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The Army Budget Office (ABO), headed by the Deputy Asst Secretary of the Army for Budget (DAB), supervises the formulation, justification, and execution of the Army budget [2]. During the 1990's, declining budgets have outpaced cuts to force structure creating a financial dilemma for senior Army leaders struggling with how to pay for Army operations with fewer dollars. During this period, the Army has been able to reduce its operating budget by lowering the number of soldiers on active duty. Throughout the downsizing period, the ABO has often been required to conduct quick turn-around analyses on the budgetary impacts of different force sizing and basing options. The Pro Forma Model was designed and developed to provide the ABO with a tool for quickly and accurately conducting these types of analyses.

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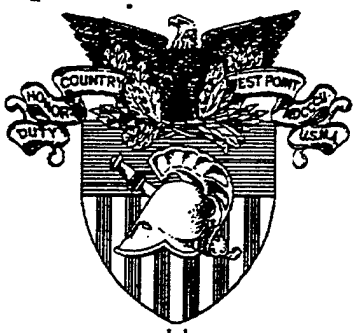

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ARMY BUDGET OFFICE
Pro Forma Model

OPERATIONS RESEARCH CENTER
TECHNICAL REPORT FY 95-2

Major Robert M. McCaleb
Major Michael P. Barbero
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June 1995

The Operations Research Center is supported by the Assistant Secretary of the Army for Financial Management and Comptroller

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U.S. Army Budget Office Pro Forma Model

A TECHNICAL REPORT

of the

OPERATIONS RESEARCH CENTER
UNITED STATES MILITARY ACADEMY

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TABLE OF CONTENTS

LIST OF FIGURES ii

LIST OF TABLES ii

ACKNOWLEDGMENTS iii

1. INTRODUCTION 1

1.1. Background 1

1.2. Preliminary and Related Work 2

1.3. Estimating OMA Savings as the Army Downsizes 3

1.4. Estimating the Impact of Downsizing 6

2. MODEL FORMULATION 7

3. DECISION SUPPORT SOFTWARE SYSTEM 13

3.1. System Development Process 13

3.2. System Architecture 15

4. MODEL VALIDATION AND NUMERICAL RESULTS 21

5. CONCLUSIONS 24

APPENDIX A: *Pro Forma* Input Used To Generate The Numerical Results In Chapter 4 26

REFERENCES 28

LIST OF FIGURES

FIGURE 1. Decision Support Software System Development Phases 14

FIGURE 2. Decision Support Software System Architecture and Modules 16

FIGURE 3. Dialog Box for Structuring the Force 17

FIGURE 4. Edit Box for Data Entry 17

FIGURE 5. Flow Diagram of User Options 19

FIGURE 6. Input Used to Generate OMA Dollar Estimates for FY94 27

LIST OF TABLES

TABLE 1. Budget Activity Groups 4

TABLE 2. Current Cost Factors 5

TABLE 3. Comparison of Actual and Estimated OMA Dollars 22

TABLE 4. Comparison of Actual and Estimated Civilian End Strengths 22

TABLE 5. Comparison of Actual and Estimated OMA Expenditures for Civilians 23

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1. INTRODUCTION

The Army Budget Office (ABO), headed by the Deputy Assistant Secretary of the Army for Budget (DAB), supervises the formulation, justification, and execution of the Army budget [2]. During the 1990's, declining budgets have outpaced cuts to force structure creating a financial dilemma for senior Army leaders struggling with how to pay for Army operations with fewer dollars. During this period, the Army has been able to reduce its operating budget by lowering the number of soldiers on active duty. Throughout the downsizing period, the ABO has often been required to conduct quick-turn-around analyses on the budgetary impacts of different force sizing and basing options. The *Pro Forma* Model was designed and developed to provide the ABO with a tool for quickly and accurately conducting these types of analyses.

1.1. BACKGROUND

Pro Forma was developed to meet the analysis needs of the primary model user, the Integration Branch of the Operations and Support Directorate of the ABO, for conducting numerous quick-turn-around analyses that assess the economic impact of various scenarios for downsizing the Army. A second important reason for developing *Pro Forma* was to automate many routine, yet complex, calculations for the budget analyses. It was hoped that automating these procedures would offset the loss of experts due to personnel turnover within the Integration Branch; experts who were responsible for conducting economic analyses. This meant system developers had to make sure that *Pro*

Forma was sufficiently friendly, robust, and versatile enough to handle a wide range of potential "what if" scenarios concerning the Army's end strength.

1.2. PRELIMINARY AND RELATED WORK

In 1991, the ABO asked the Operations Research Center (ORCEN) to develop a fully automated executive-level computer model to help meet the analysis needs of the ABO described above. Preliminary research establishing the objectives of the *Pro Forma* model is described in ORCEN Technical Report 91-4 [3]. The initial efforts to design and develop the *Pro Forma* model are discussed in ORCEN Technical Report FY92/90-2 [4]. Subsequent work modifying *Pro Forma*'s cost factors and improving the user-friendliness of the model is summarized in ORCEN Technical Report FY93-94/90-2 (draft) [6].

The ORCEN Technical Reports cited above document the evolution of *Pro Forma* through July 1994. In addition to these reports, the "Army Budget Office *Pro Forma* Model User Guide," published by the ORCEN in April 1995, gives detailed instructions for using and updating the Model. The *User Guide* also provides examples of *Pro Forma* output and documents the computer programs (written in Excel macros) for executing the mathematical calculations for the economic analysis performed by *Pro Forma.*

This report, Technical Report 95-2, documents the mathematical formulation of the model and the development of the decision support software system (DSSS) omitted

from previous technical reports. It also discusses enhancements made to the model since July 1994 that include the development and implementation of a methodology for estimating changes to the Department of the Army civilian end strength based on changes to the active duty military end strength. Additionally, the model now estimates the OMA dollar expenditures attributable to changes in the civilian end strength.

1.3. ESTIMATING OMA SAVINGS AS THE ARMY DOWNSIZES

There are many Congressionally-approved appropriations in the Army budget that have been seriously affected by downsizing the Army over the past five years. The budgets that have been impacted the most by Army downsizing are: (1) Operations and Maintenance, Army (OMA); (2) Military Personnel, Army (MPA); and (3) Army Family Housing (AFH). Two of these appropriations, the OMA and MPA funds, account for approximately 78% of the Army's budget [7]. In general, the MPA and AFH budgets are driven by Army end strength. Although the OMA budget is somewhat dependent upon Army end strength, it is not as sensitive to this as the MPA and AFH budgets. Currently, the ABO uses Budget Activity Groups (BAGs) to estimate OMA dollars. This approach has been adopted for *Pro Forma* analysis. Table 1 shows the various BAGs used by *Pro Forma* in accounting for funds required to sustain the Army's day-to-day operations.

Budget Activity Group Code	Designation
AG11	Land Forces
AG12	Land Operations Support
AG21	Mobilization Operations
AG33	Recruiting and Other Training & Education
AG41	Security Programs
AG42	Logistic Operations
AG43	Service Wide Support
AG44	Logistic Operations

Table 1. Budget Activity Groups

In *Pro Forma*, OMA dollar savings are estimated using Budget Activity Group cost factors and Army end strength data. ORCEN Technical Report FY92/90-2 discusses the procedures for computing the cost factors used in the MPA and AFH calculations. This Technical Report (FY 95-2) outlines the steps to compute the OMA cost factors and how the cost factors are used to estimate OMA savings. This report also discusses the troop-to-civilian ratios and average civilian work-year costs for estimating the impact of downsizing the Army on both civilian end strength and OMA dollar savings.

Cost Factor Calculations

As mentioned above, forecasting changes to OMA dollars based on reductions to Army end strength depends upon cost factors that must be computed ahead of time for each BAG. The cost factors computed for this study are based on the BAGs for the following major commands (MACOMs): (1) Forces Command (FORSCOM); (2) U.S. Army, Europe (USAREUR); (3) U.S. Army, Pacific (USARPAC); (4) U.S. Army, South

(USARSO); and (5) Eighth U.S. Army (EUSA). Currently, the cost factors are calculated from a three-year moving average of *dollar-to-troop* ratios, although, the use of other time horizons for the cost factor calculations is easily incorporated into the model. Dollar-to-troop ratios are calculated by dividing the OMA dollars executed annually for each BAG and MACOM by the active duty end strength for each MACOM. Chapter 2 gives the mathematical formulas for calculating the cost factors. Table 2 lists the OMA cost factors currently used in *Pro Forma* by BAG and MACOM.

	AG11	AG12	AG21	AG33	AG41	AG42	AG43	AG44
USAREUR	25.797	0.001	0.541	0.380	0.152	0.574	1.489	2.451
FORSCOM	13.619	0.205	0.116	0.160	0.015	0.089	0.292	0.001
EUSA	24.371	0.149	NA	0.287	NA	0.205	0.232	0.479
USARSO	39.561	3.926	NA	0.350	0.189	0.151	0.506	1.769
USARPAC	35.134	0.008	0.012	0.440	0.007	0.225	0.802	0.046

Table 2. Current Cost Factors (in $000 per soldier)

Pro Forma estimates OMA dollar savings by multiplying the difference (delta) between proposed Army end strength objectives and the current strength objectives times the appropriate cost factors from Table 2. The OMA savings from troop reductions are generally not realized during the same year that the troop reductions are made. Normally,

OMA savings from troop reductions made in base-year *t* yield 50% OMA savings in year *t+1* and 50% OMA savings in year *t+2*. The model computes total savings by appropriation and by OMA BAGs. It also computes savings in each MACOM by BAG.

1.4. ESTIMATING THE IMPACT OF DOWNSIZING ON CIVILIAN END STRENGTH

In determining the civilian impact of downsizing, it is necessary to first establish a relationship between civilian losses and reductions to military end strength. *Pro Forma* establishes this relationship by using troop-to-civilian ratios for each of the five MACOMs given above (see Table 2) and then estimates the civilian losses for each of these MACOMs based on the troop-to-civilian ratios. The ratios are calculated at the beginning of each fiscal year as the sum of military end strengths for the previous three fiscal years divided by the sum of the civilian end strengths for the same three fiscal years. The model then estimates the civilian end strength delta for each MACOM by dividing the troop delta by the troop-to-civilian ratios.

The next step for estimating the civilian impact of downsizing is to estimate the OMA savings attributable to the civilian delta from the previous step. In *Pro Forma*, this is done by multiplying the estimated civilian end strength delta by the appropriate cost factor for each MACOM. The mathematical formulas for calculating the troop-to-civilian ratios, the estimated civilian end strength deltas and the estimated OMA savings from civilian downsizing are discussed next in Chapter 2.

2. MODEL FORMULATION

Indices

t: denotes the current fiscal year of the planning horizon. The planning horizon is represented by the set $\{t, t+1, ..., t+t', ..., t+x\}$, where x is an indicator variable that denotes the number of years in the planning horizon and $t+x$ is the last year of the planning horizon. x takes on feasible values from the set $x \in \{1, 2, ..., X(t)\}$ and is specified by the analyst prior to running the model. t' is an indicator variable that denotes the number of years after t. t' takes on feasible values from the set $t' \in \{1, 2, ..., T(t')\}$ and $t' \leq x$.

i: index for Major Command (MACOM), where $i \in \{1, 2, ..., I(t)\}$ and the number of MACOMs, $I(t)$, depends on fiscal year t.

j: index for Budget Activity Group (BAG), where $j \in \{1, 2, ..., J(t)\}$ and the number of BAGs, $J(t)$, depends on fiscal year t.

n: number of years for calculating the n-year moving averages of $\bar{c}_{ij}(t)$, $\bar{r}_i(t)$, and $\bar{z}_i(t)$ (see below). $\{t-n, ..., t-1\}$ denotes the base years used for computing the moving averages.

k: denotes the fiscal year prior to fiscal year t where k takes on feasible values from the set $k \in \{t-n, ..., t-1\}$.

l: index for Budget Appropriation Category. l takes on values from the set {1, 2, 3, 4} according to the following: 1=OMA; 2=MPA; 3=PCS; and 4=AFH.

m: denotes the number of years after fiscal year $t+t'$ when estimated OMA savings from end strength reductions during fiscal year $t+t'$ are realized. m takes on feasible values from the set $m \in \{1, 2, ..., M(t)\}$ and $m \leq (x-t')$.

Computational Factors for Estimating OMA Savings Resulting from Reductions in Proposed Troop End Strength

$\bar{c}_{ij}(t)$: denotes the OMA cost factor for MACOM i and BAG j computed as a n-year moving average according to equation (1) below for the sequence of years $\{t-n, ..., t-1\}$.

$a_{ij}(t, t')$: total OMA savings for MACOM i and BAG j resulting from proposed end strength reductions in fiscal year $t+t'$.

$b_{ij}(t, t', m)$: total OMA savings realized in fiscal year $t+t'+m$ for MACOM i and BAG j resulting from proposed end strength reductions in fiscal year $t+t'$.

$B_{ij}(t,t',m)$: total OMA savings realized in fiscal year $t+t'+m$ from end strength reductions in all fiscal years $t+t'$ for MACOM i and BAG j.

$d_i(t,t')$: total OMA savings for MACOM i from proposed end strength reduction in fiscal year $t+t'$.

$D_{ij}(k)$: actual OMA dollars spent in fiscal year k for MACOM i and BAG j.

$e_i(t,t',m)$: total OMA savings realized in fiscal year $t+t'+m$ from proposed end strength reduction in fiscal year $t+t'$ for MACOM i.

$E_i(t,t',m)$: total OMA savings realized in fiscal year $t+t'+m$ from troop strength reduction for MACOM i.

$f_j(t,t',m)$: total OMA savings for BAG j realized in fiscal year $t+t'+m$ from proposed end strength reduction in fiscal year $t+t'$.

$g(t,t')$: total OMA savings from proposed Army end strength reduction in fiscal year $t+t'$.

$h(t,t',m)$: total OMA savings realized in fiscal year $t+t'+m$ from proposed end strength reduction in fiscal year $t+t'$.

$p_l(t,t',m)$: total savings in budget appropriation l realized in fiscal year $t+t'+m$ from proposed end strength reduction in fiscal year $t+t'$.

$v(t,m)$: percentage of estimated OMA savings realized in fiscal year $t+t'+m$.

$w_i(k)$: actual troop end strength for MACOM i and fiscal year k.

$y(k)$: inflation factor applied to both OMA and civilian work-year dollars spent in fiscal year k to inflate to current year t.

$\Delta_i(t,t')$: difference between current end strength objective and proposed end strength objective for MACOM i and fiscal year $t+t'$.

Computational Factors for Estimating Civilian Changes and OMA Savings from Changes in Proposed Troop Strengths

$q_i(k)$: actual civilian end strength for MACOM i and fiscal year k.

$\bar{r}_i(t)$: denotes the n-year moving average of *troop-to-civilian* ratios for MACOM i computed as shown in equation (13) below.

$\bar{z}_i(t)$: denotes the n-year moving average of civilian work-year costs for MACOM i computed as shown in equation (14) below.

$u_i(t,t')$: estimated civilian end strength reduction for MACOM i resulting from the troop end strength reduction in fiscal year $t+t'$.

$s_i(t,t')$: total OMA savings realized for MACOM i and fiscal year $t+t'$.

Mathematical Equations for Estimating OMA Savings Resulting from Reductions to Proposed Troop End Strength

The n-year moving average amount of OMA executed dollars per soldier, expressed in current fiscal year t dollars, computed for each MACOM $i \in \{1, 2,..., I(t)\}$ and each BAG $j \in \{1, 2,..., J(t)\}$ is

$$\overline{c_{ij}}(t) = \frac{\sum_{k=t-n}^{t-1} \left[\frac{D_{ij}(k) y(k)}{w_i(k)} \right]}{n}. \quad (1)$$

The total OMA savings from the end strength reduction for MACOM i and BAG j, and fiscal year $t+t'$ is

$$a_{ij}(t,t') = \overline{c}_{ij}(t) \Delta_i(t,t'). \quad (2)$$

As it is used here, "savings" applies to *Pro Forma* computations for scenarios to downsize the Army. However, *Pro Forma* may also be used to compute OMA costs associated with upsizing the Army where increases are made to Army end strength. In this case, "negative savings" from *Pro Forma* is interpreted as the additional OMA costs for increasing Army end strength.

The total OMA savings realized in fiscal year $t+t'+m$ for each MACOM i and BAG j, from the end strength reduction in year $t+t'$ is

$$b_{ij}(t,t',m) = a_{ij}(t,t') v(t,m). \quad (3)$$

The total OMA savings realized in fiscal year $t+t'+m$ for MACOM i and BAG j, from end strength reductions in all fiscal years $t+t'$ is

$$B_{ij}(t,t',m) = \sum b_{ij}(t,t',m). \tag{4}$$

The total OMA savings from the troop end strength reduction for MACOM i, and fiscal year $t+t'$ is

$$d_i(t,t') = \sum_{j=1}^{J(t)} a_{ij}(t,t'). \tag{5}$$

The total OMA savings realized in fiscal year $t+t'+m$ for MACOM i, from the end strength reduction in fiscal year $t+t'$ is

$$e_i(t,t',m) = \sum_{j=1}^{J(t)} b_{ij}(t,t',m). \tag{6}$$

The total OMA savings realized in fiscal year $t+t'+m$ for MACOM i, from end strength reductions in all fiscal years $t+t'$, is

$$E_i(t,t',m) = \sum e_i(t,t',m). \tag{7}$$

The total OMA savings realized in fiscal year $t+t'+m$ for BAG j, from the end strength reduction in fiscal year $t+t'$ is

$$f_j(t,t',m) = \sum_{i=1}^{I(t)} B_{ij}(t,t',m). \tag{8}$$

The total OMA savings across all MACOMs i from proposed troop end strength reductions in fiscal year $t+t'$ is

$$g(t,t') = \sum_{i=1}^{I(t)} d_i(t,t') . \tag{9}$$

The total OMA savings realized in fiscal year $t+t'+m$ across all MACOMs i from end strength reductions in fiscal year $t+t'$ is

$$h\ (t,t',m) = \sum_{i=1}^{I(t)} e_i(t,t',m) . \tag{10}$$

Finally, the total dollar savings realized in $t+t'+m$ for appropriation l, from end strength reductions in <u>all</u> $t+t'$ is

$$p_l(t,t',m) = \sum h_i(t,t',m) \text{ if } l = \text{OMA}. \tag{11}$$

$$p_l(t,t',m) = \sum_{i=1}^{I(t)} [0.5\,\Delta_i(t,t')c_{il}] \text{ if } l \neq \text{OMA}. \tag{12}$$

Mathematical Equations for Estimating Civilian Changes and OMA Savings from Changes in Proposed Troop Strengths

The n-year moving average *troop-to-civilian* ratio for MACOM i is

$$\bar{r}_i(t) = \frac{\sum_{k=t-n}^{t-1} \left[\frac{w_i(k)}{q_i(k)} \right]}{n} . \tag{13}$$

The n-year moving average civilian work-year cost, expressed in current fiscal year t dollars, for each MACOM i is

$$\bar{z}_i(t) = \frac{\sum_{k=t-n}^{t-1} [z_i(k) y(k)]}{n} . \tag{14}$$

The civilian end strength changes resulting from the proposed troop end strength reduction for MACOM i, and fiscal year $t+t'$ is

$$u_i(t,t') = \frac{\Delta_i(t,t')}{\bar{r}_i(t)} . \tag{15}$$

Finally, the total OMA savings resulting from the reduction in civilian end strength for each MACOM i, and fiscal year $t+t'$ is

$$s_i(t,t') = [0.5\, u_i(t+t'-1)\bar{z}_i(t)] + [0.5\, u_i(t+t'-2)\bar{z}_i(t)] . \tag{16}$$

3. DECISION SUPPORT SOFTWARE SYSTEM

In meeting the analysis needs of the ABO, it was necessary for the ORCEN to design and develop a user-friendly model capable of estimating the impact of a wide range of "what if" changes to Army end strength on various budget accounts. One of the major development efforts of this project was to embed the mathematical equations of the *Pro Forma* Model in a decision support software system (DSSS), thereby making it possible for the ABO to quickly estimate dollar expenditures for different force structure and basing options. The development of DSSS for the *Pro Forma* Model also met the second major purpose of this project: to overcome the loss of analysis expertise due to a high turnover of personnel within the ABO.

3.1. SYSTEM DEVELOPMENT PROCESS

DSSS development was accomplished in four phases:

Phase 1. Functional Decomposition of the Problem.
Phase 2. Preliminary Design of the *Pro Forma* Architecture and System Modules.
Phase 3. Development of a *Pro Forma* Prototype.
Phase 4. Full Development of the *Pro Forma* DSSS.

The *Pro Forma* development process is shown in Figure 1 along with the sub-steps accomplished in each major phase. The development process shown here follows an approach used by McGinnis [5] to develop a DSSS for resource scheduling for the U.S. Army's Basic Combat Training (BCT) Program.

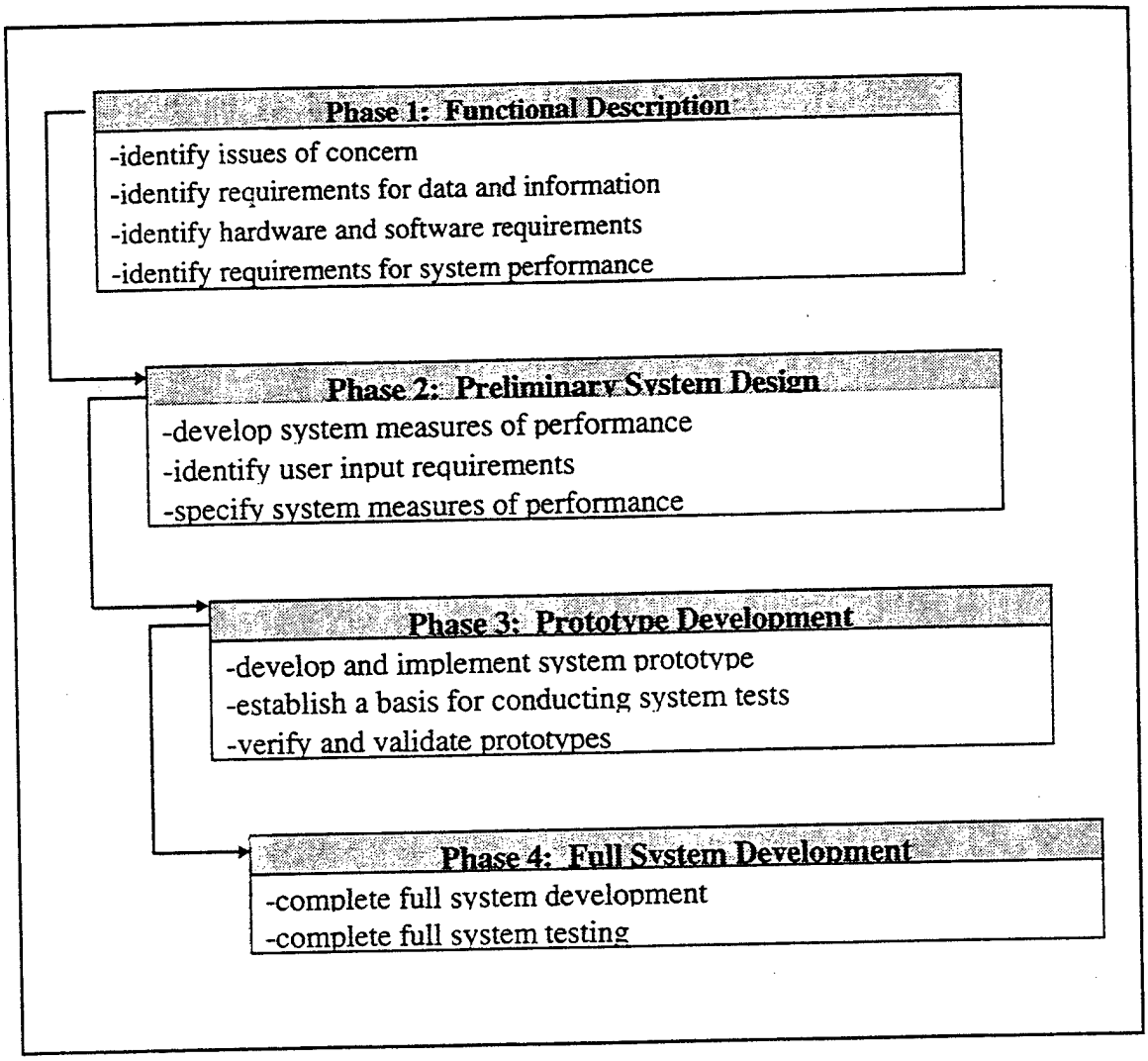

Figure 1. Decision Support Software System Development Phases

The main objective of Phase 1 was to identify the primary functions of *Pro Forma* in terms of how the system could best support the ABO's budget estimate process. In Phase 2, system architecture was graphically represented through a set of interconnected modules where each module corresponds to a functional requirement of the system (see Figure 2). The system modules are:

1. input and output module;
2. system functions module;
3. functional procedures that define the logic and rules by which each module operates; and
4. flow of data between modules.

In Phase 3, prototypes of each module were implemented within a common computer operating system (see Figure 2). Rule-based Procedures and Protocols were developed to control the flow of data between modules. The final step of Phase 3 was prototype testing. In Phase 4, the modules were linked to form the complete system. Phase 4 concluded with full system testing.

3.2. SYSTEM ARCHITECTURE

As mentioned above, the DSSS for the *Pro Forma* Model is based on a modular design. The DSSS has been implemented in a computer spreadsheet environment called *Microsoft Excel for Windows*. In the Microsoft Excel spreadsheet, the system modules are dynamically linked (see Figure 2) to enable dynamic data exchange (DDE). The system functions are automated through the use of advanced macros programmed in Excel. Macros provide flexibility for implementing and fully automating the estimation routines and for streamlining calculations. The functionality of each *Pro Forma* module is characterized by the descriptive module names.

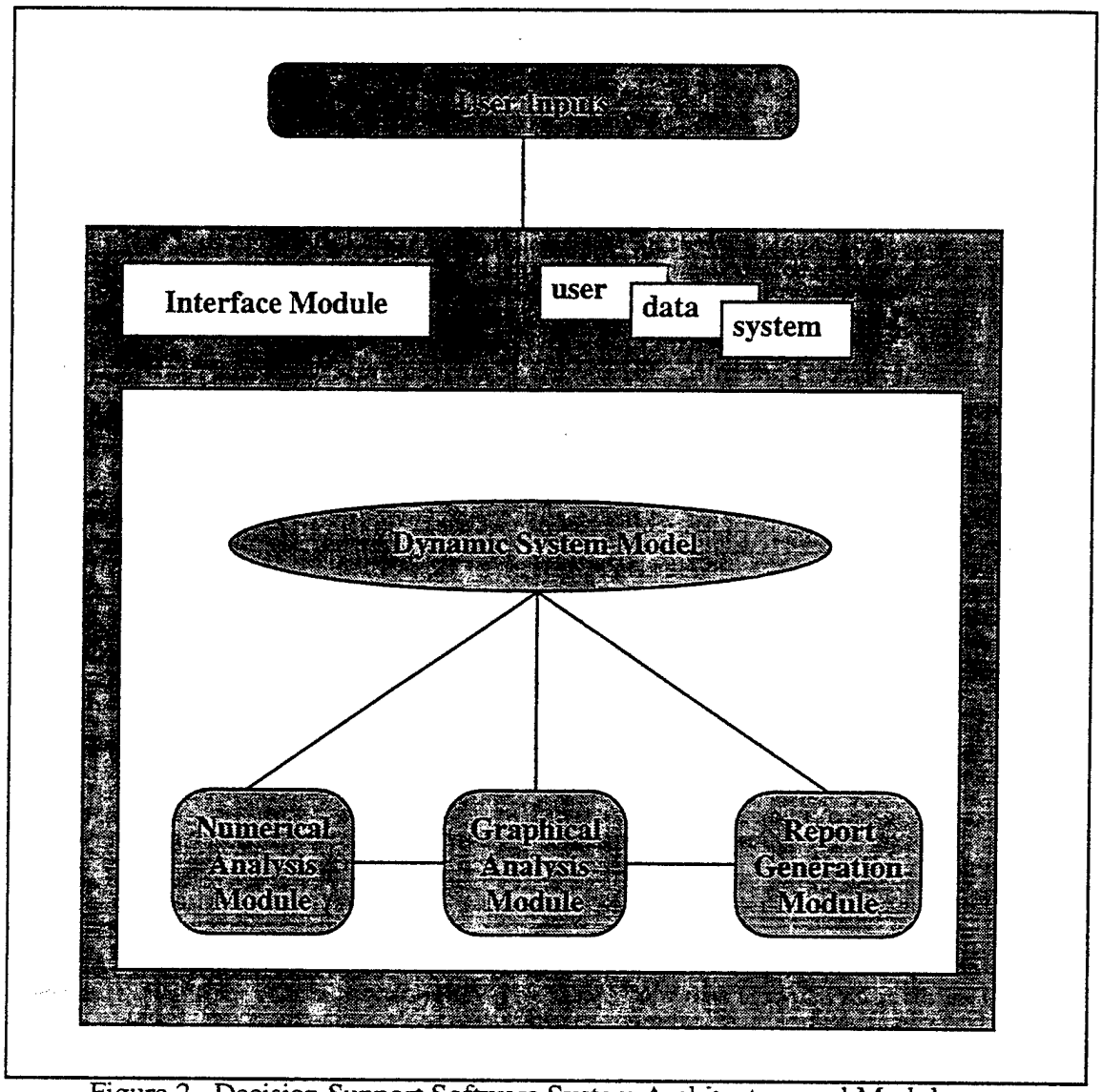

Figure 2. Decision Support Software System Architecture and Modules

The *Numerical Analysis Module* allows the user to either edit the current military end strength or to select one of three different methods for entering the proposed military end strengths. *Pro Forma* estimates of dollar savings are based on the difference between the current Army end strength objectives and proposed end strength objectives input by

the user. This data is entered into *Pro Forma* by "clicking" various options available through either a Dialog Box (Figure 3) or an Edit Box (Figure 4).

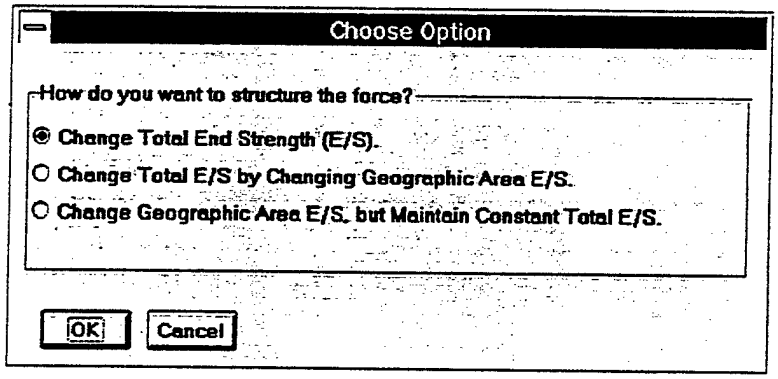

Figure 3. Dialog Box for Structuring the Force

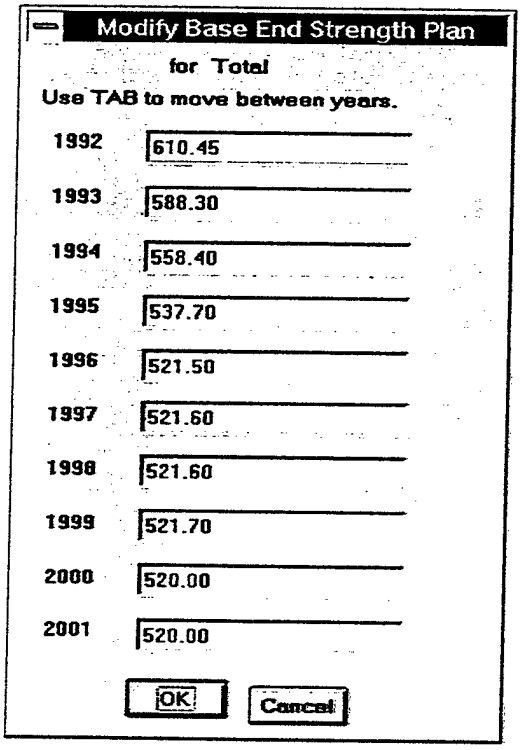

Figure 4. Edit Box for Data Entry

Dialogue boxes like the one in Figure 3 include user options and instructions for entering force structure data. Edit boxes, as shown in Figure 4, allow the user to modify end strength data for the Army and the MACOMs.

The automated approach followed by *Pro Forma* users for analyzing force structure changes is analogous to the manual procedures used in the past by the ABO for estimating the budgetary impact of force structure changes. The flow diagram shown below in Figure 5 outlines the sequence of steps followed by the *Pro Forma* user [4].

As seen in Figure 5, the *Pro Forma* user has three options for restructuring the proposed force plan. Option 1 allows the user to reduce the total end strength of the Army. Selecting this option causes the end strength of each MACOM to be reduced by the same percentage that is applied to the Army end strength. Option 2 allows the user to reduce the proposed end strength of the Army by reducing the end strength of one MACOM at a time. End strength reductions applied to a MACOM in Option 2 are then automatically reflected in the end strength of the Army. Option 3 allows the user to reduce the end strength of a given MACOM and then redistribute the soldiers to other MACOMs. In other words, the total end strength of the Army does not change though the end strength for a selected MACOM is reduced. There are two options available to the user for redistributing the soldiers taken away from a "selected" MACOM: (1) redistribute all soldiers to FORSCOM (when FORSCOM is not the MACOM being reduced); and (2) redistribute the soldiers taken away from one MACOM proportionally across the other MACOMs that were not reduced.

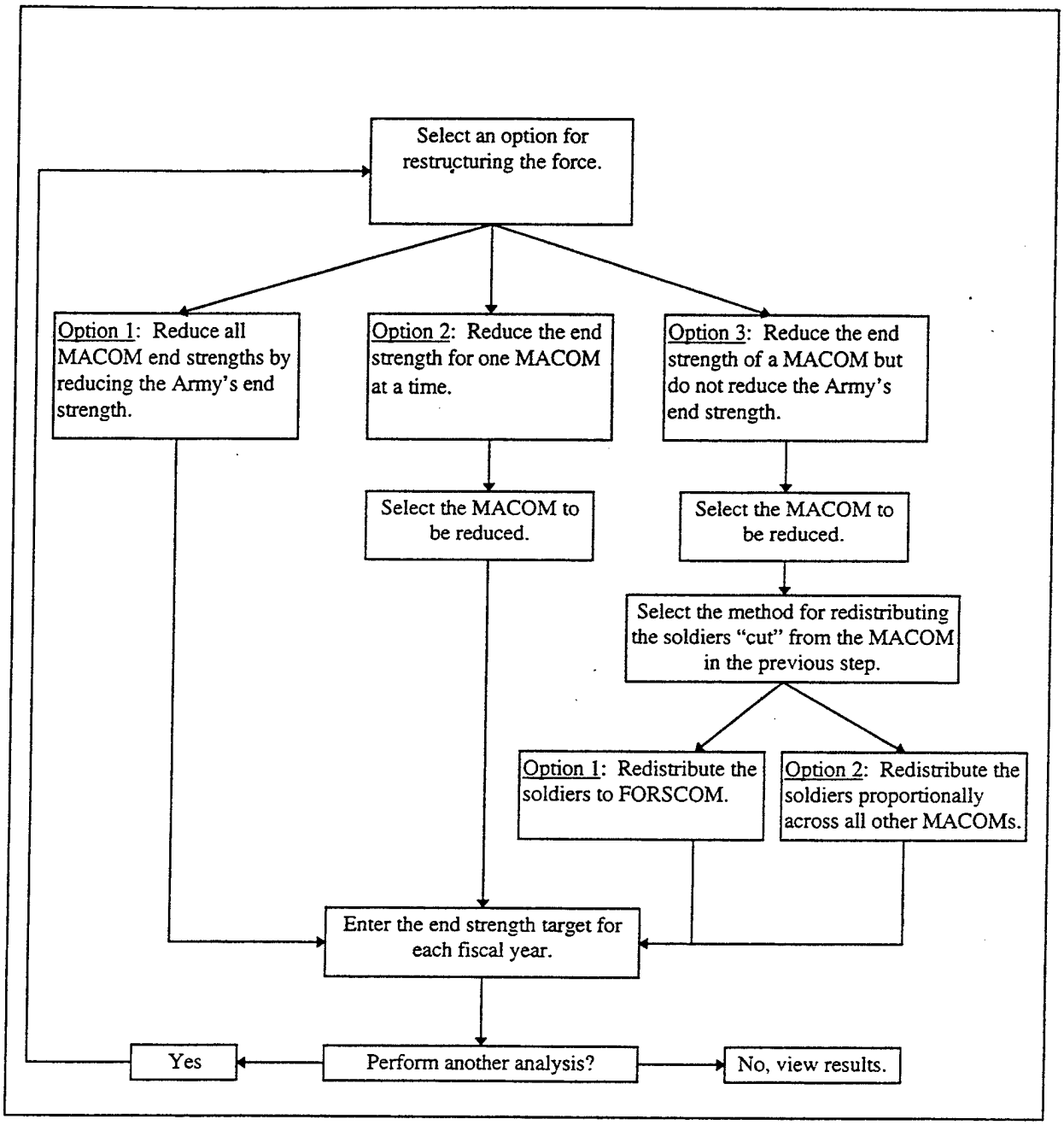

Figure 5. Flow Diagram of User Options

After data is entered in *Pro Forma* to reflect current and proposed military end strengths, the *Numerical Analysis Module* computes the OMA dollar estimates for the total Army, MACOM and Budget Activity Group. The model also estimates changes to civilian end strength and the impact of these changes on the OMA account.

The *Graphical Analysis Module* displays graphical output of the military end strengths and budget estimates based upon the proposed force structure. It also displays graphical output of civilian end strength and the civilian OMA dollar estimates based upon changes to military end strength. The *Report Generation Module* prints numerical and graphical results. *Pro Forma* output can be saved under user-designated names for future reference. The user may review both numerical and graphical results by either displaying them to the computer monitor or by printing them using the appropriate menu option from a Dialog Box or by simultaneously pressing the "Ctrl-p" keys from the keyboard. The reader is referred to *The Army Budget Office Pro Forma Model User Guide* for sample model output and detailed instructions for using the model.

4. MODEL VALIDATION AND NUMERICAL RESULTS

The methodology for validating *Pro Forma* is covered in two previous ORCEN Technical Reports: ORCEN Technical Report FY92/90-2 and ORCEN Technical Report FY93-94/90-2 (draft). Unfortunately, there are still not enough years worth of data to conduct a bona fide experiment to validate *Pro Forma*. Due to insufficient data, the "goodness" of *Pro Forma* is validated year-by-year by comparing the estimated OMA dollar expenditures for a fiscal year from the model with actual OMA dollar expenditures from the same fiscal year.

The data shown in Table 3, taken directly from *Pro Forma*, compares the actual OMA dollars spent for each MACOM during FY94 with the OMA dollar expenditures estimated for the same year.[1] The row labeled "Total" in this table (and in Tables 4 and 5 as well) is determined by summing the actual expenditures or civilian end strengths, as the case may be, for the five MACOMs. The percent differences between the actual and estimated expenditures shown in the right most column of Tables 3, 4, and 5 are computed by dividing the difference between the actual and estimated values by the estimated value. Negative percent differences indicate that *Pro Forma* over-estimated the actual OMA dollar expenditures. As shown in Table 3, *Pro Forma* under-estimated the total of the actual OMA expenditures for the five MACOMs during FY94 by approximately 18 percent.

[1] The *Pro Forma* input used to generate all of the numerical results in Chapter 4 is shown and discussed in Appendix A.

MACOM	FY94 OMA Dollars Spent (millions)	*Pro Forma's* Estimate of OMA Dollars Spent (millions)	Percent Difference Between the Actual and Estimated OMA Dollars Spent
USAREUR	$2,090.42	$1,545.60	35.25%
FORSCOM	$3,321.86	$2,804.04	18.47%
EUSA	$536.83	$564.21	-4.85%
USARPAC	$500.43	$554.65	-9.78%
USARSO	$232.07	$183.84	26.24%
TOTAL	$6,681.61	$5,652.34	18.21%

Table 3. Comparison of Actual versus Estimated OMA Dollars

Table 4 compares the actual civilian end strength in each MACOM at the end of FY94 with the estimated civilian end strength given by *Pro Forma*. Again, the percent differences are given in the far right column. The results show that *Pro Forma* underestimated the sum of the actual civilian end strengths for the five MACOMs by approximately five percent.

MACOM	FY94 Civilian End Strength (thousands)	*Pro Forma's* Estimated Civilian End Strength (thousands)	Percent Difference Between the Actual and Estimated Civilian End Strength
USAREUR	32.91	30.27	8.72%
FORSCOM	25.51	25.00	2.04%
EUSA	9.75	10.07	-3.18%
USARPAC	6.66	6.49	2.62%
USARSO	2.38	1.89	25.93%
TOTAL	77.21	73.72	4.73%

Table 4. Comparison of Actual versus Estimated Civilian End Strengths

Finally, Table 5 compares the actual OMA expenditures for civilians in each MACOM during FY94 with estimated expenditures for civilians in FY94. In this case, *Pro Forma* over-estimated the sum of the MACOMs' actual expenditures by almost six percent.

MACOM	FY94 OMA Expenditures for Civilians (millions)	*Pro Forma's* Estimate of OMA Expenditures for Civilians (millions)	Percent Difference Between the Actual and Estimated OMA Expenditures for Civilians
USAREUR	$1,014.84	$1,198.68	-15.34%
FORSCOM	$936.95	$943.57	-0.70%
EUSA	$296.10	$263.51	12.34%
USARPAC	$238.72	$254.11	-6.06%
USARSO	$75.20	$58.20	29.21%
TOTAL	$2,561.81	$2,718.07	-5.75%

Table 5. Comparison of Actual and Estimated OMA Expenditures for Civilians

From Tables 3, 4, and 5, it is easily seen that the greatest discrepancies between *Pro Forma's* estimates of either the actual expenditures or end strengths are for the USAREUR and USARSO MACOMs. At the time this Technical Report was written, it was not clear why *Pro Forma* was producing such large discrepancies for these two MACOMs. However, it may be explained, in part, by the occurrence of uncontrollable events such as troop deployments and end strength reductions that seem to have had a more profound effect on these two MACOMs. Future work on this model will include investigating these discrepancies in more detail. In spite of these fairly substantial discrepancies for the USAREUR and USARSO estimates, the model users from the ABO feel that the overall accuracy of *Pro Forma* is adequate for their analysis needs.

5. CONCLUSIONS

The *Pro Forma* model has been an outstanding tool for the ABO during the downsizing of the Army. This model gives the ABO the ability to quickly estimate savings generated from reductions in the end strength of the Army. Although the Army's total end strength is relatively stable now at 495,000 soldiers, the Army has recently made plans to reduce its end strength by an additional 20,000 soldiers by fiscal 1998 [1]. Therefore, the ABO still needs *Pro Forma* to evaluate future reductions to the force that will certainly occur. Additionally, the civilian end strength of the Army will continue to decline through fiscal 2001 [7]. Thus, the ABO certainly needs the most recent enhancements to *Pro Forma* that estimate the OMA dollar savings attributable to reductions in civilian end strength.

5.1. SUMMARY AND CONTRIBUTIONS OF WORK

One contribution of this Technical Report is the mathematical formulation of the model. The equations in Chapter 2 explain in detail how all estimated savings and civilian end strength predictions are calculated. A second major contribution of this work is the documentation of the decision support software system (DSSS) that is a significant part of the *Pro Forma* model. The DSSS in *Pro Forma* is the link between the user and the mathematical equations. In other words, the DSSS is the key to the user-friendliness of this model. The last major contribution of this report is to document the enhancements made to the model since July 1994 that include the development and implementation of a

methodology for estimating reductions to the Army's civilian end strength and the OMA dollar savings attributable to these civilian reductions.

5.2. SUGGESTIONS FOR FUTURE RESEARCH

The ABO is currently satisfied with the capabilities of *Pro Forma.* However, this report concludes with a brief description of future work that will make this model even better.

- Add a macro and dialog boxes that would automate the update of the model at the beginning of each fiscal year.
- Permit the user to input proposed civilian end strength reductions for each MACOM and let the model estimate the OMA savings generated by these proposed civilian reductions.
- Revise the current cost factors that are used for the MPA, AFH, and PCS appropriations.
- Incorporate the reserve component into the model.
- Include the costs of VSI, SSB, SERB, early retirement, and unemployment into the model.

APPENDIX A

PRO FORMA INPUT USED TO GENERATE THE NUMERICAL RESULTS IN CHAPTER 4

Numerical results were taken directly from *Pro Forma* to conduct the model validation described in Chapter 4. These numerical results, which are part of *Pro Forma's* output, were generated by inputting data into the *aguser.xlw* spreadsheet of *Pro Forma* as shown in Figure 6 below.

The end strengths listed under the "Current Troop Strength Plan" category in Figure 6 are actual military end strengths for fiscal years 1992 and 1993. FY92 and FY93 entries for "Proposed Troop Strength" were zeroed-out for each MACOM forcing the "Delta" values, where the Delta = Current Troop Strength - Proposed Troop Strength, to equal the FY92 and FY93 actual military end strengths for each MACOM. This establishes a baseline for validating *Pro Forma's* OMA dollar and civilian end strength estimates using the actual total military end strengths for each MACOM. This approach makes it possible to compare the actual FY94 expenditures and civilian end strengths for each MACOM with the estimated FY94 expenditures and civilian end strengths predicted by *Pro Forma.*

Proposed Troop Strength Plan (000's of Troops)

Total End Strength

Geographic Location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL										
Europe										
CONUS										
Korea										
Panama										
Pacific										

Current Troop Strength Plan (000's of Troops)

Geographic Location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL	611.00	572.00								
Europe	100.97	86.28								
CONUS	225.22	223.98								
Korea	21.86	21.14								
Panama	5.25	5.15								
Pacific	15.21	14.86								

Delta (000's of Troops) (Current Troop Strength Plan - Proposed)

Geographic Location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL	611.00	572.00								
Europe	100.97	86.28								
CONUS	225.22	223.98								
Korea	21.86	21.14								
Panama	5.25	5.15								
Pacific	15.21	14.86								

Figure 6. Input Used to Generate OMA Dollar Estimates for FY94

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