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User Interface Techniques in the Counseling Module of TOPS

T. G. Yow

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Energy Division

USER INTERFACE TECHNIQUES IN THE COUNSELING MODULE OF TOPS

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ABSTRACT

The Transportation Operational Personal Property Standard System (TOPS) is an automated information management system to help administer the personal property transportation program for the Department of Defense (DOD). TOPS was fielded at four prototype sites in the late summer of 1988. Prototype testing is currently underway, with system deployment scheduled for 1989. When fully deployed, TOPS will save DOD both time and money and help ensure that all shipments made by armed services personnel are handled quickly and efficiently.

The success of the TOPS system depends upon several key factors. Of course, TOPS must give transportation clerks at military personal property shipping offices a tool with which they can perform their jobs with greater ease, speed, and correctness. However, before TOPS can achieve success in the field, it must first find acceptance from the transportation clerks themselves.

To ensure acceptance of the system by end users, TOPS system analysts and programmers at Oak Ridge National Laboratory (ORNL) made the design of an effective, consistent user interface one of their primary goals. As the "front-end" of TOPS, the Counseling module presented unique opportunities and challenges in the design of man/machine interface. Hopefully, this interface design effort has produced a module that will afford transportation clerks throughout the United States and overseas a user-friendly, effective introduction to the TOPS system.

The purpose of this document is to examine the user interface techniques used in the Counseling module of TOPS to ensure user acceptance and data base integrity, both key elements in the ultimate success of TOPS.

1. INTRODUCTION

1.1 BACKGROUND

The Military Traffic Management Command (MTMC) operates the personal property transportation program of the Department of Defense (DOD). This program is responsible for handling the movement of personal property belonging to members of the military when these individuals receive orders to report to new duty stations throughout the continental United States (CONUS) and overseas. Currently, this program is administered manually, a labor-intensive, time-consuming undertaking that last year saw the processing of thousands of shipments at a cost of approximately $2 billion. In addition, the system is not without imperfections, often resulting in the loss or mishandling of the personal property of armed services personnel.

In 1983 the Oak Ridge National Laboratory (ORNL) agreed to apply its expertise to the design and development of an integrated, automated information management system to help MTMC better administer its personal property program. The resulting system, the Transportation Operational Personal Property Standard System (TOPS), is a decision-support system designed to allow transportation clerks to process the shipments for which they are responsible with less time and greater efficiency.

The TOPS system was developed using the software tools Problem Statement Language/Problem Statement Analyzer (PSL/PSA),[1] ORACLE Data Base Management System and ORACLE's applications generator

[1]Developed by ISDOS, Inc., of Ann Arbor, Michigan.

(SQL*Forms),[2] and the UNIX operating system. TOPS was fielded at four prototype sites in the summer of 1988. Prototype testing is currently underway, with system deployment scheduled for 1989.

1.2 TOPS USER INTERFACE

The success of the TOPS system depends upon several key factors. Of course, TOPS must give transportation clerks at military personal property shipping offices (PPSOs) a tool with which they can perform their jobs with greater ease, speed, and correctness. However, before TOPS can achieve success in the field, it must first find acceptance from the transportation clerks themselves.

To ensure acceptance of the system by end users, TOPS system analysts and programmers at ORNL made the design of an effective, consistent user interface one of their primary goals. Quite simply, TOPS users must be introduced to a system that is easy to learn, simple to use, and consistent in interface design. The standards and conventions for this user-friendly interface, described in the ORNL report Standards and Conventions for the TOPS User Interface, provided guidelines for ORNL analysts in the development of the five modules that make up the TOPS system: Counseling, Outbound, Nontemporary Storage (NTS), Inbound, and Quality Assurance (QA).

1.3 COUNSELING MODULE

Of these five modules, Counseling represents the "front-end" of TOPS. Because the Counseling module is (1) the point of initial contact between the user and the system and (2) the point of

---

[2]Trademarked by ORACLE Corporation, Belmont, California.

initial data capture for data used throughout the TOPS system, this module presented unique opportunities and challenges in the design of man/machine interface. In particular, the human interface design of the Counseling module was geared toward achieving two goals.

First, as the point of initial contact between user and system, the Counseling module was designed to effect a gentle meeting of man and machine, particularly for those users not experienced in the use of computer systems. Special attention was given to anticipating possible user needs and user errors, providing convenient navigational aids, and deriving data whenever possible to save the user time and keystrokes.

Second, as the point of initial data capture for data used throughout the TOPS system, the Counseling module was designed to ensure data base integrity by providing effective data validation techniques, by preventing illogical or inconsistent data entry whenever possible, and by logically deriving data for the user when such derivations are possible.

This design effort has produced a module that will afford transportation clerks a user-friendly, effective front-end to the TOPS system. When deployed, TOPS will save DOD both time and money and help ensure that all shipments made by armed services personnel are handled quickly and efficiently.

The purpose of this document is to describe the human interface techniques used in the Counseling module of TOPS to ensure user acceptance and data base integrity, both key elements in the ultimate success of TOPS. It is not the purpose of this document to present elaborate SQL coding for the sake of demonstrating programming skill or the complex transportation functionality represented in the TOPS system. Indeed, several of the other

TOPS modules (e.g., Outbound and NTS) contain SQL coding and transportation functionality that are more complicated than that found in the Counseling module. Instead this document focuses on examples of user interface techniques that demonstrate the attempt that was made to anticipate user needs and to translate those needs into the appropriate coding.

Section 2 of this report provides a brief introduction to the transportation functions modeled in TOPS. Section 3 describes the basic user interface techniques employed in the Counseling module of TOPS, and Section 4 outlines more advanced user interface techniques.[3]

---

[3]This document does not discuss basic ORACLE user interface techniques that are part of the SQL*Forms code (for example, validation of data type, date format validation, List of Field Values options). These topics are well documented in the ORACLE users manuals and are also discussed in detail in the TOPS Standards and Conventions document, which should be considered a companion piece to this report.

2. TRANSPORTATION REVIEW

2.1 HIGHLIGHTS

When a member of the armed services (or a civilian employed by the military) receives orders to report to a new duty station, he must decide what to do with his personal property for the duration of his new assignment. The member is counseled at a PPSO, where the counselor checks for prior shipments on the member's current orders, determines the member's weight entitlements (derived from the rank and pay grade), advises him of his options, and gathers other information that will be needed to expedite the processing of the member's requested personal property shipments, including the authorized weight, the actual weight, the pickup address, and the delivery address of each shipment.

If the member decides that he wants his personal property shipped to his new duty station or home address (instead of stored), an outbound clerk arranges for a carrier to pick up and deliver the shipment and calculates shipment costs. At destination an inbound clerk notifies the member of his shipment's arrival and arranges for delivery. After the shipment is delivered, a QA inspector checks the shipment for damage and returns the inspection results to shipment origin, where they become part of permanent files kept on the carrier.

If the member decides to have his personal property put into NTS instead of having it shipped, an NTS clerk arranges for a storage contractor to pick up the shipment and store the property in a warehouse, where it remains until the member requests its removal or until the member's storage entitlements expire.

2.2 AUTOMATED TRANSPORTATION

Currently, transportation clerks in PPSOs must manually gather, organize, and process all of the data needed to handle a shipment. In addition, they must keep track of countless pertinent details that could possibly affect the processing of a shipment to ensure that the member receives the best service the transportation program has to offer.

TOPS was designed to help transportation clerks perform their jobs better. It must be emphasized that TOPS does not do transportation for the user. As an automated, decision-support information management system, TOPS incorporates the transportation functionality to help transportation clerks gather information, make sound transportation decisions, coordinate various shipping activities, and produce the forms and reports needed to document each shipment.

The work done by a counselor during his interview with the member lays the groundwork for all of the subsequent work to be done on any of the member's shipments. All of the data captured and all of the determinations made during the interview between counselor and member affect the way in which any given shipment is processed. For this reason, it is critical that counselors have at their fingertips a system designed to help them gather and store data in a correct and logical manner, to assist them in making decisions and advising the member of his rights and options, and to alert them to possible obstacles to the smooth, trouble-free processing of a shipment.

As a critical element in the design of the module that allows the counselor to lay this groundwork, the user interface techniques employed in Counseling indeed help set the stage for the successful deployment of TOPS.

3. BASIC USER INTERFACE TECHNIQUES

3.1 INTRODUCTION

The Counseling module contains more than 50 applications with a total of approximately 100 pages (screens) for user input. For the purposes of this report, only a few sample applications and screens have been selected. These have been chosen to give a representative look at the user interface techniques used in the Counseling module.

3.2 FORMAT VALIDATION

Because the Counseling module is the point of initial data entry for TOPS, it is imperative that the user interface of this module safeguard the format of data entered into the data base. Format validation, one of the most basic of interface techniques used in the Counseling module, was done using validation triggers coded in ORACLE's query language, SQL. Data format validation triggers assist the user in two ways: (1) they can be used to guard against simple typographical errors and (2) they can be used to enforce the consistency of like data in a data base. A look at the first page of the Counseling module's member orders screen/application (Fig. 1) will help demonstrate how this technique is used.

An obvious candidate for format validation is the member's social security number. This data base element is one of the key identifiers for records in the TOPS data base. When combined with the member's orders number, the member's social security number uniquely identifies each member in the data base.

```
*-----------------------------------*-----------------------------------*
|            Member ID              |            Service Data           |
|                                   |                                   |
| SSN            : ___________      |      Branch            : _        |
| Last Name      : ________________ |      Rank              : _____    |
| First Name     : _______________  |      Navy Rank/Rate    : ____     |
| Middle Name/MI: _________________ |      Pay Grade         : ____     |
|                                   |      Over 2 Yrs. (Y/N): _         |
*-----------------------------------*-----------------------------------*
|                          Orders Data                                  |
|                                                                       |
|   Type of Orders  : ___                  Orders No.    : __________  |
|   With TDY (Y/N)  : _                    Orders Date   : _________   |
|   Deployment (Y/N): _                    Paragraph No.: ___           |
|                                                                       |
|                      Orders Amended (Y/N): _                          |
|                                                                       |
|       HQ Issuing Orders    : ____________________________________    |
|       Approx. Report. Date: _________                                 |
|                                                                       |
```

```
Form: orders      Block: pathway      Page: 1    SELECT:     Char Mode: Replace
```

Fig. 1. First page of the member orders application.

Therefore, it is imperative that the social security number always be typed in the same format each time the user inputs data or attempts to query the data base for information that has already been stored.

The SQL statement used to validate the format of the member's social security number is as follows:

```
select 'x' from dual where translate
(:one.member_social_security_number,'0123456789-',
'9999999999-') = '999-99-9999'
```

This trigger ensures that the counselor has entered the member's social security number in the format '999-99-9999'. Moreover, if the counselor fails to input the member's social security number in this format, he receives an error message: "Please enter the member's SSN in the format 999-99-9999." Note that the error message not only informs the counselor that he has made an input error, but it also tells him what input is expected. As indicated in the TOPS Standards and Conventions document, all error messages in TOPS must be direct and positive, telling the user how to complete a field correctly so that he may proceed.

3.3 DATA VALIDATION

The user interface in the Counseling module was also designed to check the content of data input by the counselor. In some cases this validation amounts to no more than a check to make sure that the counselor has, for example, input a valid branch of service for the member,

```
select 'x' from dual
where :one.member_branch_of_service
in ('A','F','M','N')
```

with an appropriate error message if the input is unacceptable (i.e., if the trigger fails): "Please enter either 'A', 'F', 'M', or 'N' for the member's branch of service." Such checks, albeit simple, are a crucial part of TOPS user interface: they ensure that data are entered into the data base correctly, thereby also ensuring that data can be retrieved from the data base using selection criteria that have been clearly defined.

3.4 LOGIC VALIDATION

Basic validation triggers can also be used to check the logic of user input, looking at several pieces of data together to determine whether or not they are logically compatible. For example, after the counselor inputs the member's branch of service, he is asked for the member's rank (see Fig. 1). Then after the counselor has entered the rank, a validation trigger attempts to match the branch of service with the rank to make sure that the rank is (1) a valid rank and (2) a valid rank for this branch of service:

```
select rank from rank_to_pay_grade
where rank = :one.member_rank
and branch_of_service = :one.member_branch_of_service
```

This check is performed by accessing a TOPS data base table called rank_to_pay_grade to look for a valid match under the columns rank, pay_grade, and branch_of_service. If this match can be found (i.e., if the trigger succeeds), the counselor is allowed to proceed; if not, he receives an error message: "Please enter a valid rank for this branch of service. Check List of Field Values." Note that the error message contains a reminder that the counselor can find additional help by requesting the List of Field Values option if he cannot remember valid ranks for a given branch of service.

Logic validation checks can also be used to ensure the logical coupling of dates. For instance, as seen in Fig. 1, the counselor must enter the approximate date when the member must report to his new duty station. Since the member cannot report to a new duty station until after he has received orders to do so, a trigger was created to compare the reporting date to the member's orders date:

```
select 'x' from dual
where to_date(:one.approximate_reporting_date) >
to_date(:one.orders_date)
```

If the trigger succeeds, the user is allowed to continue. If not, the user is shown an appropriate error message and asked to reenter the correct data. Such triggers force the counselor to input dates that make sense in the real world of transportation.

3.5 DATA RETRIEVAL

Some of the user interface techniques in the Counseling module were designed to help the counselor by retrieving data when such retrievals are logically possible, thus saving the counselor time and keystrokes. And because the data are retrieved and the counselor does not have to type values for the field(s) involved, this technique also has the benefit of minimizing the possibility of user input error. If we make a small addition to the example above where rank and branch of service are checked for a logical match, we can see how data can be retrieved for the user if his input is valid:

```
select pay_grade into one.member_pay_grade
from rank_to_pay_grade
where rank = :one.member_rank
and branch_of_service = :one.member_branch_of_service
```

In this example, the pay grade for a given rank and branch of service is retrieved from a data base table and placed in a field on the counselor's screen (see Fig. 1). Later coding prevents the counselor from entering the pay grade field, thus eliminating the possibility that he could type over the correct value that has been retrieved for him.

3.6 DATA DERIVATION

Simple data derivations have been performed throughout the Counseling module to help the counselor perform his job with greater ease and speed. Occasionally these derivations involve merely selecting a logical default response for the user. For example, if the counselor indicates (see Fig. 2) that a member who has no dependents is being sent overseas for a tour of duty, it follows that the member is making an unaccompanied tour overseas (that is, he is going overseas alone).

Therefore, we can construct a trigger that checks the values in the fields dependent_travel_authorized ('N') and tour_overseas ('Y') to derive the value in the field accompanied_tour_overseas ('N'), as well as the values for dependent_travel_concurrent ('N') and dependent_travel_delayed ('N'), fields that are relevant only if a member is going accompanied overseas. In addition, since the member has no dependents, we can selects 0's (zeroes) into the fields indicating the number of dependents over and under 12.

Data derivation techniques can also be used to "undo" data already input or derived. For example, in Fig. 2 we see the prompts where the counselor is asked whether or not the member has a spouse in service who also has orders to report to a new

```
*-------------------------------------------------------------------------*
|          Current Duty Station: ____________________________________      |
|          New Duty Station    : ____________________________________      |
|                                                                           |
|          Unit Losing Member  : ____________________________________      |
|          Unit Gaining Member : ____________________________________      |
|                                                                           |
| In Pay Status at Dest. (Y/N): _    Retirement/Separation Date: ________   |
*-------------------------------------------------------------------------*
| Enter Y or N:                                                             |
|                Dependent Travel Authorized  : _                           |
|                Move to Govt. Housing        : _                           |
|                Tour Overseas                : _                           |
|                Accompanied Tour Overseas    : _                           |
|                Dependent Travel Concurrent  : _                           |
|                Dependent Travel Delayed     : _                           |
|                Joint Move Spouse in Service : _                           |
|                Combined Move Spouse in Serv.: _                           |
|                                                                           |
| Number of Dependents 12 and Over: __    Number of Dependents Under 12: __ |
|                                                                           |
Form: orders      Block: pathway      Page: 2    SELECT:     Char Mode: Replace
```

Fig. 2. Second page of the member orders application.

duty station. When member and spouse are moving their households goods together, each has weight entitlements that depend upon rank and pay grade. If the couple are moving within CONUS, their weights are simply added together (combined spouse move). However, under certain conditions (e.g., traveling overseas to a weight restricted area or moving into government housing), the weight is limited to the full entitlement of the higher-ranking member plus the baggage allowance of the spouse (joint spouse move).

If the counselor indicates that this is a joint spouse move, an 'N' is automatically selected into the field combined_spouse_move (since the two options are mutually exclusive), and the cursor skips to the first of the number of dependents fields.

However, let us suppose that the counselor indicates that this is not a joint spouse move. He types 'N', and the cursor moves to the next field (combined_spouse_move). Here he may enter either 'Y' or 'N', depending on the situation. In this case let us say that he enters 'Y', indicating that this is a combined spouse move.

Now imagine that the counselor realizes he has made an error and backs up to the field joint_spouse_move to change his input. He types 'Y' for joint_spouse_move. A trigger on this field checks the value in the field combined_spouse_move and sees that both = 'Y'. Therefore, the trigger changes the value in the field combined_spouse_move to 'N' and skips to the first of the number of dependents fields.

Thus, the user interface triggers on these fields keep track of the input and changes to input so that the values are always checked against each other to ensure logical data combinations. The counselor cannot inadvertently "trick" the system and create

an illogical coupling of data. Therefore, the counselor can feel confident that he will not make an input error that will damage the data base. He has a system designed to help him do the best job he can.

Such derivations may seem simplistic, but they eliminate the necessity for the user to input values that the system should be able to derive from the facts given. They also prevent the user from inputting illogical combinations (like indicating that a member is going accompanied overseas when he has no dependents) that might cause a failure at some later point when the system attempts to perform a given function based on logical assumptions about the coupling of data.

3.7 CONDITIONAL MANDATORY

The SQL*Forms applications generator has an option that allows a programmer to indicate whether or not a data field is mandatory. However, in the world of transportation some fields are mandatory only under certain conditions. For these fields the mandatory option in SQL*Forms cannot be used (since it enforces the mandatory attribute all of the time). In such instances a SQL trigger is necessary to define the conditions under which a field is mandatory.

In Fig. 2 we see where the counselor is asked to indicate whether or not a member's dependents are authorized to travel as a result of these orders. If the answer is 'Y', then the fields indicating the number of dependents over and under 12 must be entered before the counselor is allowed to proceed. Such a measure ensures that the system will have the data it needs when it later derives the amount of unaccompanied baggage a member and

his dependents (if any) are allowed to ship as a result of these orders.

3.8 NAVIGATION

Another user interface technique employed to help the counselor perform his job with less effort and increased speed is ease of navigation. In instances where input supplied by the counselor can be used to determine the next applicable field, the cursor is automatically advanced to this field, skipping fields that do not apply.

In Fig. 3 we see page 3 of the member orders screen, which the counselor uses to input data about the account numbers to which a shipment is to be charged. All branches of service require a transportation account code and an accounting classification. However, only the Army requires a movement designator code, while the Navy NMF code is needed only for Navy shipments. Because the counselor has already input the member's branch of service, we can determine which charge fields are applicable and which are not and move the cursor accordingly, thus eliminating the necessity for the counselor to navigate through fields that do not apply.

To accomplish this navigation, a trigger was placed on the transportation account code field to look at the member's branch of service and determine the next move:

```
#exemacro case one.member_branch_of_service is
when 'A' then gofld one.movement_designator_code;
when 'N' then gofld one.navy_nmf_code;
when others then gofld
one.member_fiscal_year_of_detach;
end case;
```

```
*-------------------------------------------------------------------------*
|  Accounting Classification:                                             |
|                                                                         |
|  Transportation Account Code: ____    Navy NMF Code            : ____ |
|  Movement Designator Code   : ____    Fiscal Year of Detachment: _    |
|                                                                         |
|                  _ Commit member data before proceeding.                |
*-------------------------------------------------------------------------*
| Do you want to:                                                         |
|   Return to page 1 of screen  : _     Go to the shipment screen: _      |
|   Enter spouse in service data: _     See entitlements data    : _      |
|                                                                         |
Form: orders      Block: pathway      Page: 3    SELECT:     Char Mode: Replace
```

Fig. 3. Third page of the member orders application.

This trigger eliminates unnecessary keystrokes by automating cursor movement, thus simplifying the counselor's job.

Ease of navigation is also a consideration when the counselor completes inputting data for one application and is ready to proceed to another task. The normal procedure would be for the counselor to exit the current application, return to the menu, and then choose the next function to be performed. However, returning to the menu is often cumbersome, especially in systems like TOPS that encompass many functions and must thus have many menu levels to accommodate all of the possible options a user might select. In such cases returning to the menu and selecting another option might take as many as seven keystrokes.

To reduce the number of times a user must renegotiate the menu system to continue his work, an attempt has been made to anticipate the user's next move and to offer him immediate access to the desired application without the necessity of returning to the menu. As seen in Fig. 3, after the counselor has committed to the data base data about the member and his orders, he is offered several navigational choices.

First the counselor is offered the option of returning directly to page 1 of the current application, an option that might be highly desirable if the counselor wanted to recheck/revise some data, query on another member, or begin inputting data on another member (a likely choice in the case of deployment orders, when numerous members move as a unit). Without this navigational choice, the counselor might be forced to press the PREVIOUS PAGE key several times to return to page 1 of the application.

If the counselor indicated earlier that the member had a spouse in service (see Fig. 2), he is next offered the option of

entering data about the spouse. If no spouse is involved, this field is automatically skipped.

If the counselor answers 'N' to both of these prompts, he is next offered quick navigation to the applications that seem the most likely options given the transportation functions that the counselor still needs to complete for this member and his shipments. Two navigational possibilities are offered. First, the counselor is asked if he wants to move immediately to the shipment application: a response of 'Y' to this question will save the counselor approximately five keystrokes, as well as the time it takes to move through the menu. A response of 'N' will take the counselor to the next prompt, which asks if he wants to move directly to the entitlements application, a likely choice since the rules governing shipment processing are directly related to a member's weight entitlements (Figs. 4a and 4b). On the two pages of this screen, data previously input by the counselor are automatically retrieved and other data are derived for the counselor to allow him to proceed quickly with the processing of the member's shipment.

3.9 ACCESS CONTROL

Triggers can also be used to control a user's access to a particular application. This technique is effective in limiting screen access to those who actually need the screen to input data relevant to the shipment they are processing. For example, in Sect. 3.8 we saw how triggers are used to automatically skip the spouse question when the counselor has indicated earlier that there is no spouse in service for this member. By preventing the cursor from entering this field, the trigger actually prevents the user from accessing the spouse application, where he could enter spouse data for a member who has no spouse, creating

```
*----------------------------------------------------------------------------*
| Name   : ________________, ______________ ______________   SSN: __________ |
| Branch: _      Orders No.: __________                                       |
*----------------------------------------------------------------------------*
|                                                                            |
|                               Orders Data                                  |
|                                                                            |
|     Type of Orders    : ___                  Member Has Depend.: _         |
|     With TDY          : _                    Tour Overseas     : _         |
|     Deployment Move   : _                    Accompanied Tour  : _         |
|                                                                            |
|                  Move Into Govt. Housing: _                                |
|                  Joint Spouse Move      : _                                |
|                  Combined Spouse Move   : _                                |
|                                                                            |
|                                                                            |
|                _ Press NEXT PAGE to see entitlements data.                 |
|                                                                            |
------------------------------------------------------------------------------
 Form: entitle     Block: pathway     Page: 1   SELECT:     Char Mode: Replace
```

Fig. 4a. First page of the weight entitlements application.

```
JTR Auth. Wt. PCS: _____                    Member UB Wt. : ____
JTR Auth. Wt. TDY: _____                    Depend. UB Wt.: ____
Spouse Auth. Wt. : _____                    Spouse UB Wt. : ____

Admin. Restricted Wt.: _____                UB Wt. Adjustment: ____
Admin. Wt. Adjustment: _____                Spouse Wt. Adjust: _____

     Member Chooses Surface Alternative: _   Altern. Wt.: _____

                _ Commit member entitlements data here.

Form: entitle     Block: pathway     Page: 2     SELECT:     Char Mode: Replace
```

Fig. 4b. Second page of the weight entitlements application.

contradictions in data that could adversely affect shipment processing for this member. By controlling screen access, this user interface technique ensures data base integrity, a particularly useful measure when users are inexperienced using a new system or program.

4. ADVANCED USER INTERFACE TECHNIQUES

4.1 INTRODUCTION

In a system as large and complex as TOPS, it naturally follows that the user interface can also be elaborate. In Sect. 3 we looked at several simple techniques used in the Counseling module to create an effective, appealing human interface for the front-end of TOPS. In this section we will be looking at more advanced user interface techniques that suggest the complexity of the user needs modeled in TOPS.[4]

4.2 DATA RETRIEVAL

An example of advanced data retrieval in the Counseling module can be seen in Figs. 5-7. Figure 5 represents page 1 of the shipment application, which the counselor uses to input data about a particular shipment requested by the member. One piece of information supplied by the counselor is an indication of whether or not this particular shipment is a removal of property from storage (NTS).

A trigger checks to see if the field shipment_out_of_nts = 'Y'. If the value is 'Y', the trigger calls a new application, which queries the data base and displays for the counselor all shipments (if any) this member currently has stored in NTS (see

---

[4]Because the coding necessary to implement the user interface design found in the Counseling module is often difficult to present visually, an effort has been made to select as examples only those triggers that can be easily described or displayed in a visual format.

```
Name  : _______________,_______________ _______________ SSN: ___________
Branch: _      Orders No: __________          Shipment Status: __

    Shipment Number    : __          Expected Method of Shipment: ______
    Type of Shipment   : ___         Shipment out of NTS (Y/N)  : _
    Estimated Weight   : _____       Local Move (Y/N)           : _
    Est. Pro. Gear Wt.: _____        Deployment Move Number     : _____

Accounting Class. : ____________________________________________________

Spec. Circumstance: ____

Bluebark/MIA Auth. Signer Name  : ________________________________
Bluebark/MIA Auth. Signer Title : ________________________________

Power of Attorney  Name         : ________________________________
Power of Attorney  Relationship : ______________

Shipment Contains Firearms (Y/N): _        Motorcycle: _        POV: _

Form: shipment    Block: pathway    Page: 1    SELECT:    Char Mode: Replace
```

Fig. 5. First page of the shipment application.

Fig. 6). After the retrieved records are displayed, the counselor selects the shipment that is to be removed from NTS.

A trigger then uses the code of the NTS contractor who has the shipment in storage and the facility code for the warehouse where the shipment is stored to retrieve from a data base table the warehouse address for the storage facility. Another data base table is accessed for the NTS service order number and lot number (shipment identifiers). The address is copied back into the shipment application as the pickup address of this shipment (see Fig. 7), while the NTS service order number and lot number are copied back into a remarks field on the last page of the shipment application as a means of identifying the property to be removed from NTS (see Fig. 10, which is discussed later).

This series of triggers accomplishes two things for the counselor. First, the address retrieval eliminates seven lines of input, thus saving time and keystrokes. This retrieval also eliminates the possibility of input error, thus protecting the integrity of the data base.

4.3 LOGIC VALIDATION

Figures 5-8 demonstrate the use of advanced logic validation in the Counseling module. As explained in the preceding section of this report, if shipment_out_of_nts = 'Y', a trigger calls a new application that queries the data base for the member's NTS shipments.

If the query retrieves no record of an NTS shipment for the member, another trigger tests for two possibilities. First, as seen in Fig. 8, the counselor is asked if this is a remote counseling shipment (that is, the counselor and the member are at

Summary of Member's NTS Shipments

Orders No.	Ship. No.	Serv. Ord. No.	Lot No.	Contractor Code	Storage Facility	Wt.	Resp. GBLOC

Use arrow keys to move to desired shipment. Then press SELECT.

Form: nts_sum Block: pathway Page: 1 SELECT: Char Mode: Replace

Fig. 6. First page of the NTS shipment summary application.

```
Authorized Origin City    : _____________________
                  County  : _____________________
                  State   : __  _________________
                  Country: _____________________

                    Pickup Information
Street     : ____________________________________________
City       : ____________________________
County     : ____________________________
State      : __  ________________________   Section of State: _
Zip/APO/FPO: ____________________
Country    : ______________________
Phone      : _____________

Origin GBLOC: ____  Rate Area: _________  DTGBL Zone: __  DPM Zone: __

Desig. Agent Name : ________________________________
       Relation   : ________________
       Phone      : _____________

Form: shipment    Block: pathway    Page: 2    SELECT:    Char Mode: Replace
```

Fig. 7. Second page of the shipment application.

```
No NTS shipment can be found for this member in the local data base:

                    Is this remote counseling? _

Form: nts_sum     Block: pathway     Page: 2    SELECT:     Char Mode: Replace
```

Fig. 8. Second page of the NTS shipment summary application.

one location and the member's shipment is at another location; thus, the shipment record would be in the data base at another PPSO instead of in the counselor's local data base). If the counselor answers 'Y', then a flag is set indicating that this is remote counseling (the flag is used later in the Counseling module), the counselor is returned to the shipment application, and the cursor moves to the next field.

If the counselor indicates that this is not remote counseling, then the only remaining possibility is that the counselor has made an error in saying that this is a shipment out of NTS. In this case, the counselor is returned to the shipment application, an 'N' is selected into the field shipment_out_of_nts, and the cursor moves to the next field.

Using this user interface technique accomplishes several things. First, it ensures data integrity by monitoring and evaluating the validity of user input. Second, it helps reassure the user that his input is being checked and that the possibility of his making an error and endangering the integrity of the data base is minimized. This element of man/machine interface helps strengthen the "partnership" between user and system, thus contributing to the success of TOPS.

4.4 DATA DERIVATION

On page 4 of the shipment application (Fig. 9) is an instance of data derivation that reflects the complexity of the TOPS system. The counselor is asked for the shipment's released valuation option (i.e., the amount of insurance coverage requested for this shipment). The valid responses are 'BASIC' (the default option for which the government pays), 'HIGHER', and 'REPLACE' (two

Shipment Value	SIT/Temporary Storage
Released Valuation Option: _____ Declared Valuation Amount: _____ Estimated Cost to Member : _____	Authorized at Origin (Y/N): _ Authorized at Dest. (Y/N) : _ Number of Days Authorized : ___

Reweigh Requested at Destination (Y/N) : _
Inspection Requested at Destination (Y/N) : _
Additional Service Requested (Y/N) : _

Does Member Have a Carrier/Contractor Preference: _
Is Member Willing To Pay for C/C Preference : _

Form: shipment Block: pathway Page: 4 SELECT: Char Mode: Replace

Fig. 9. Fourth page of the shipment application.

instances of extra coverage for which the member must pay a certain amount).

If the counselor accepts 'BASIC', the cursor skips to the field sit_authorized_at_origin. If the counselor inputs either 'HIGHER' or 'REPLACE', the cursor moves to the field declared_valuation_amount (declared value of the shipment). After the counselor enters an amount, a trigger first calculates (using an algorithm provided by the military) the cost of basic insurance coverage for this shipment and copies it to a hidden field:

```
select ((1.25 * :one.estimated_weight) / 100) * 64
into one.basic_cost from dual
```

If the value is 'HIGHER', then a trigger calculates the cost to the member for the additional insurance coverage he has requested and copies this value to a hidden field:

```
select ((:one.declared_valuation_amount / 100) * 64) -
:one.basic_cost into one.estimated_cost_valuation from dual
```

The calculation for the cost to the member of the 'REPLACE' option is as follows:

```
select ((:one.declared_valuation_amount / 100) * 0.85) -
:one.basic_costinto one.estimated_cost_valuation from dual
```

In each of these cases, the user interface technique performs functions that help the counselor do his job better. First, the coding that calculates the costs for the member's insurance coverage will always contain the latest algorithms as dictated by the military; therefore, the counselor can always be sure that the calculations being performed are in accordance with military regulations. In addition, the counselor will be relieved of the

tedious and sometimes difficult task of doing mathematical calculations. In relieving the counselor of this task, the user interface techniques used in this module free him to concentrate on his interaction with the member he is counseling.

4.5 AUTOMATED REMINDERS

The user interface techiques in Counseling were also designed to print for the user timely reminders of work to be done, screens to be accessed, or obstacles to be avoided. Many of these are quite simple, like reminding the counselor to access the additional services application when additional_service_requested = 'Y' (see Fig. 9); others are more elaborate.

For example, when the counselor commits shipment data after completing data entry on the shipment application (see Fig. 10), several triggers are called, each of which was designed to ease the burden of work on the counselor. First, a trigger automatically sets the status of the shipment = 'IC' (in counseling). Another trigger checks the shipment authorized origin and authorized destination to retrieve the authorized shipment mileage into a hidden field:

```
select miles into one.authorized_distance
from domestic_mileage
where destination_state = :one.authorized_destination_state
and (destination_county_city =
:one.authorized_destination_county
or destination_county_city =
:one.authorized_destination_city)
```

The same trigger then checks the actual pickup address and delivery address to retrieve the requested distance into a hidden field:

```
DD1299 Mailed In (Y/N)  : _                    Mail Out (Y/N): _
Preparing Installation  : ______________________________________
Date DD1299 Prepared    : _________     Date Printed: _________
Block 13 Remarks:
_______________________________________________________________
Reason No Signature     : ______________________________________

Name Certifying Officer : ______________________________
Title Certifying Officer: ______________________________

              _ Press COMMIT to commit shipment data.

Form: shipment    Block: pathway    Page: 6    SELECT:    Char Mode: Replace
```

Fig. 10. Sixth page of the shipment application.

```
select miles into one.requested_distance
from domestic_mileage
where destination_state = :one.delivery_address_state
and (destination_county_city = :one.delivery_county
or destination_county_city = :one.delivery_address_city)
```

Then if the actual distance is further than the authorized_distance, the counselor sees a warning message: "There is a probable excess cost on this shipment because of excess distance." This statement warns the counselor to access the excess cost screen and to collect an excess cost payment from the member if conditions warrant this advance collection.

4.6 ACCESS CONTROL

Limiting user access to certain applications is particularly useful when system users are inexperienced or uncertain about the steps needed to complete a given job. In Fig. 5 we see the prompt asking whether or not a shipment contains a privately owned vehicle (POV). After entering basic shipment data for a shipment containing a POV, the counselor must access the POV application to enter additional data (see Fig. 11).

Let us say that a member has two shipments, the first of which contains a POV. In order to prevent the counselor from accessing the POV screen and entering POV data for the wrong shipment, the POV application, like many others in the Counseling module, has a trigger to test to be sure the counselor has the correct shipment before allowing him to continue:

```
select shipment_number from shipment
where member_social_security_number =
:one.member_social_security_number
and orders_number = :one.orders_number
and shipment_number = :one.shipment_number
and shipment_contains_pov = 'Y'
```

```
Name  : _____,_____ _____ SSN: _____
Branch: _    Orders No.: _____      Ship. No.: __

     Make : _____                ID Number      : _____
     Model: _____                License Number : _____
     Year : __                   Licensing State: __

                    Is POV Drivable (Y/N): _

                         _ Commit POV data.

Form: pov        Block: pathway     Page: 1    SELECT:     Char Mode: Replace
```

Fig. 11. First page of the POV application.

If this statement is true, it means the counselor has selected the correct shipment for which to enter POV data. If it fails, the counselor sees the following error message: "This shipment does not contain a POV." The trigger then returns the counselor to the shipment application, where he can query the data base to retrieve the correct shipment. This user interface trigger both prevents the counselor from continuing and returns him to the application he needs to access in order to determine the correct shipment number.

4.7 FUNCTION CONTROL

In addition to limiting access to certain applications, triggers can prevent the user from performing certain data base functions, like inserting a record into the data base or updating data. To see how such a trigger is used in the Counseling module, let us say that a counselor has finished interviewing a member and has signed off on the member's shipments. Furthermore, the outbound clerk has already scheduled the shipments for pickup by a carrier.

After this shipment has entered the system and been handled by several different offices, it is important to prevent clerks from arbitrarily modifying data about the member or the shipment. Therefore, many Counseling applications have triggers to prevent counselors from modifying a record after they have signed off on a shipment. Immediately after the counselor accesses an application, a trigger is called that checks shipment status: if the shipment_status_code = 'IC', the counselor is allowed to proceed; if the status code is anything except 'IC', then the counselor is warned not to update the retrieved record. However, the counselor is allowed to remain on the screen and to scroll through the pages of the application to review data if he wishes.

To ensure that the counselor does not make any changes to any records retrieved, there are also PRE-UPDATE triggers that check shipment status. If the counselor tries to modify the retrieved data and commit these revisions, the trigger is fired. As before, if shipment_status_code = 'IC', then the commit succeeds; if not, the commit fails and the record is not updated. At the same time the counselor sees a message explaining that the record has not been updated.

4.8 AUTOMATED FUNCTIONS

One of the most user-friendly of the techniques used in the Counseling module is the automation of tasks that would take the counselor an inordinate amount of time if he were forced to do the work manually. Not only do these techniques save the counselor time and effort, but they also ensure that he is freed from the fatigue and boredom of repetitive tasks, conditions that often result in user error.

One example of automated functionality triggers in the Counseling module is found in the application that allows the counselor to update the member's social security number and/or orders number. Because the social security number and the orders number are primary keys in the TOPS data base, these two data elements are found in all data base tables that deal with the member and/or his shipments. Thus, a decision to modify the member's social security number and/or his orders number would affect the majority of tables in the data base.

If the counselor had to update one or both of these data elements in every record in all affected tables, the task would take a tremendous amount of time and the necessity of retyping the new

data over and over again would increase the danger of input error to an unacceptable level. Therefore, an application (see Figs. 12a and 12b) was created in the Counseling module to allow the counselor to update the member's social security number and/or orders number with a minimum amount of time and a limited number of keystrokes.

The counselor accesses the application seen in Figs. 12a and 12b when he is certain that the member's social security number and/or orders number has been input incorrectly. First the counselor must indicate whether or not he wishes to update the member's social security number (the counselor is offered the option of updating the orders number on the second page of this application, seen in Fig. 12b). Notice the warning that cautions the user about the consequences of updating a data base primary key. If he wishes to update the social security number (or SSN), the counselor must first type in the new SSN in the correct format ('999-99-9999'). A trigger validates the format. Another trigger checks to make sure that the new SSN is not the same as the old SSN, a measure taken to ensure that the computer system does not spend needless time and memory replacing the SSN with the same SSN.

Then the counselor is asked to retype the SSN exactly as before. Again, triggers check the format and the data content. In addition, another trigger verifies that the two SSNs just typed are identical, thus minimizing the possibility of a typographical error. After the trigger verifies that there is a match, the counselor is asked if he is ready to commit the new data to the data base, a simple precautionary measure to signal the significance of the update the counselor is making. Such techniques might sound like scare tactics, but making the counselor a little cautious is preferable to allowing him to endanger the data base by making important decisions casually.

```
Name   : _______________,_______________ _______________      SSN: ___________
Branch: _     Orders No.: __________

   Update Member SSN (Y/N): _

   (NOTE: Updating the member's SSN will alter ALL records in the data
          base for this member. Check all changes before committing.)

                    New SSN        : ___________

                    Retype New SSN: ___________

                 Commit Change to Data Base (Y/N): _

Form: mbr_key     Block: pathway     Page: 1    SELECT:     Char Mode: Replace
```

Fig. 12a. First page of the member key update application.

```
SSN: _____                    Orders No.: _____

Update Orders No. (Y/N): _

(NOTE: Updating the member's orders number will alter ALL records in
       the data base that contain this orders number. Check input.)

                New Orders No.        : _____

                Retype New Orders No.: _____

                Commit Change to Data Base (Y/N): _

Form: mbr_key     Block: pathway     Page: 2    SELECT:     Char Mode: Replace
```

Fig. 12b. Second page of the member key update application.

If the counselor indicates that he is ready to update the data base with the new member social security number, a trigger first prints a message to the counselor: "Please wait while data base is being updated." This kind of message is important when the processing will take a significant amount of time. The user should be informed of such delays to forestall worry about whether "anything is happening."

While the user is waiting, behind-the-scenes processing is checking each data base table for records with the member's old SSN. When found, these records will be updated with the new SSN indicated on the counselor's screen. The result is an automated, thorough update of more than 27 data base tables, an update free of human frailties like input errors or memory lapses. The counselor is saved countless keystrokes and the burden of trying to make sure that he types the SSN correctly each time and that he does not forget any tables that are affected by the data change.

5. SUMMARY

The new TOPS system created by ORNL analysts and programmers for use by the transportation clerks in over 240 PPSOs in CONUS (overseas TOPS is planned for a later deployment) represents the collective hard work and commitment of many men and women. When deployed, it will give the world of transportation a powerful tool with which to better serve members of the military.

TOPS is one of the largest decision-support systems for which human factors were a major design consideration. As the front-end of this powerful new system, the Counseling module was designed to serve as a friendly introduction to TOPS. This introductory module will provide a bridge between the user and the system that will help pave the way for the successful deployment of TOPS and a long and beneficial partnership between man and machine.

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