- End User Manual

The Users Manual is a high level, nontechnical overview of a specific AIS application and its use in the business process. Refer to the Standard for further description.

The End User Manual provides detailed information necessary to enable the functional user to effectively use the system. The emphasis in this appendix is on the End User Manual. The following is the formal structure specified in DoD-STD-7935A:

DoD-STD-7935A

**END USER MANUAL
TABLE OF CONTENTS**

SECTION 1. GENERAL

- 1.1 Purpose of the End User Manual
- 1.2 Purpose of the System
- 1.3 References
- 1.4 Terms and Abbreviations
- 1.5 Security

SECTION 2. SYSTEM SUMMARY

- 2.1 Overview
 - 2.1.1 Application Summary
 - 2.1.2 Performance
 - 2.1.3 Controls
- 2.2 System Environment
 - 2.2.1 Hardware Required
 - 2.2.2 Software Required
- 2.3 Contingencies and Alternate Modes of Operation
- 2.4 Assistance and Problem Reporting

SECTION 3. ACCESS TO THE SYSTEM

- 3.1 First-Time Use of the System
 - 3.1.1 Equipment Familiarization
 - 3.1.2 Access Control
 - 3.1.3 Installation and Setup
- 3.2 Initiating a Session
- 3.3 Stopping and Suspending Work

SECTION 4. PROCESSING REFERENCE GUIDE

- 4.1 Capabilities
- 4.2 Conventions
- 4.3 Processing Procedures
 - 4.3.1 Variable Title (Identify)
 - 4.3.2 Variable Title (Identify)
- 4.4 Related Processing
- 4.5 Recovery from Errors and Malfunctions
- 4.6 Messages

3. DEVELOPING SECTIONS OF THE END USER MANUAL

Like all documentation components of DoD-STD-7935A, the End User Manual is a structured document with specific information to be included under each numbered paragraph. The numbering scheme, the contents of each paragraph, and the information contained in each paragraph is strictly laid out and must be followed to conform to the Standard. The following is an extraction of this Standard. If documentation developers are unclear about the nature of the information to be included under each paragraph heading, the actual DoD-STD-7935A should be consulted and used in this effort.

You will notice that Sections 1 through 3 of the End User Manual, Table of Contents, DoD-STD-7935A, address the important generalities of the system where as Section 4. Processing Reference Guide provides the End User with the necessary processing procedures of the business. If the procedures are complicated or extensive, the Standard suggests that additional sections be added using the same paragraph structure as in Section 4.

SECTION 1. GENERAL

1.1 Purpose of the End User Manual. This paragraph describes the purpose of the End User Manual either in the following words or modified if appropriate:

"The objective of the End User Manual for (Project Name) (Project Number) is to provide the end user with the information necessary to use the system effectively, including operation of (identification of terminal or personal computer) equipment."

1.2 Purpose of the System. This paragraph states the purpose of the system, the specific objectives to accomplish the mission, the expected benefits and the major functions of the application.

1.3 References. Identify other documents which the end user may need in accomplishing tasks and procedures. Specify the name of the document, author or source, reference number, title, date and security classification, if any.

a. **Project Request.** Indicate the project proponent and a reference to the Structured Requirements Analysis Planning (STRAP) report or other documentation that initiated the project.

b. **Hardware documentation** such as that addressing setup, powerup and powerdown, packing for relocation, activation operation or maintenance.

c. Software documentation of an operating system, utility software or documents oriented to an end user for related systems. References to methodologies could be listed in this section. An example is the IDEF Modeling Techniques Workshop Participant Workbook, D. Appleton Company, Inc., 1986, 1987 and 1988.

d. Previously published documentation on the project if needed for accomplishing the end user's tasks. An example might be a reference to the Functional Description of the project.

1.4 Terms and Abbreviations. Either include a list or reference an appendix of terms, definitions and acronyms unique to this document.

1.5 Security. Under this paragraph, an opening sentence stating that precautions have been taken to protect the hardware, software and data of the system (name). Then cite the following kinds of security precautions addressed:

a. Assignments of User IDs and Passwords to access the hardware and any user account reporting requirements.

b. Assignments of User Names and Passwords to control access to the software. Describe how access levels vary. For instance, you may want to indicate that access levels vary, depending on whether the user is restricted to search and retrieval activities, data entry, interactive retrieval and update or ad-hoc queries and reports.

c. A statement of how data integrity is assured, and how error checking/correcting procedures and data backup procedures are employed.

d. A statement to the effect that regulations regarding the unauthorized disclosure or use of User IDs, User Names or Passwords are to be applied to all such items assigned to the user. In addition, the user must comply with all privacy requirements. Unauthorized copying of data, documents or software is prohibited.

SECTION 2. SYSTEM SUMMARY

2.1 Overview. This section provides a nontechnical presentation of information on the overall system. Detailed technical information should be presented in other sections.

2.1.1 Application Summary. This paragraph explains the uses of the application and the user activities which it supports. It describes the main functions performed by the system showing:

- a. The logical parts of the system from the end user's viewpoint.
- b. The communications paths and techniques.
- c. The interfaces to other systems.
- d. The organizations that provide input to the system or receive output from it.

2.1.2 Performance. Describe the overall system performance capabilities, such as times and capacity constraints, which the end user can expect in accomplishing major functions.

2.1.3 Controls. This paragraph briefly describes the supervisory controls necessary to manage or audit the system.

2.2 System Environment. This paragraph describes the configuration of the hardware and software necessary to support the system. An overview of the host or LAN configuration is provided, but more detail is needed for workstation configurations.

2.2.1 Hardware Required. This paragraph identifies and describes the hardware required to run the system.

2.2.2 Software Required. This paragraph identifies and discusses software capabilities necessary to use the system. It includes software components developed for the application as well as the operating system, utilities and other supporting systems.

2.3 Contingencies and Alternate Modes of Operation. This paragraph includes a statement as to what the user may expect in systems operations during emergencies, wartime or conditions of alert.

2.4 Assistance and Problem Reporting. This section describes online or manual help features, and identifies points of contact or other resources and procedures to assist the user when problems are encountered.

SECTION 3. ACCESS TO THE SYSTEM

3.1 First-Time Use of the System. This section is intended to describe detailed step-by-step procedures oriented to the first-time/occasional end user. Enough detail should be presented so that the end user can reliably access the system even before learning the details of its functional capabilities.

3.1.1 Equipment Familiarization. This paragraph describes the following kinds of features, as appropriate:

- a. Procedures for turning power on and making any adjustments.
- b. Visual display screen capabilities.
- c. How to identify, position and use the cursor.
- d. Keyboard layout, function keys, and pointing devices such as a mouse.
- e. Procedures for turning power off and any special sequencing operations required.

3.1.2 Access Control. This paragraph gives an overview of system access and security features visible to the end user, such as:

- a. How to obtain a password: who to contact; which form to submit.
- b. How the user can change, add or delete a password.
- c. Confidentiality – security and privacy considerations regarding storage and various output media generated by the end user.

3.1.3 Installation and Setup. This paragraph shall describe any special procedures which the end user must perform in order to be identified or authorized to access or install software on the equipment, or to enter parameters for AIS operation.

3.2 Initiating a Session. This paragraph provides the end user with step-by-step procedures on how to begin work. Also include a problem checklist for difficulties encountered.

3.3 Stopping and Suspending Work. This section describes how the user can interrupt or stop the system.

SECTION 4. PROCESSING REFERENCE GUIDE

This section shall provide the end user with technical information on processing. DoD-STD-7935A advises that if the procedures are complicated or extensive, additional sections 5, 6, ... may be added using the same paragraph structure as used in section 4. The Standard states on page 88 that the organization of the document will depend on the characteristics of the AIS being documented. For example, if the tasks of end users vary depending upon the organization echelon in which they work, Section 4 might be oriented to headquarters functions and Section 5 to remote site functions.

SECTION 4. PROCESSING REFERENCE GUIDE - MENUS USED IN THE SYSTEM

4.1 Capabilities. This paragraph provides an overview of the use of the system describing menus, functions, transactions and their interrelationships.

4.2 Conventions. This paragraph describes the conventions used, such as rules for assigning names or codes, abbreviations, colors on the screens and use of audible alarms.

4.3 Processing Procedures - MENUS

NOTE: Detailed procedures are intended to be presented in the subparagraphs of paragraph 4.3. Depending on the design of the AIS, the subparagraphs might be organized on a function-by-function basis or on a menu-by-menu basis. For a transaction-oriented system the organization might be on a screen-by-screen basis.

4.3.1 Variable Title (Identify). The title of this paragraph shall identify the function, menu, transaction or other process being described. This paragraph shall describe and give examples of menus, data entry forms, outputs, diagnostic messages or alarms and help facilities which can provide online descriptive or tutorial information. The format for presenting this information can be adapted to the particular characteristics of the AIS, but a consistent style of presentation must be used, i.e., the descriptions of menus must be consistent, the descriptions of transactions must be consistent among themselves.

4.3.2 Variable Title (Identify). This paragraph shall describe the second function, menu or other procedure using the same format for information as used in paragraph 4.3.1. Additional functions, menus or other procedures should be described in paragraphs 4.3.3 through 4.3.n.

4.4 Related Processing. This paragraph shall identify and describe any related batch, offline or background processing performed by the AIS that is not invoked directly by

the end user and is not described in paragraph 4.3. Any end user responsibilities to support this processing will be specified.

4.5 Recovery from Errors and Malfunctions. This paragraph shall describe responsibilities of the end user for making and retaining all recorded data which can be used to replace primary copies of data in event of errors, defects, malfunctions or accidents. Step-by-step procedures shall be described as necessary.

4.6 Messages. This paragraph shall list, or refer to an appendix which lists all error messages, diagnostic messages and information messages which can occur while accomplishing any of the end user's functions described in paragraphs 4.3 through 4.6. The normal corrective action that should be taken after any such message should be identified and described.

Continuing with this example, section 5 would be as follows:

SECTION 5. PROCESSING REFERENCE GUIDE - COMMAND LANGUAGE USED IN SYSTEM

Then the same paragraph structure as section 4 would be followed for items 5.1 through 5.6:

5.1 Capabilities.

5.2 Conventions.

5.3 Processing Procedures - COMMAND LANGUAGE

etc.,

SECTION 6. PROCESSING REFERENCE GUIDE - GUIDE TO FUNCTIONS

6.1 Capabilities.

6.2 Conventions.

6.3 Processing Procedures - FUNCTIONS

etc.,

4. MANUAL PREPARATION

There are two distinct stages in preparing the End User Manual:

1. A Draft End User Manual is prepared for the Alpha Test of the application developed.
2. An Integrated End User Manual is compiled for the Beta Test and Deployment.

Draft documentation should evolve throughout the INTERACTIVE-APPLICATION-DEVELOPMENT activity. As each component of the application is completed and unit tested, an application developer or documentation specialist prepares draft documentation for peer reviews. If the application developed is complex with a fairly large number of people performing narrow sets of functions, it may be practical to issue separate sections of the manual for each type of user (e.g., administrative, engineers, project managers, etc.). This documentation is updated and consolidated for the Alpha Test. Copies of the Draft End User Manual are made for the Alpha Test Team, the IPR Team, the Development Team and other interested parties. It is not a formal publication.

Following the Alpha Test, corrections and various required modifications are made to produce an End User Manual for the Beta Test. The Beta Test will be testing the end user documentation as well as the application itself.

If the application developed is an extension or additional enhancement of a previous project, an Integrated End User Manual is compiled following the Alpha Test. Since the Beta Test is for a "live" environment, existing documentation for the business process should be integrated with the new documentation.

5. PACKAGING OF THE END USER MANUAL

The End User Manual should be a 3-ring binder type, with divider tabs for all major sections and appendices.

6. MAINTENANCE OF END USER MANUAL

The creation and maintenance of the End User Manual should be the responsibility of the Application Development Team until transition of the application to the support group for deployment. At this time, maintenance responsibilities should be transferred to the support agency.

APPENDIX C

BILATERAL NSS USER MANUAL

Section 1. General

1.1 Purpose of the End User Manual. The objective of the End User Manual for the Bilateral Negotiation Support System (NSS) is to provide the end user with the information necessary to use the system effectively, including operation under the Microsoft Windows 3.0 environment.

1.2 Purpose of the System. The purpose of the Bilateral NSS is to assist one or two negotiators in achieving an equitable solution to a negotiation problem. Each negotiation session allows the user to enter issues, weights and utilities associated with each issue. After receiving inputs from both negotiators, the program will calculate and display the results in both tabular and graphical formats. Users also can modify any input variables and perform "what-if" analysis to see any effects on the final results.

1.3 References. Further information on NSS theory and Windows 3.0 operation may be obtained from:

a. Bui, T. and Sivasankaran, T., "Fuzzy Preferences in Bilateral Negotiation Support Systems", 24th Annual Hawaii International Conference on System Sciences, January 8-11, 1991, pp. 687-694, IEEE Computer Society Press.

b. Bui, T., Co-op: A Group Decision Support System for Cooperative Multiple Criteria Group Decision-Making, Springer-Verlag, Berlin, 1987.

c. Microsoft Windows User's Guide, version 3.0. Microsoft Corporation, 1990.

1.4 Terms and Abbreviations. All terms and abbreviations unique to the Bilateral NSS are explained in the applicable sections of the manual. Additional Windows 3.0 terminology may be obtained from the glossary section of the Windows User's Guide.

1.5 Security. Password protection is provided for all user sensitive information. The 5 character password is non-modifiable once entered. A dialog box requesting user confirmation is presented for all operations that would overwrite any existing files.

Section 2. System Summary

2.1 Overview. The Bilateral NSS is a software program based on multiple attribute utility theory and the concept of joint utility. Although not required, the following procedure is normally used to operate the program:

- a. Identify a common set of issues about which the parties disagree.
- b. Define the range of values for each issue by assigning initial offers.
- c. Prioritize each issue by assigning relative weights to them.
- d. Within the range of values for each issue assign utility values.
- e. Compute joint utility curves by combining the utility functions of each party.
- f. Observe negotiation results and modify user variables to search for better solutions.

2.2 System Environment.

2.2.1 Hardware Required. This program will operate on any IBM compatible PC with at least 640K of Random Access Memory (RAM). A hard disk is not required.

2.2.2 Software Required. This program requires DOS 3.1 or higher and the Microsoft Windows 3.0 operating system to run. Additionally, two dynamic link libraries (DLL) called VBRUN100.DLL and VBTOOLS.VBX must be located in any directory in your path.

2.3 Contingencies and Alternate Modes of Operation. N/A

2.4 Assistance and Problem Reporting. An on-line help system is available at all times. To bring up the main help screen select the Index command from the Help menu on the main screen. The main help screen contains help on ten subject areas. Select the button to the left of the subject area that you want help on and press the Get Help button.

To get context sensitive help during the program just press the "?" button on the bottom right corner of any screen.

Section 3. Access to the System

3.1 First-Time Use of the System. Follow the steps below to start the program:

a. From the Windows Program Manager screen select the Run command under the File Menu.

b. Type "nss" in the text box provided if the nss.exe file is in your path. If nss.exe is not in your path then you must type in the entire pathname. Press Enter and the Bilateral NSS opening screen will appear.

c. If you want help with the program before starting, simply select the Index command under the Help Menu. A help screen will appear with instructions on how to use the program.

d. To begin a new negotiation session, follow the steps in paragraph 3.2 below. On-line help is available at all times by selecting the "?" button located at the bottom of each screen.

3.2 Initiating a Session. Follow the steps below to start a new negotiation session:

a. Select the Start New Session command under the File Menu.

b. Type a filename (up to 8 characters) to save your work under then press the OK button.

c. Enter your name, party and a 5 character password in the spaces provided. Don't forget your password since once it is entered it cannot be changed. Press the OK button to continue.

d. The Main Selection Menu will appear with the top two options available. The last three options are not available (shown as grayed out text) until both parties have entered initial starting offers for each issue. Select the Issue Parameters option and press the OK button to continue.

e. The Issue Parameters screen has three entries for each issue -- Issue Name, Unit Value and Initial Starting Offer. Issue names can be up to 15 characters

long. The Unit Value (up to 7 characters) is the unit of measure for an issue -- e.g., dollars, years, etc. Initial starting offers (0 to 30000) can be entered directly into the text box or selected by using the scroll bars beside each issue.

f. To add a new issue just press the Add New Issue button at the bottom of the screen. Likewise, to delete an issue press the Delete Issue button and enter the number of the issue you want to delete. Once you are done press the OK button to accept your entries.

g. Once both parties have entered initial starting offers the last three options on the Main Selection Menu will be available. Select the Issue Priority option and press the OK button. At this point a password screen will appear asking you to enter your password. Type in your 5 character password and press Enter (the program is case sensitive so capitalize any letters you did when you initially entered it).

h. The next screen gives you three choices for ranking each issue -- equal weighting, direct prioritization and pairwise comparison. Select your choice and follow the instructions. After completing your rankings you will be returned to the Main Selection Menu.

i. Select the Utility Values option and press the OK button. You will again be requested to enter your password.

j. The Utility Value screen lists all session issues on the left side and the seven utility values for the currently active issue on the right side. To enter utility values follow this procedure:

1. Click the option button to the left of any issue you want to update.

2. At the bottom of the utility graph are the seven range points for that issue. Above each range point is a column of utility values from 0 to 100. Select a utility value for each range point (0 being no utility and 100 being maximum utility).

3. Repeat steps 1 and 2 for each issue. Press the OK button to accept your data and return to the Main Selection Menu.

k. To view the results of the negotiation at this point select the Negotiation Results option and press the OK button. The Negotiation Results screen will appear.

1. The Negotiation Results screen displays three sets of tabular data -- highest joint utility, mid-point utility and relative importance utility. Additionally, there is a Scratch Pad that allows you to enter any range point (the green Descriptor column) to observe how the individual party and total utility values will be affected.

m. To print out the results on the screen press the Print button. To save the screen results as an ASCII text file press the Save button. To view the results graphically press the Display Graphs button at the bottom of the screen.

n. The Graphs screen allows you to view the weighted or unweighted results of any issue. Just select the issue from the list at the left of the screen and select either the Weighted or Unweighted option button below it.

o. To quit the current session and save your work just press the Quit button on the Main Selection Menu and follow the instructions.

3.3 Stopping and Suspending Work. You may quit the current session you are working on at any point. If you are in the middle of entering data press the OK button for that screen if you want to update those entries. After returning to the Main Selection

Menu press the Quit button and a Save screen will appear. If you want to save your newly entered data and overwrite the old file just press the Save button. Otherwise, press the Cancel button. At this point you can start a new session or open a prior one.

To save your work without going through the Main Selection Menu just select the File Menu on the Bilateral NSS main screen and select the Save or Save As commands. The Save command will allow you to save your data under the current session name and Save As will let you save your data under any filename.

To quit the Bilateral NSS program select the Exit Program command under the File Menu and follow the prompts.

Section 4. Processing Reference Guide - Menus

4.1 Processing Procedures - Menus. There are two menus associated with the opening Bilateral NSS screen -- File and Help.

4.1.1 File Menu. There are five commands under the File Menu:

4.1.1.1 Start New Session. This command is selected to start a new negotiation session. A dialog box will appear requesting a filename to save your data under.

4.1.1.2 Open Prior Session. This command is selected to open a previous negotiation session. A dialog box will appear that allows you to browse through any drive and directory for a prior session's data. Only filenames with a .nss extension will be shown in the file list box.

4.1.1.3 Save Current Session. This command is selected to save the current negotiation data under the currently active filename. A dialog box will appear

that asks you if you want to save the data under the current name. Select Save to store the data or Cancel to abort the command.

4.1.1.4 Save Current Session As. This command is selected to save the current negotiation data under any user entered filename. A dialog box will appear that allows you to enter any filename up to 8 characters long. Select Save to store the data or Cancel to abort the command

4.1.1.5 Exit Program. This command is selected to end the Bilateral NSS program. A dialog box will appear that allows you to save the current negotiation data under the currently active filename. Select Save to exit the program after saving the latest negotiation data or Cancel to exit the program without saving the latest data.

4.1.2 Help Menu. There are two commands under the Help Menu:

4.1.2.1 Index. This command is selected to bring up the main help menu. A screen will appear that explains the help system and allows the user to select from a menu of ten subject areas.

4.1.2.2 About... This command brings up the Bilateral NSS credit screen.

Section 5. Processing Reference Guide - Procedures

5.1 Starting a New Negotiation Session. To begin a new session select the Start New Session command under the File Menu and follow the procedures below:

a. Enter any filename up to 8 characters in the text box provided. Press the OK button to continue.

b. Next, enter your name, party and a 5 character password in the textboxes provided. Don't forget your password since once it is entered you can't change it. Press the OK button to continue.

c. When the Main Selection Menu is displayed select the Issue Parameters option and press the OK button.

d. Enter up to 10 issues and an initial starting value using the scroll bars next to each issue. A new issue may be added by clicking on the Add New Issue button at the bottom of the screen. To delete an issue click on the Delete Issue button.

e. Once both parties have entered initial starting values you can enter your weightings and utilities by selecting the appropriate option from the Main Selection Menu.

f. Selecting the Negotiation Results option from the Main Selection Menu will give you a tabular display of the results of the current session. Clicking on the Display Graphs button at the bottom of the screen will display the issues in graphical form.

5.2 Opening a Prior Negotiation Session. To open a prior negotiation session select the Open Prior Session command from the File Menu and follow the procedures below:

a. A dialog box will appear with three list boxes to let you select which drive or directory to search in. Double clicking on a directory in the directory list box will make that your default directory. Only filenames with a .nss extension will be shown.

b. To select a file either double click on the filename or press the OK button after clicking once on the filename.

c. After selecting the file, the Main Selection Menu will appear. You can then select any option that is not grayed out.

5.3 Saving a Negotiation Session. To save a negotiation session select the Save Current Session command under the File Menu and follow the procedures below:

a. A dialog box will appear asking you whether you want to save the current data using the filename you entered when you started the session.

b. Press the OK button to save your data or press the Cancel button to return to the previous screen. Remember that selecting OK will overwrite any previous data you may have stored in that file.

5.4 Saving a Negotiation Session Under a Different Name. To save a negotiation session under a different name select the Save Current Session As command under the File Menu and follow the procedures below:

a. Enter the name you want to save your data under in the text box provided. A filename can consist of any combination of letters and numbers up to eight characters. The filename will automatically be given a .nss extension.

b. Press the Save button to save your data or the Cancel button to return to the previous screen. Remember that selecting Save will overwrite any previous data you may have stored in that file.

5.5 Using the Main Selection Menu. There are five selection options for each party. They are:

- a. Issue Parameters - this option allows either party to add or delete issues.

Initial starting offers are also entered on this screen.

- b. Name or Party - this option allows either party to enter or change their name or party data. If this is the party's first entry for the session they will also enter a five character password.

- c. Issue Priorities - this option allows either party to adjust the weighting given to each issue.

- d. Utility Values - this option allows either party to enter or update the utilities assigned to each issue.

- e. Negotiation Results - this option allows either party to view the results of the current negotiation session. A Scratch Pad is provided to allow a party to perform "what-if" analysis on the results.

- 1. Pressing the Display Graphs button brings up a screen that allows you to view the results in graphical form. Both weighted and unweighted results can be viewed.

- 2. Pressing the Save or Print buttons will send the negotiation results in ASCII form to the disk or printer, respectively.

5.6 Entering/Changing Party Data. To enter or change party data select the Name or Party option from the Main Selection Menu and follow the procedures below:

- a. If you are entering this data for the first time a dialog box will appear with empty textboxes for name, party and password.

b. Enter up to 15 characters for your name and party. Your password must be five characters long and can consist of any combination of letters and numbers. Don't forget this password since once it is accepted it can not be changed.

c. If you are updating previously entered information a dialog box requesting your password will appear. Enter your password and press Enter.

d. Change the name or party information in the textboxes provided and select OK when you are done.

5.7 Entering Issue Parameters.

a. Three types of data are entered for each issue:

1. Issue Name - (max. of 15 characters)

2. Unit Value - (max. of 7 characters) the unit of value that describes the issue. For example, if contract length was an issue, then the unit value might be years.

3. Initial Starting Offer - (range 0 to 30,000) the starting value that you propose for this issue. To use the scroll bars click the outer arrows to increment the value by one and the inside of the scroll bars to increment by 25.

b. To add a new issue press the Add New Issue button and a new set of textboxes will appear.

c. To delete an issue press the Delete Issue button and enter the number of the issue you want to delete.

d. You can enter a maximum of ten issues in each session.

5.8 Entering Issue Priorities.

a. There are three ways of assigning issue priorities:

1. Equal Prioritization - all issues are assigned a weighting equal to $1/(\#$ of issues). If equal priority is chosen the program will calculate the weighting and display it in a message box.

2. Direct Prioritization - the user can enter an individual weighting value for each issue. If direct priority is chosen a screen will be displayed that allows you to select a weighting value for each issue. Allowable values are between 0 and 10.

3. Pairwise Comparison - the user indirectly chooses a weighting value by comparing the issues to each other in pairs. If pairwise comparison is chosen a screen will be displayed that asks you to select between two issues at a time. This process will be repeated for all possible combinations of issues. The program will then calculate the proper weightings. (not available in version 1.0)

5.9 Entering Utility Values. After selecting the Utility Values option from the Main Selection Menu a screen will be displayed that allows you to enter your utility values for each issue.

a. There are seven evenly separated range points associated with each issue.

The range for each issue is bounded by the initial starting offer of each party.

b. To enter utility values select an issue from those available in the leftmost box.

c. For each of the issue's seven range points, click a utility button that best describes your desirability for that point. Utility values range from 0 to 100 (0 being no utility and 100 being maximum utility).

d. Repeat steps b and c for all issues.

e. After entering all the utility values select the OK button.

5.10 Displaying/Modifying Negotiation Results.

a. Select the Negotiation Results option from the Main Selection Menu.

b. From the Negotiation Results screen you have four choices:

1. Display issue graphs using the Display Graphs button.

2. Save the results of the current screen in ASCII text format using the Save button.

3. Print the results of the current screen to the active printer using the Print button.

4. Do "what-if" analysis on the current results using the Scratch Pad portion of the screen.

c. To do "what-if" analysis click on any of the green Descriptor Value boxes. Enter any value desired that is within the range for that issue.

d. Press the Enter key on your keyboard and observe the newly calculated utility values for each party. Also note the change in total utility at the bottom of the screen.

e. Scratch Pad values initially default to the highest joint utility values.

5.11 Displaying Graphs. To view the graphs for each issue you must first select the Negotiation Results option from the Main Selection Menu.

- a. Press the Display Graphs button on the Negotiation Results screen.
- b. Once the Graphs screen is displayed you can select an issue in the leftmost box.
- c. The initial screen default displays the graphs using weighted values. To select unweighted values you must click on the unweighted option button at the bottom of the screen.

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