Logistics Management Institute

Interactive Electronic Technical Manual Cost-Benefit Analysis Tool

User's Guide

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November 2000

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This report is the user's guide for the Interactive Electronic Technical Manual Cost-Benefit Tool. It provides a description of the tool's layout and several tutorials that instruct the user how to operate the tool. This report is a companion report to *Costs and Benefits of Integrated Electronic Technical Manuals (IETM) to Navy Training and Education.*

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Chapter 1
Introduction

The Interactive Electronic Technical Manual (IETM) Cost-Benefit Analysis Tool is an Excel spreadsheet-based model that compares the costs and benefits of candidate IETM deployment alternatives. This tool applies technology from previous LMI cost-benefit models for law enforcement[1] and commercial aviation[2] to IETMs. We invite anyone who may benefit from using the tool to read this manual and investigate its current features.

The project team has discovered that the training or operational organizations that use IETMs have not compiled much of the data needed to perform a complete cost-benefit analysis. Although this lack of data limits the applicability of the model, it represents an opportunity to demonstrate the types of data, and data repositories, required for future analyses. By demonstrating our cost-benefit analysis methodology on a notional set of IETM projects and alternatives, the model aids the user in identifying the types and formats of data to gather for future analyses.

The current model has three modes of operation: standard analysis, sensitivity analysis, and simulation. The tool also has a utility worksheet that helps the user to estimate the cost of converting a paper manual, or a low-level electronic manual (ETM), to a higher-level ETM or IETM. A companion utility also helps the user to load a new IETM project into the workbook for analysis.

The remainder of this manual is organized as follows:

- *Chapter 2: Description of the Tool* explains the layout of the application.
- *Chapter 3: Tutorials* includes instructions on loading a set of projects, importing data into the application, each of the three modes of operation, and the conversion cost utility worksheet.
- *Appendix: Description of Variables* explains what each variable in the analysis represents.

This tool must be used with caution and discretion. The primary purpose of this tool is to demonstrate the features and types of analysis that an IETM cost-benefit

[1] Cooper, W., J. Dukovich, and J. Bouffard, "The Corrections and Law Enforcement Technology Assessment System (CLETAS)," Proceedings of IEEE International Engineering Management Conference, San Juan, May 1999.

[2] Logistics Management Institute, *The Aviation System Analysis Capability Air-Carrier Cost-Benefit Model,* Report NS804S1, Eric M. Gaier, Alexander Edlich, Tara S. Santmire, and Earl R. Wingrove, January 1999.

analysis tool should have, given sufficient access to development, maintenance, and training data for a relatively thorough sample of IETMs. Because this body of data does not currently exist, the methods in this tool remain largely rudimentary; the assumptions that we used to develop these methods may change as we learn more. Therefore, the user should take special heed when the tool—particularly its default values—disagrees with the user's personal experience.

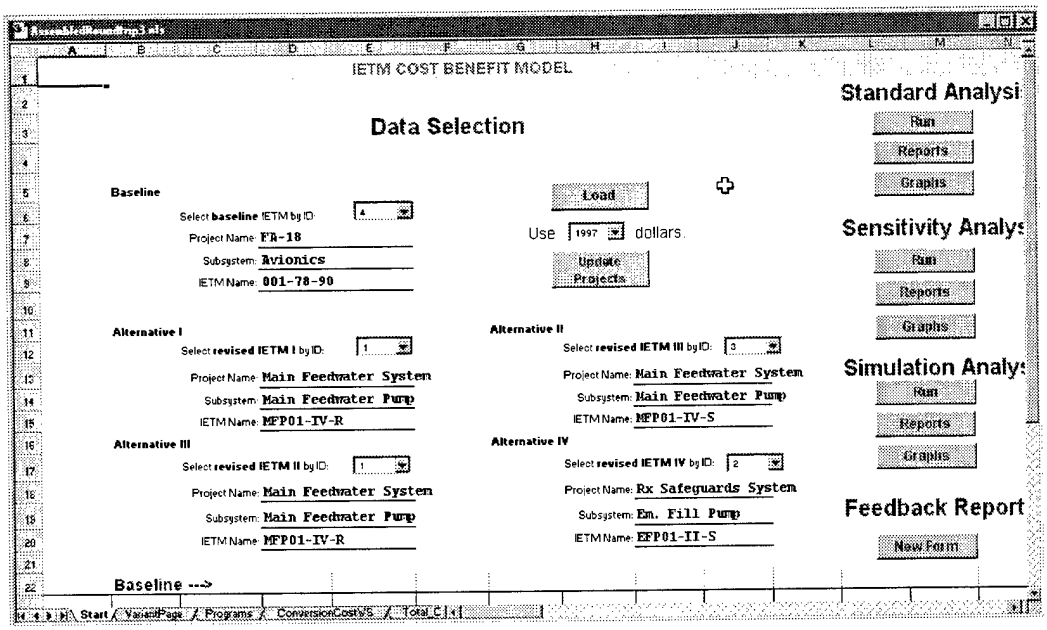
Chapter 2
Description of the Tool

This tool compares one or more alternative programs to a historical, baseline program. The user can compare up to four alternatives at once with a baseline that the user chooses or creates. Typically, all available program data for the baseline and the alternatives reside in a Programs sheet. The user selects the baseline and alternatives from a Start sheet and clicks a button that loads them onto tables in the Start sheet. After adjusting the data (if desired), the user then runs a standard analysis, sensitivity analysis, or simulation. To perform a sensitivity analysis or simulation, the user must also specify a high and low variant for a set of desired parameters in a special Variants sheet prior to running the analysis. All three analysis routines generate reports and graphs that the user can access from the Start sheet. The tool has five basic components: the Start sheet, the Variants sheet, the Programs sheet, Reports sheets, and output graphs.

START SHEET

This sheet (Figure 2-1) is the "command center." It allows the user to load data in preparation for an analysis, modify the data, and run the analysis. It also provides controls that send the user to output reports and graphs. It contains data that the user loads from the Programs sheet or enters manually.

Figure 2-1. Start Sheet



PROGRAMS SHEET

This sheet (Figure 2-2) holds the raw, historical data for any available programs. Because of the lack of data sources, loading a database of programs into this page automatically, as originally intended, is infeasible at present. Nevertheless, this sheet is useful as a repository for data that will be used in more than one analysis.

Figure 2-2. Programs Sheet

	Entry ID	Program	Subsystem Name	IETM Serial Number	ACAT	IETM Class	Report Date	Procurement Cost	Dev. Cost
Units	none	none	none	none	none	none	none	$1000	$1000
Data Sheet Var?	No	No	No	No	No	No	No	Yes	Yes
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Jan-1994	60.00	290.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Apr-1994	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Jul-1994	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Oct-1994	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Jan-1995	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Apr-1995	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Jul-1995	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Oct-1995	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Jan-1996	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Apr-1996	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Jul-1996	0.00	0.00
	1	Main Feedwater System	Main Feedwater Pump	MFP01-IV-R	1	4	Oct-1996	0.00	0.00

Each program is arranged as a set of cost reports. Each cost report has its own date and takes up one row in the Programs sheet. Each report consists of several variables that describe how the IETM has progressed in its life cycle since the previous report. For example, if maintenance and revisions have cost $10,000 since the previous report, the user should find that value in the "Period Maintenance/Revisions Cost" column in the current cost report's row. The appendix describes each variable in the cost report in detail.

The tool uses the cost report concept so it can compare how the costs and benefits accrue over time between the baseline and alternative programs. For example, initial development and procurement costs may make an advanced IETM seem prohibitively expensive in comparison with a Class II ETM over the first several months of the program. Over subsequent years, however, the advanced IETM may provide maintenance and training savings that make it cheaper over the long term. By comparing the programs with each cost report as a data point, the tool can in some cases provide insight into whether an initially more expensive program eventually will reach a "break even" point with regard to a less-expensive alternative.

Because the tool directly compares cost reports from a baseline program to cost reports from one to four alternative programs, the user must ensure that the time interval between each report is consistent for each program in the analysis. We have standardized on quarterly time intervals, and some of the utilities in this tool assume quarterly time intervals. The user can choose to use annual intervals, monthly intervals, or other intervals if desired. Comparing a program that has monthly cost reports with a program that has quarterly cost reports is impermissible, however. Such a comparison will produce meaningless results. To compare

these programs, the user would have to combine the values in the monthly cost reports to create quarterly reports or divide each quarterly report evenly to create three monthly reports.

As long as programs have consistent time intervals for their reports, they can be compared directly—even if the reports do not share the same date or if one program has more cost reports than the other. The tool converts all dollar values into constant-year dollars, so dates do not matter. In the event that one program has more reports than another, the tool ignores the additional cost reports in the comparison. For example, if one program had six cost reports and another had eight, the tool would compare the six cost reports of the first program with the first six cost reports of the other.

VARIANTS SHEET

This sheet (Figure 2-3) allows the user to insert a high and/or low variant for each parameter in the analysis. For example, the tool considers student hourly pay in calculating training costs associated with an IETM. These costs may vary depending upon the specific students involved; perhaps an analyst believes that the actual costs will fall within ±10 percent of the nominal student pay. The user can enter these variants as percentages of the nominal value on the Variants sheet and then run a sensitivity analysis to see how these variations would affect the outcome.

Figure 2-3. Variants Sheet

Sensitivity Analysis And Simulation Variants Page

Alternative 1 --->

	Report Date	Procurement Cost	Dev. Cost	Period Maintenance/ Revisions Cost	IETM Orientation Training	A-School Conversion	C-School Conversion	Training OH Cost	Avg. Student Hourly Pay
	MM/DD/YYYY	*$1000*	*$1000*	*$1000*	*$1*	*$1000*	*$1000*	*$1000*	*$1/hr*
Low (% Nominal)				60			75		90
High (% Nominal)					120		125		110

REPORT SHEETS

These sheets (Figure 2-4) display the raw output values that an analysis generates. These values feed the output graphs.

Figure 2-4. Sample Reports

Net Savings Report

Period	Baseline	Total Net Savings: Revised I	Revised II	Revised III	Revised IV
1		-$282,436.32	-$209,543.10		
2		-$289,489.60	-$57,671.93		
3		-$84,036.13	-$35,443.40		
4		$27,951.62	-$22,004.56		
5					
6					
7					
8					
9					
10					
11					
12					

Sensitivity Analysis Summary Page: Net Savings At Last Period

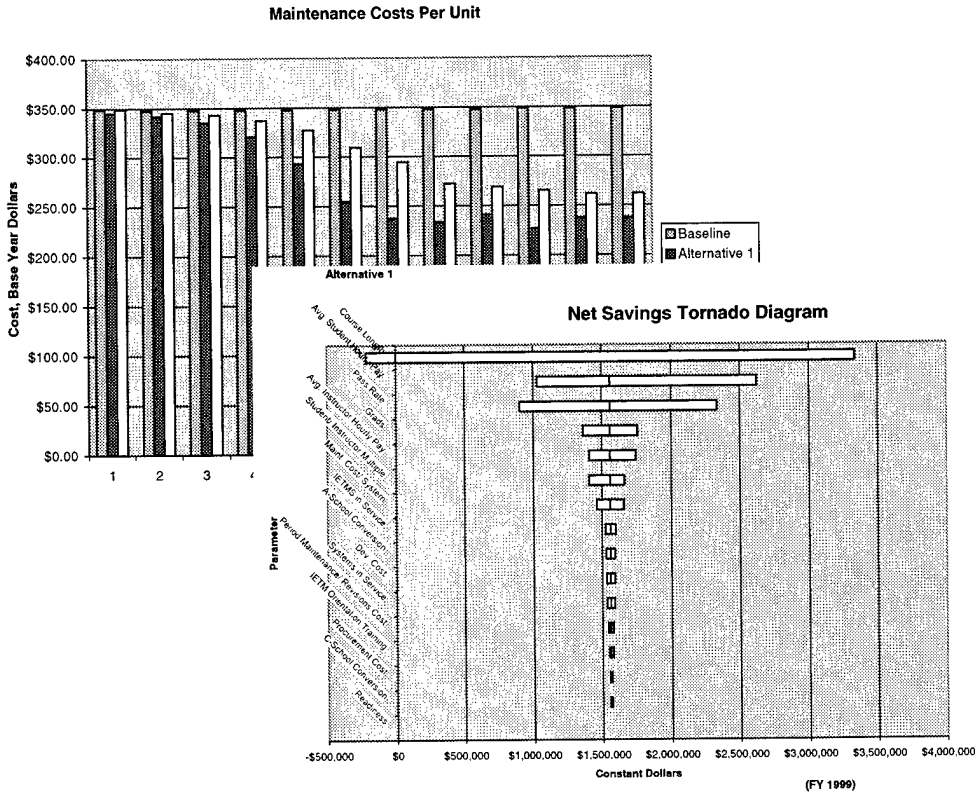
Alternative 1 --->

	Report Date	Procurement Cost	Dev. Cost	Period Maintenance/ Revisions Cost	IETM Orientation Training	A-School Conversion	C-School Conversion	Training OH Cost	Avg. Instructor Hourly Pay
	MM/DD/YYYY	*$1000*	*$1000*	*$1000*	*$1*	*$1000*	*$1000*	*$1000*	*$1/hr*
Low		1253323	1253323	1253323.3	1253323.3	1253323	1253323	1253323	1253323.3
Nominal		1253323	1253323	1253323.3	1253323.3	1253323	1253323	1253323	1253323.3
High		1253323	1253323	1253323.3	1253323.3	1253323	1253323	1253323	1253323.3
Offset 1		1253323	1253323	1253323.3	1253323.3	1253323	1253323	1253323	1253323.3
Offset 2		0	0	0	0	0	0	0	0
Offset 3		0	0	0	0	0	0	0	0
Magnitude		0	0	0	0	0	0	0	0

OUTPUT GRAPHS

The model automatically generates output graphs, including bar charts that compare the costs of a baseline program to its alternatives and a chart that compares the net savings of each alternative relative to the baseline (Figure 2-5). The sensitivity analysis routine produces charts that show, for each alternative, the net savings relative to the baseline and the total cumulative cost (TCC) of the alternative. These charts—which are called tornado diagrams—show the sensitivity of the output variables (net savings, TCC) to variations in each of the input variables. They sort the variables according to their effect on the output; the most sensitive variable appears at the top, the least sensitive at the bottom.

Figure 2-5. Sample Charts

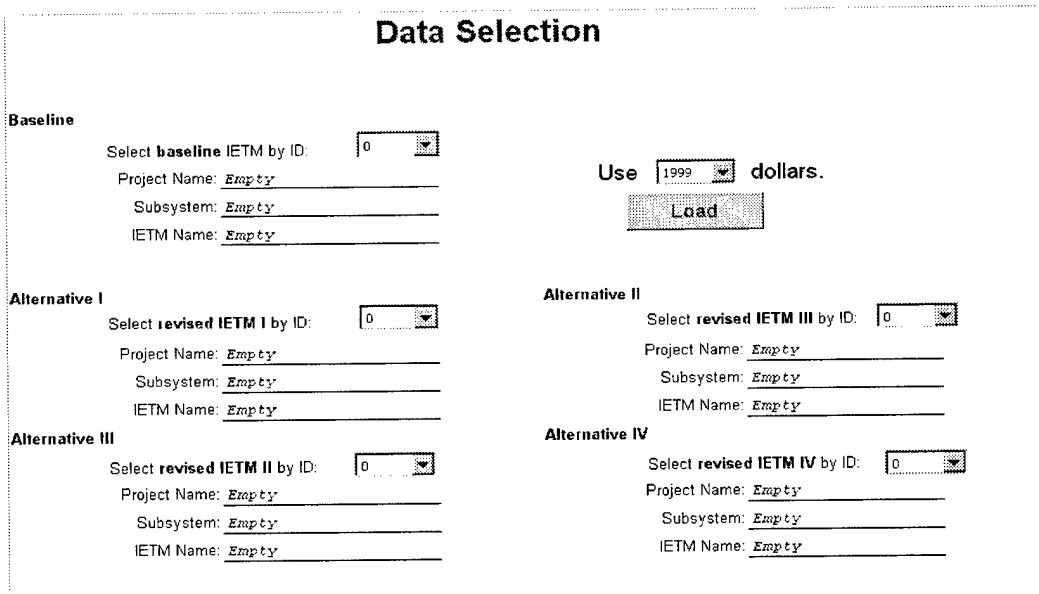


Chapter 3
Tutorials

LOADING INPUT DATA

The first step in performing a cost-benefit analysis is to load the data you need. You do this through controls that are located on the start sheet, under the "Data Selection" heading. Figure 3-1 shows these controls.

Figure 3-1. Data Loading Controls



This tutorial compares two different alternatives against a baseline. The baseline case will be a Class II IETM for an emergency fill pump. The other two cases will be for similar pumps. Alternative I represents a Class IV IETM with a training program optimized to capitalize on its advanced features. Alternative II represents a transition to a Class IV IETM without changing the training program. In this tutorial, you select these alternatives, select a base year for the financial data, load the data into their respective tables, and inspect the data.

1. Select *2* in the pull-down box with the "Select baseline IETM by ID" caption. You should see the lines underneath the caption update automatically to appear as shown in Figure 3-2.

Figure 3-2. Selecting the Baseline Project

Baseline

Select **baseline** IETM by ID: 2

Project Name: *TUTORIAL Fill System*

Subsystem: *Em. Fill Pump*

IETM Name: *EFP01-II-S*

Here's what happens: The data for each IETM has a unique ID, much like a database key. When you select "2" in the pull-down menu, the spreadsheet retrieves the system name, subsystem name, and IETM name from the first line in the Programs sheet that had a *2* for its ID.

Note: The data itself has not yet been loaded into the Start sheet table. We do this because loading the data from the Programs sheet into the Start sheet takes time. The actual data are loaded all at once, using the "Load" button.

2. Select *1* in the Alternative I IETM ID pull-down menu, and *3* in the Alternative II pull-down menu.

3. Select a fiscal year for the data in the pull-down menu just above the "Load" button; choose 1997.

By selecting a fiscal year, you tell the application to convert any money values from the Programs sheet into base-year dollars. The dollar values in the Programs sheet are expressed in then-year dollars.

4. Load the data by clicking the "Load" button. The project information should now appear in bold, rather than italic, indicating that the ID in the pull-down menu has not changed since the last load.

5. Review the baseline and alternative data. The data tables for each case are located under the Selection Data controls. Each alternative should have 12 rows of data, which should be filled in completely.

6. Save your work.

If you toggle back and forth between the raw data in the Programs sheet and the loaded data on the Start sheet, you will observe that the loaded data only show the values that the analysis routines need. Additionally, the money values have been converted to 1997 dollars.

Note that you do not need to use the Programs sheet at all. If you wish, you may clear the data tables on the Start sheet and enter a case by hand. You also may

load a baseline and a set of alternatives and then modify any values in the data tables that you desire. For example, you could load the same case from the Programs sheet as both the baseline and Alternative I and subsequently modify the Alternative I data table to reflect some planned modification.

IMPORTING DATA

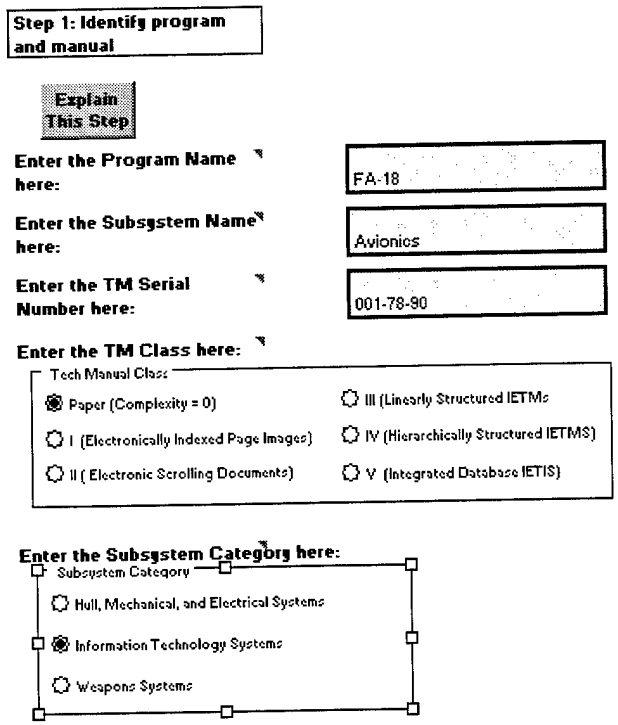
The first tutorial uses sample data that are already in the tool. This tutorial explains how to import your own data into the tool, using a separate utility workbook. It is possible to add data directly to the Programs sheet. We do not recommend this approach, however, because the tool performs no validity check on the data. If you use the utility provided for this purpose, it will automatically check the data for you and catch most (but not all) input errors.

To start the tutorial, open the data importing utility. This utility resides in the same directory as the tool itself; it should have a name similar to "ImportDataUtil.xls." In this tutorial, you will import a project for an imaginary FA-18 avionics IETM. The data values that you will use have been picked at random; they are for illustrative purposes only.

1. Step 1 of the utility is at the top of the UserSheet worksheet. In this step, the user enters data that do not change over time: the program name, the subsystem name, the tech manual serial number, the technical manual class, and the subsystem category.

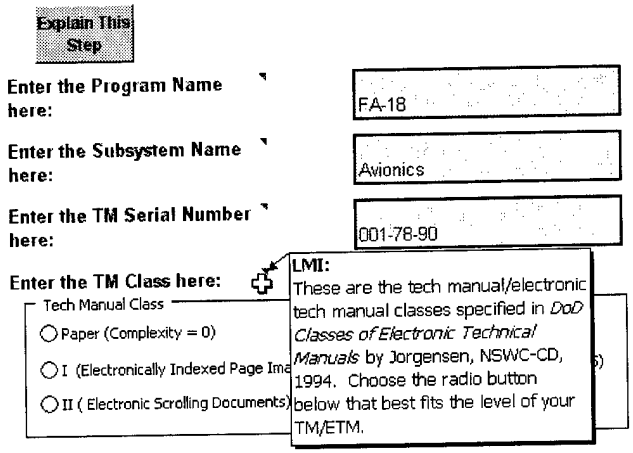
   - ➤ In the blue cell labeled "Enter the Program Name Here," enter "FA-18".
   - ➤ In the blue cell labeled "Enter the Subsystem Name Here," enter "Avionics."
   - ➤ In the blue cell labeled "Enter the TM Serial Number Here," enter "001-78-90."
   - ➤ In the control box labeled "Enter the TM Class Here," click on the "Class IV" radio button.
   - ➤ In the control box labeled "Enter the Subsystem Category Here," click on the "Information Technology Systems" radio button. The worksheet should now look like Figure 3-3.

Figure 3-3. Step 1—Data Importing Utility



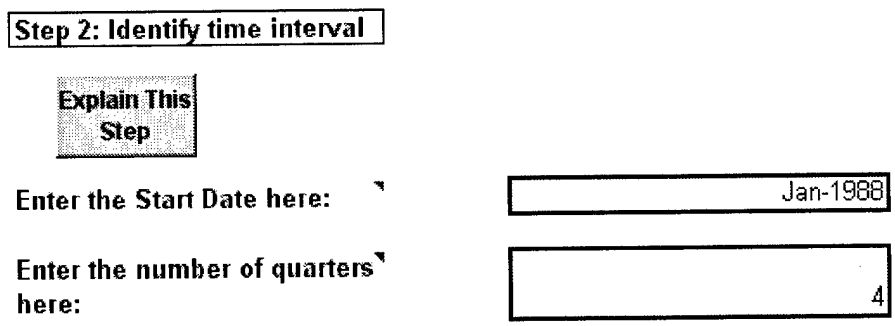
If you have a question about an item that you must enter, place your mouse cursor over the small red triangles near that item's label. Doing so will pop up a comment box that describes the item further (see Figure 3-4).

Figure 3-4. Built-in Comment Box



2. In Step 2, you create a time frame for the project by entering a start date and a number of time intervals. The start date corresponds to the date when program office personnel first report accrued costs for the technical manual. The number of quarters will be used to generate dates of subsequent cost reports; the tool assumes quarterly cost reporting. (If you want to use another time interval, you will have to delete the automatically generated dates and insert your own dates in Step 3.) Enter "1/1988" for the start date and 4 for the number of quarters (see Figure 3-5).

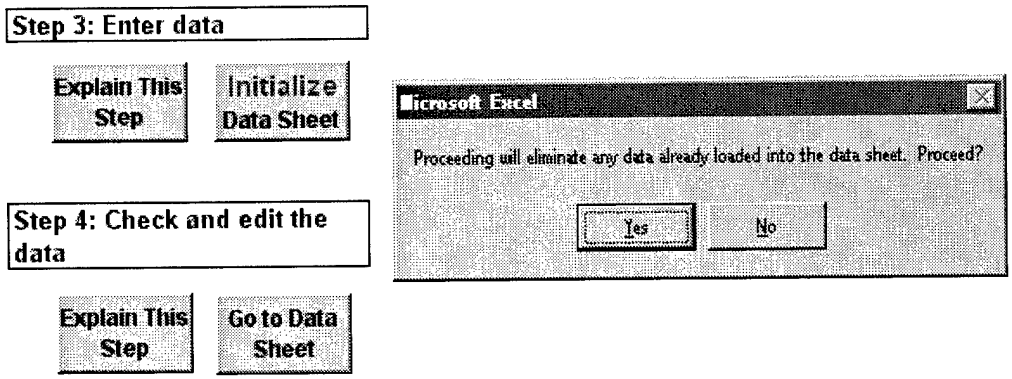
Figure 3-5. Step 2—Data Importing Utility



In most cases, it should be acceptable to roll-up or break down cost reports of different time intervals so that they can be entered as quarterly data. For example, it is acceptable to roll up three monthly reports or split the data from one semi-annual report to generate quarterly data.

3. Next, you will need to enter the cost data for the manual into the datasheet. Click the "Initialize Data Sheet" button on the Usersheet worksheet. You will see a text box with a warning like the one in Figure 3-6. Click "Yes" on the text box to proceed to the data sheet.

Figure 3-6. Step 3—Data Importing Utility



When the data sheet appears on your screen, you will see that any previous data have been wiped out. In response to steps 1 and 2, the data sheet has filled four lines on the data sheet with the project's general information and report dates (Figure 3-7). The tool automatically generates this data as a shortcut for the user. If you wish, you may manually delete and re-enter any information on the Datasheet. (This is generally not recommended; a notable exception would be when the user wishes to change the time interval from the quarterly interval assumed by the utility.)

Figure 3-7. Newly Initialized Data Sheet

Return to User Sheet	Entry ID	Program	Subsystem Name	IETM Serial Number	Category	IETM Class	Report Date	Procurement Cost
Units	none	none	none	none	none	none	none	$1000
Data Sheet Var?	No	No	No	No	No	No	No	Yes
		FA-18	Avionics	001-78-90	Information Technology	4	Jan-88	
		FA-18	Avionics	001-78-90	Information Technology	4	Apr-88	
		FA-18	Avionics	001-78-90	Information Technology	4	Jul-88	
		FA-18	Avionics	001-78-90	Information Technology	4	Oct-88	

4. This step will be tedious; please be patient. Fill in the data sheet as shown in Figures 3-8 and 3-9. If you complete this step correctly, these data will pass the data check of Step 5. If you are uncertain about what a column heading means, move the cursor over the red triangle at the corner of the heading cell. When you are done, return to the user sheet by clicking the button at the top-left corner of the sheet.

Figure 3-8. Data Sheet Entries, Part 1

Report Date	Procurement Cost	Dev. Cost	Period Maintenance/ Revisions Cost	IETM Orientation Training	C-School Conversion	Training OH Cost	Avg. Student Hourly Pay	Avg. Instructor Hourly Pay	St In: M
one	$1000	$1000	$1000	$1	$1000	$1000	$1/hr	$1/hr	no
lo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Ye
Jan-88	100	25	0	50	0	100	12	18	
Apr-88	0	25	15	50	0	100	12	18	
Jul-88	0	25	15	50	0	100	12	18	
Oct-88	0	25	15	50	0	100	12	18	

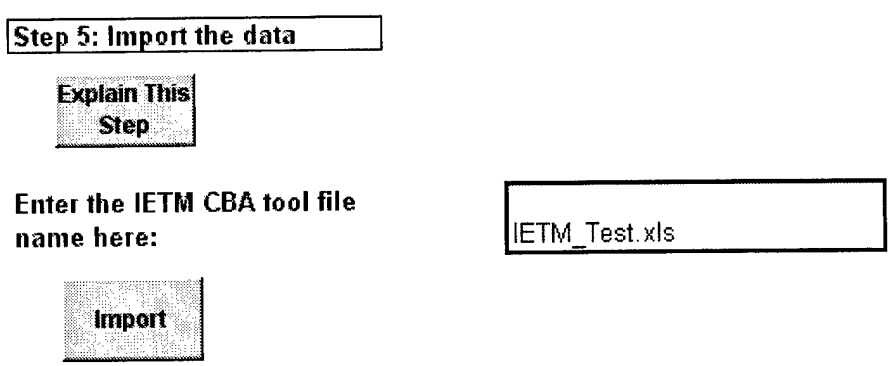
Figure 3-9. Data Sheet Entries, Part 2

stor	Student/ Instructor Multiple	Pass Rate	Course Length	Grads	Maint. Cost/ System	Systems in Service	IETMS in Service	Readiness
	none	none	weeks	none	$1	none	none	% FMC
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18	12	77	13	14	400	500	650	80
18	12	82	13	15	25	500	650	93
18	12	87	10	14	25	500	650	82
18	12	91	10	15	25	500	650	83

Step 4 allows you to return to the data sheet without re-initializing the project data. No automated data checking occurs here; the purpose of this step is to give you a chance to double-check the data-entry work, if you wish.

5. Step 5 requires the user to designate the name of the IETM CBA tool workbook. If this workbook is in a different directory than the data importing utility's directory, you must specify the path also. For the purpose of this tutorial, copy your IETM CBA tool workbook to the working directory and rename the copy "IETM_Test.xls." Then enter that name in the blue cell labeled "Enter the IETM CBA Tool file name here" (Figure 3-10).

Figure 3-10. Step 5—Data Importing Utility

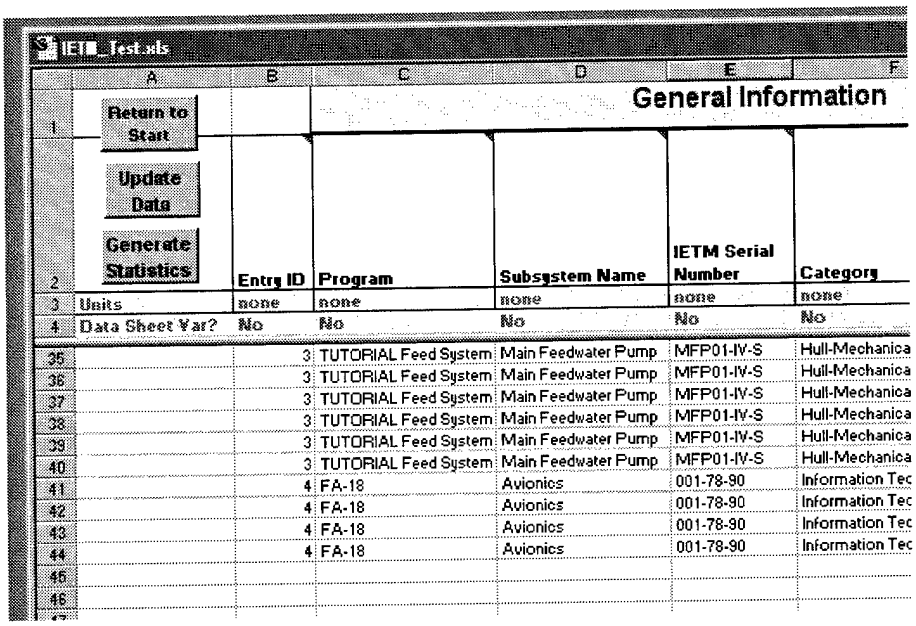


6. Click the "Import" button. If you entered the data correctly and completely in step 4, you should see a text box that reads "Data Check OK." If you do, click "OK" to continue. If not, you will see an error message explaining what is wrong with the current data cell. When you acknowledge that message, you will find yourself on the data sheet, with the affected cell highlighted. Correct the cell, return to the user sheet, and click the "Import" button to try again.

7. When you have successfully loaded the data into the IETM_Test.xls workbook, save your work, close the data importing utility, and open the IETM_Test.xls workbook.

8. Go to the Programs worksheet. You should see the project appended to the current list of projects in the sheet. It also should have its own unique Entry ID (Figure 3-11).

Figure 3-11. Programs Sheet



35	3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanica
36	3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanica
37	3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanica
38	3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanica
39	3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanica
40	3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanica
41	4	FA-18	Avionics	001-78-90	Information Tec
42	4	FA-18	Avionics	001-78-90	Information Tec
43	4	FA-18	Avionics	001-78-90	Information Tec
44	4	FA-18	Avionics	001-78-90	Information Tec

9. Click the "Update Data" button. This step allows the tool to recognize the new data set. It also leaves you at the Start sheet. To verify that the data set has been added, click on any of the pull-down boxes. The new entry ID should be in the pull-down list.

10. To erase the new data set, return to the Programs sheet. Clear the data set and click the "Update Data" button again. Check a pull-down box on the Start sheet to verify that the new data set is no longer in the pull-down list.

11. Close the IETM_Test.xls workbook.

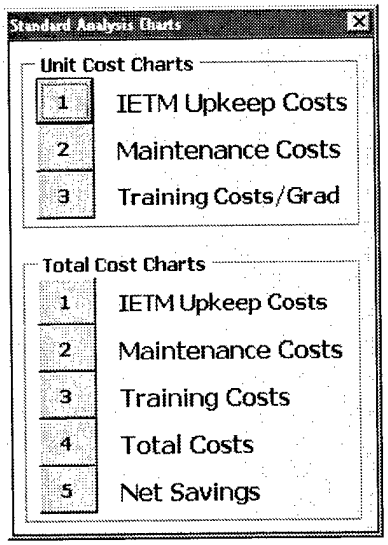
STANDARD ANALYSIS

A standard analysis computes costs by category for items such as training and maintenance. The analysis routine generates three reports and eight output graphs. In this tutorial, you will run an analysis and inspect the output. To follow along with this tutorial, you will need to have completed the first tutorial, and the spreadsheet must be unmodified since.

1. Run the analysis by clicking the "Run" button under the "Standard Analysis" heading in the Start sheet.

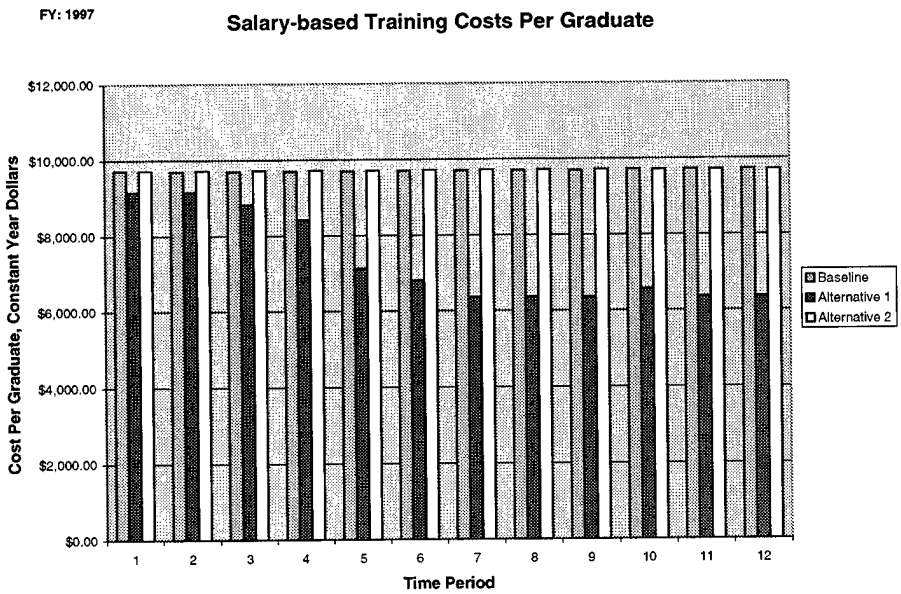
2. Look at the graphs. Click the "Graphs" button under the "Standard Analysis" heading in the Start sheet. The form in Figure 3-12 should appear.

Figure 3-12. Standard Analysis Chart Form



3. Click on the third unit cost chart button—the button labeled "Training Costs/Grad." A graph similar to the one in Figure 3-13 should appear.

Figure 3-13. Unit Training Cost Chart



The chart in Figure 3-13 shows the cost, per graduate, to provide training on the equipment that the IETM documents. Recall that Alternative I is a Class IV IETM with the training curriculum redesigned to take advantage of the IETM's advanced capabilities. As a result, the cost per student dropped as the new curriculum took hold and instructors became more effective at implementing it. The second alternative had no such curriculum redesign; the numbers show that training continues with no significant departure from the baseline.

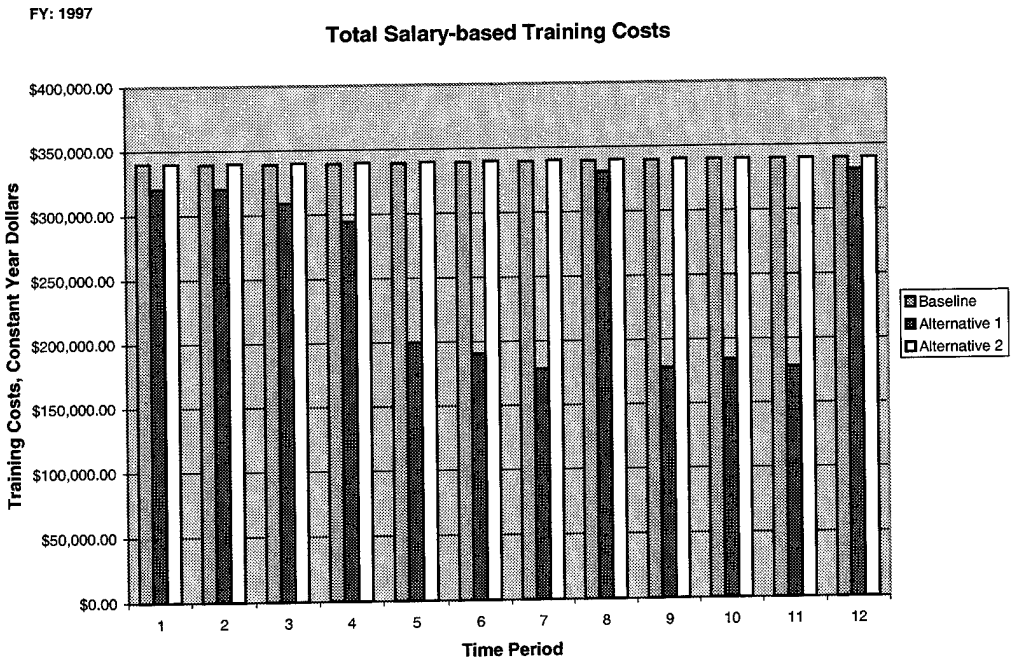
Keep the following points in mind:

- These numbers, and the numbers throughout this user's guide, are strictly notional. Actual cases may behave differently.

- The time period is not fixed; it depends on the interval between report dates for the data. The time step must be consistent, however, across the baseline and the alternatives. In this and other tutorials, each time step is one calendar quarter.

4. Click the "Graphs" button in the upper right corner of the chart sheet. Doing so hides the current chart and restores the chart selection form. Click button 3 under the Total Costs heading in the form—the button labeled "Training Costs." The chart shown in Figure 3-14 should appear.

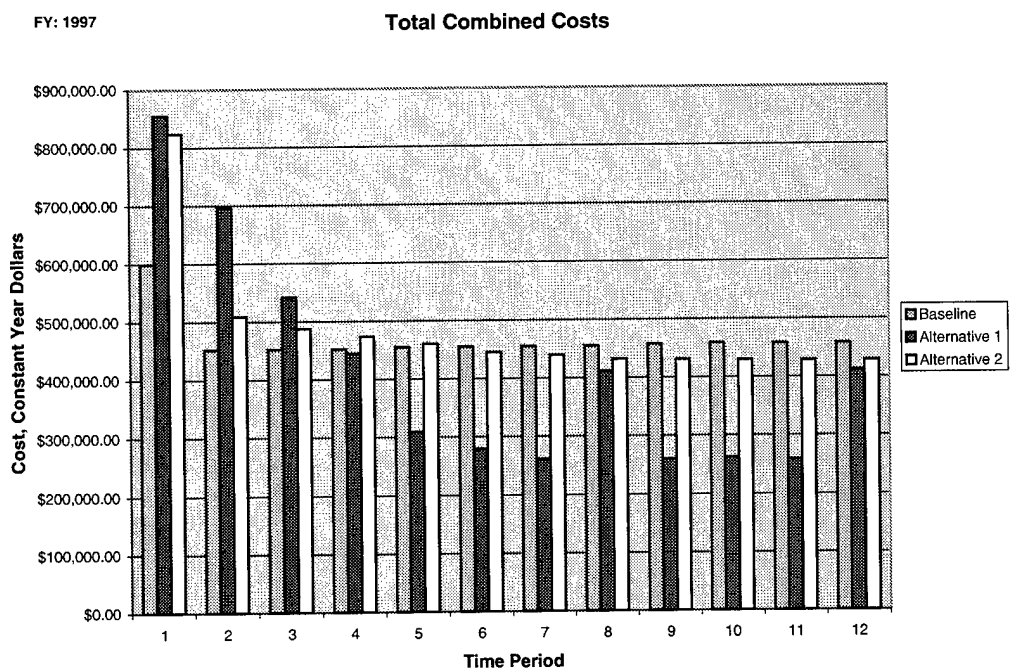
Figure 3-14. Total Training Costs Chart



Notice the two distinct spikes in the Alternative I costs that do not appear in the unit (cost/graduate) training costs. These spikes occur because an extra class graduated in quarters 8 and 12 as a result of condensing the curriculum. Starting in quarter 5, Alternative I holds five classes a year, compared with four a year for Alternative II and the baseline. Although training expenditures are uniform on a day-to-day basis, the utility assumes that costs occur when students graduate. Therefore, for the first 3 quarters of the year, the actual unit training costs are higher for Alternative I than the chart shows; the 4th quarter makes up the difference.

5. Now look at the combined total costs. Click the "Graphs" button, then select button 4 under the "Total Costs" heading in the chart selection form. The chart shown in Figure 3-15 should appear.

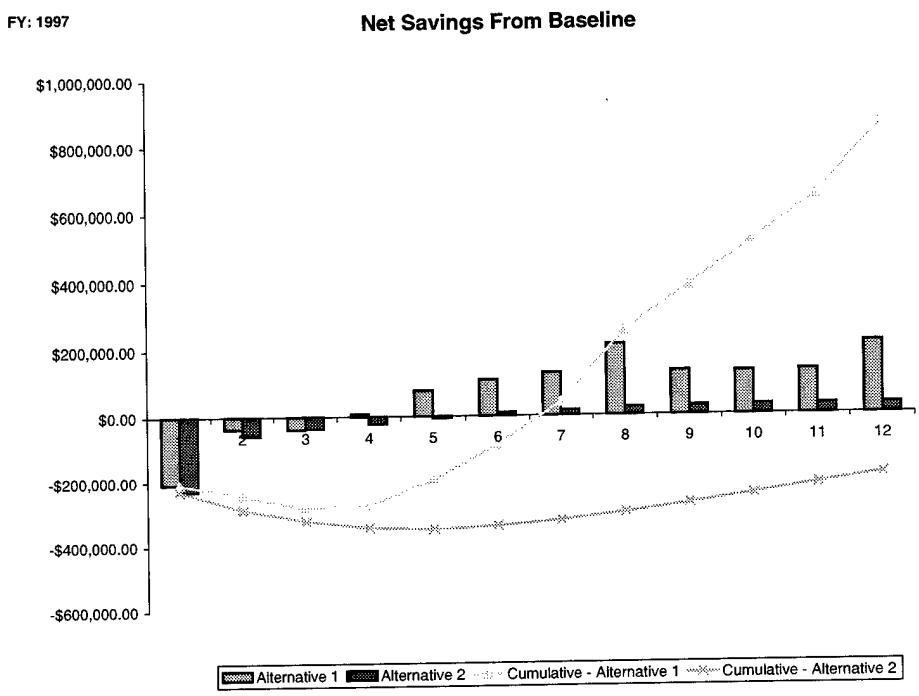
Figure 3-15. Total Combined Costs Chart



Alternative I and Alternative II have significant initial costs, presumably associated with development of the IETM. Alternative I has the highest initial costs because, in addition to the new IETM, the program also overhauls its training system. As time goes on, Alternative I has the lower costs because it enjoys savings from both reduced maintenance costs and reduced training costs. Although Alternative II exhibits only lower maintenance costs—because it is an easier-to-use IETM—it still generates some savings. To find out exactly how much savings each alternative provides with respect to the baseline, look at the net savings chart.

6. Click the "Graphs" button, then click button 5 under the "Total Costs" heading on the chart selection form. The chart shown in Figure 3-16 should appear.

Figure 3-16. Net Savings Against Baseline



Clearly, Alternative I is the best choice because it saves money with respect to the baseline. It breaks even during quarter 7, and it saves close to $860,000 by the last quarter of available data. Alternative II starts to gain on the baseline by quarter 5, but the savings it exhibits in quarters 5 through 12 do not bring it back to the break-even point.

PROGRAM SIZE: AN ASIDE

The IETM Cost-Benefit Analysis Tool is flexible enough to perform several types of analyses. For example, the user can do a notional study by loading a program as both a baseline and an alternative case and modifying the alternative data to reflect the expected effects of some proposed change. This technique allows the user to answer questions such as, "Assuming that we can save 8 percent per unit per quarter on maintenance costs with a new IETM, but the IETM will cost an extra 4 percent per quarter for revisions and upkeep, does pursuing the alternative make sense?"

To avoid making assumptions about new technologies, the user could find two pieces of similar equipment to compare. For example, if the goal is to pick an

IETM class for a new feed pump, the user might choose a feed pump with a Class II IETM and a feed pump with a Class IV IETM and compare their unaltered historical data to see which alternative is better.

What if one program is larger than the other, however? The user would have to convert the total costs of each program to a cost per unit program size to compare them directly. But what is a "unit program size"? Three different types of units—graduates, equipment units, and IETM units—contribute to the size of a program, but not in an easily combinable way. Therefore, the application computes net savings in the following manner:

- It computes the unit cost of maintenance for the baseline and the alternative, then scales their difference by the number of the alternative's equipment units to get the total net maintenance savings.
- It scales the difference of the costs per graduate by the number of the alternative's graduates to get the net training savings.
- It scales the difference of the costs per IETM by the quantity of the alternative's IETMs to get the net IETM upkeep savings.

The sum of these three values, combined with the difference in certain other costs between programs, is the total net savings. Thus, to the maximum extent possible, the net savings figure reflects the amount of money saved by choosing the alternative over a baseline program of similar size.

For the tutorial example, we chose to assign all three programs the same number of graduates per year, the same IETM quantity, and the same number of operational units. This special case allows the user to compare the baseline and all the alternatives directly. If the alternatives have different sizes, they cannot be compared directly; they can be compared only against the baseline. To make a direct comparison between two alternatives, the user must run a new analysis with one of the two alternatives recast as the baseline.

SENSITIVITY ANALYSIS

You will need to complete the first tutorial to follow along with this tutorial.

1. Verify that the scenario you used in the Standard Analysis tutorial is loaded into the Start sheet: The baseline program should be Program 2, the first alternative should be Program 1, the second alternative should be Program 3, and the fiscal year should be 1997.
2. Go to the Variants sheet.

The Variants sheet allows you to select a high and low variant for each parameter loaded onto the Start page. The range is expressed as a percentage of the

parameter's nominal value. For example, if you check the Alternative I table in the Start sheet, you would find that the average student pay is essentially constant, at $12.63 per hour, throughout the data set (1997 dollars). We think that the pay for our program may range between $11.00 and $15.00 an hour. $11.00 is 87 percent of $12.63; $15.00 is 119 percent of $12.63.

3. Enter 87 percent in the cell for Alternative I with the column heading "Average Student Hourly Pay" and the row heading "Low (% Nominal)." Enter 119 percent in the same column, in the row with the heading "High (% Nominal)". The Variants sheet should look as it does in Figure 3-17.

Figure 3-17. Variants Sheet With Student Pay Variants Added

Sensitivity Analysis And Simulation Variants Page

Alternative 1 --->

	Report Date	Procurement Cost	Dev. Cost	Period Maintenance/ Revisions Cost	IETM Orientation Training	A-School Conversion	C-School Conversion	Training OH Cost	Avg. Student Hourly Pay	Avg. Instructor Hourly Pay
	MM/DD/YYYY	*$1000*	*$1000*	*$1000*	*$1*	*$1000*	*$1000*	*$1000*	*$1/hr*	*$1/hr*
Low (% Nominal)									87	
High (% Nominal)									119	

4. Make the following additions to Alternative I as well:

   a. Enter 90 percent/110 percent as the low and high variants for "Average Instructor Hourly Pay."

   b. Enter 80 percent/120 percent under "IETM Orientation Training."

   c. Enter 80 percent/120 percent under "Period Maintenance/Revisions Cost."

5. Make the following additions to Alternative II:

   a. Enter 80 percent/110 percent under "Average Instructor Hourly Pay."

   b. Enter 80 percent/120 percent under "Procurement Cost."

   c. Enter 90 percent/130 percent under "Course Length."

6. Go back to the Start sheet, and click the "Run" button under the "Sensitivity Analysis" heading. It could take a few minutes to complete the run.

The sensitivity analysis routine works by re-running the standard analysis routine for each high and low variant in the Variants page. After the sensitivity analysis concludes, the tool also performs an additional standard analysis. The reason for

this procedure is that the sensitivity analysis "hijacks" the standard analysis report pages to generate its own data. Running the standard analysis after the sensitivity analysis ensures that the standard analysis reports and graphs correspond to the nominal data on the start sheet. If you run a standard analysis with one set of alternatives and then run a sensitivity analysis with a second set of alternatives, the standard analysis graphs and reports will reflect the second set of alternatives.

7. Click the "Graphs" button in the Start sheet under the "Sensitivity Analysis" heading.

8. Review the net savings charts for Alternatives I and II. They should look like Figures 3-18 and 3-19.

Figure 3-18. Net Savings Tornado Diagram for Alternative I

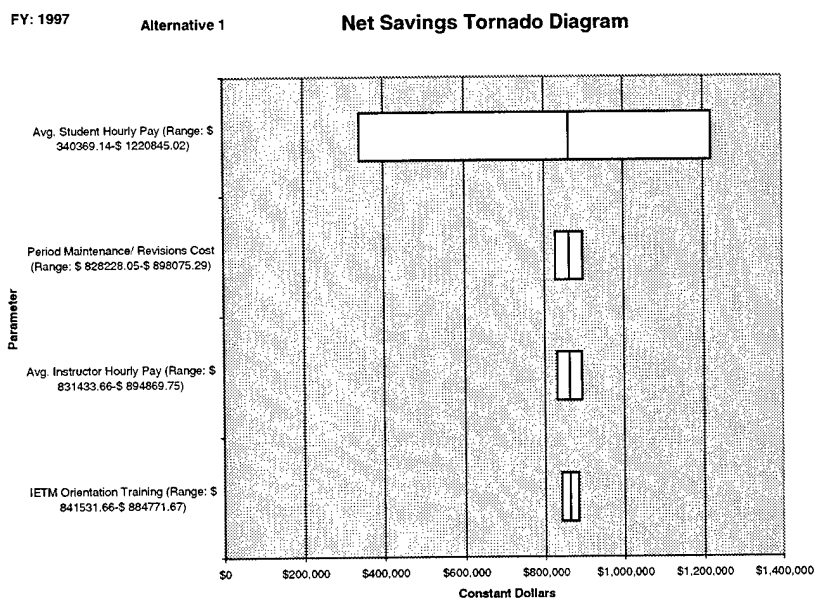
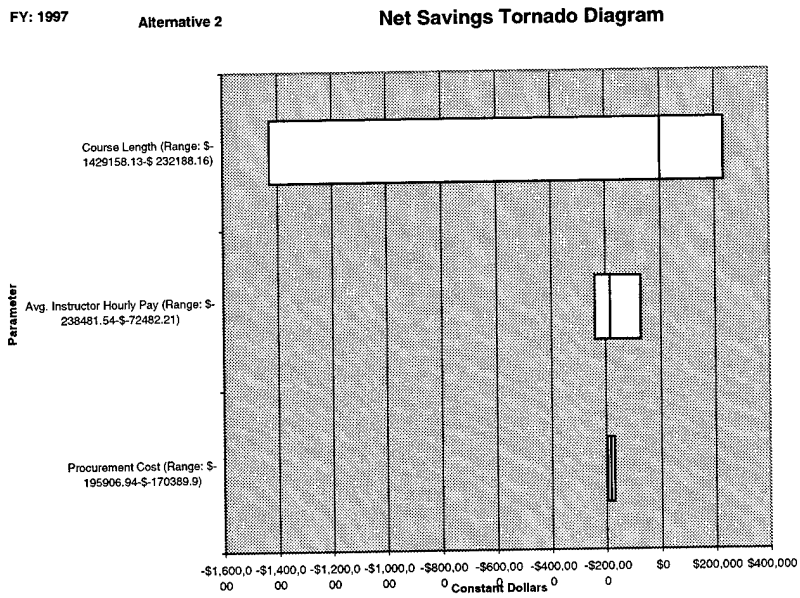


Figure 3-19. Net Savings Tornado Diagram for Alternative II



Clearly, student pay dominates the outcome. Keep in mind that the data that generated these graphs are notional; in a real-world case, student pay may have a smaller effect, and other variables may have a much larger effect. Given the results here, however, the analyst obviously would want to research student pay further. A smaller range of estimates would greatly improve the certainty of the analysis.

CONVERSION COST UTILITY WORKSHEET (AND VARIATIONAL STUDY, PART I)

The conversion cost utility worksheet is a tool that provides a common sense, rule-of-thumb method for estimating the cost of converting from a lower class of technical manual to a higher-class manual. Although these estimates rely on rules of thumb provided by personnel with experience with such conversion projects, the inherent variability in these projects and the relatively small amount of data about them suggest that actual projects may depart considerably from these rules. Because the conversion cost utility builds on these rules (and therefore introduces even further variability), it falls under the category of "quick and dirty" tools. Nevertheless, it provides a solid theoretical framework for solving a problem that has yet to be addressed: converting a Class II or III ETM into a Class IV or V IETM.

This tutorial explains how the utility computes a conversion cost as the user steps through the process of creating a conversion cost estimate. It also builds on lessons from preceding tutorials to demonstrate how to perform a variational study

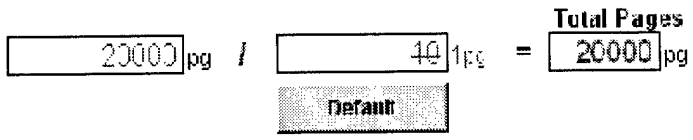
of one program. The tutorials on the standard and sensitivity analyses compare actual programs to another program that serves as a baseline. In this tutorial and the one that follows, you will modify the baseline from these tutorials and store a modified program. Then you compare it with the original baseline.

1.a. Open the IETM CBA tool; use the tabs to go to the conversion cost utility worksheet (the "ConversionCostWS" tab).

At the top of this worksheet, you should see "Step 1: Page Estimate." Although the tool can compute estimates for ETM-to-ETM conversions in addition to paper manual-to-ETM conversions, it still uses a book paradigm to estimate the size of the conversion. The tool uses this approach because all current rules of thumb base their estimates on a cost-per-paper-manual-page basis. If a page count is not available or does not apply to the manual to be converted, the utility estimates a page count on the basis of the size of the manual in kilobytes (K).

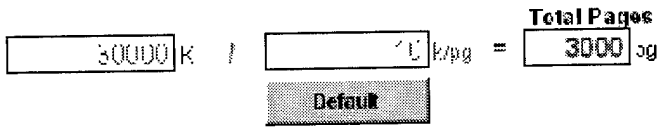
1.b. In the Step 1 section of the worksheet, click on the "Number of paper manual pages" in the "Paper or electronic?" radio button list. Then enter "20,000" in the cell next to the list. You should see this number appear in the cell (Figure 3-20).

Figure 3-20. Step 1—Conversion Cost Utility



1.c. Notice that there are three boxes in Figure 3-20. The one on the left holds the user input. The one on the right holds the final page estimate. The one in the middle, with the default button underneath it, holds the kilobyte-to-page conversion factor, if needed. To see how this conversion works, select the "Size in kilobytes" option from the radio button list, and change 20,000 to 30,000 in the input box. The changes should appear as in Figure 3-21.

Figure 3-21. Step 1—Conversion from Kilobytes to Pages



Notice that the units of the input box have changed to K, for kilobytes, in the input box, and k/pg in the conversion box. In addition, the 10 in the default box is no longer lined out, meaning that the sheet divides the input value by 10 to get its page estimate.

1.d. The 10kg/pg value is a default. We arrived at this default by looking at several ETMs in portable data format (PDF) and comparing their page counts with their memory sizes. This number may vary, however, and you may feel that another value is more accurate, based on personal experience. Change the number in the conversion box to 15. Then click the "Default" button. The total pages should reduce to 2,000 when you make the change, and then go back to 3,000 when you restore the default value.

2. Select Class II for the original technical manual. This selection will start the conversion project with an electronically indexed ETM of electronic page images. The "Initial Complexity" cell should now read $12.50/pg.

3.a. Select Class IV for the converted tech manual. The "Final Complexity" cell should now read $200.00/pg.

Our "complexity scores" are really just the rules of thumb themselves: the cost-per-page of converting from a paper manual to a manual of the designated class. It should be possible to enhance these rules of thumb by assigning a relative complexity to the ETM/IETM and converting that complexity to a corresponding cost-per-page, and we have designed this utility to handle that eventuality. We have seen promising methods that take this approach—most notably an ETM functionality matrix for assessing relative complexity.[1] These methods have not yet developed, however, to the point that we can use them in the utility to estimate costs per page.

3.b. We have seen wide variation in the reported cost per page for converting to ETMs of the various classes. For example, we have seen numbers as low as $25.00 per page and as high as $250.00 per page for converting from paper to a Class IV IETM. With this in mind, we enable users to adjust the values by hand. Set the "Final Complexity" cell in Step 3 to $175.00/pg.

[1] See <home.mmcable.com/mandmp/albaiacba/index.htm>.

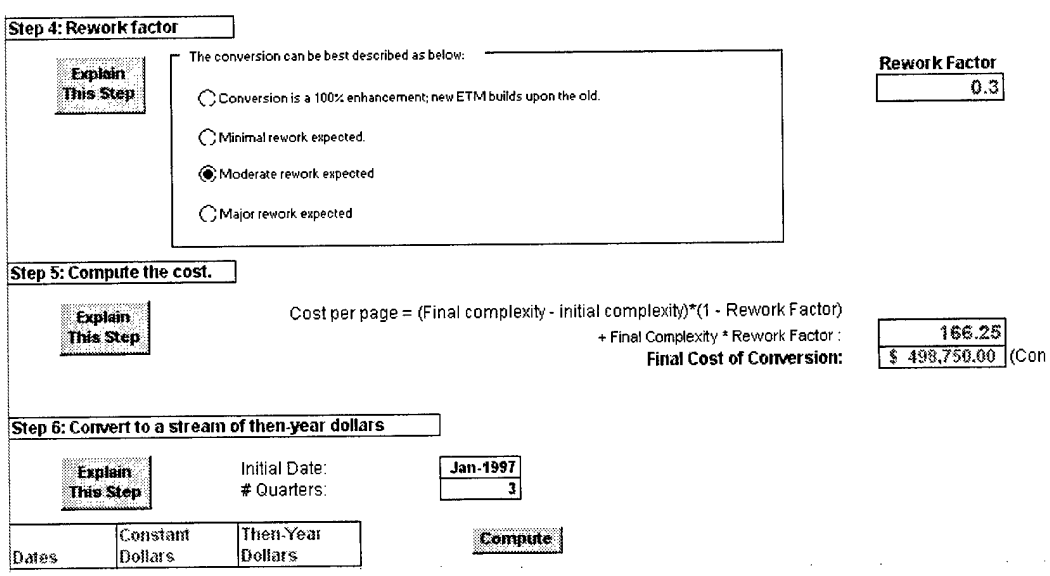
4. Set the rework factor in Step 4 to "Moderate rework expected."

The concept of rework stems from the idea that proceeding directly from a lower-class ETM to a higher-class ETM is not always feasible. In the tutorial example, if we could proceed directly from the original Class II ETM to the final Class IV IETM, the expected cost per page is simply $175.00–$12.00, or $163.00. That is the best case scenario. In the worst case, the team will not be able to save any work by using the Class II ETM and will have to start from scratch. The expected cost would then be $175.00. Realistically, the cost is likely to fall somewhere between these two extremes. The expected amount of rework—converting the original ETM's file format into something compatible with the Class IV's software and so forth—decides where the actual cost falls inside the range provided by the two extremes. The *.3* value for "Moderate work expected" means that the cost will be slightly closer to the best-case scenario than to the worst-case scenario.

5. The worksheet automatically estimates the conversion cost, based on your inputs. It should be slightly less than $500,000 if you have entered everything properly.

6.a. We estimate that the conversion project will last for three quarters, starting in January 1997. Why this date? It is the same start date as that of sample program 2 (the Emergency Fill Pump) on the programs sheet. We use the results of this tutorial to create a modified program that is based on the Emergency Fill Pump program. Enter "1/1997" into the "Start Date" cell of Step 6. Enter *3* in the "# quarters" cell. The worksheet should now look like Figure 3-22.

Figure 3-22. Steps 4, 5, and 6



6.b. Click the "Compute" button. The tool will spread the total cost of the conversion into three equal parts over three quarters and adjust them for inflation (Figure 3-23). The "Constant Dollars" column holds the conversion cost as expressed in year 2000 dollars. The "Then-Year Dollars" column takes the constant dollars and further adjusts them to account for inflation during each quarter. The final cost stream for this project should appear as shown in Figure 3-23.

Figure 3-23. Converting Estimate to Then-Year Dollars

Step 6: Convert to a stream of then-year dollars

Explain This Step

Initial Date: Jan-1997
Quarters: 3

Compute

Dates	Constant Dollars	Then-Year Dollars
Jan-97	$166,250.00	$161,857.11
Apr-97	$166,250.00	$162,565.83
Jul-97	$166,250.00	$162,848.80
Sum:	$498,750.00	

6.c. If you don't like a uniform expenditure rate, you can adjust the dollar amounts by hand in the "Constant Dollars" column. The "Then-Year Dollars" column will automatically update to reflect your changes. The user is responsible for ensuring that the dollar amounts in the "Constant Dollars" column sum to the total conversion cost as given in Step 5. If you don't want to use quarterly time intervals, you can adjust the dates manually.

6.d. Save your work. In the next tutorial, you will use it to create a modified program that is based on the second program listed in the Programs sheet.

SIMULATION ANALYSIS (AND VARIATIONAL STUDY, PART II)

In the preceding tutorial, the user estimated a cost for converting from a Class II ETM to a Class IV IETM. In the first part of this tutorial, we use that data and make a few other assumptions to create a new program, based on a program that is used as a baseline in the Standard Analysis and Sensitivity Analysis tutorials. The second part of this tutorial uses the baseline and modified programs in a simulation analysis.

1. Open the tool and go to the Programs sheet. Copy all 12 cost reports of the program with an Entry ID of 2. Paste them into the first available row of data. Make sure there are no blank rows between the existing data and the data that you just pasted (see Figure 3-24).

Figure 3-24. After Copying Second Program to Programs Sheet

	A	B	C	D	E	F
1	Return to Start		General Information			
2	Update Data / Generate Statistics	Entry ID	Program	Subsystem Name	IETM Serial Number	Category
3	Units	none	none	none	none	none
4	Data Sheet Var?	No	No	No	No	No
35		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
36		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
37		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
38		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
39		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
40		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
41		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
42		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
43		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
44		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
45		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
46		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
47		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
48		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
49		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
50		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
51		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
52		2	TUTORIAL Fill System	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical

2. Every program needs its own unique Entry ID. Because you are creating the program directly (as opposed to importing it through the data importing utility) you need to assign this ID by hand. In the Entry ID column, change *2* to *4* in every row of the new data.

Also, in every row of the new data, make the following changes:

3. In the "Program" column, change the value from "TUTORIAL Fill System" to "Tutorial."

4. In the "IETM Serial Number" column, change the value to "new."

5. In the "IETM Class" column, change the value to *4*. The new program should now look as it does in Figure 3-25.

Figure 3-25. New Program After Tutorial Step 5

General Information

Return to Start | Update Data | Generate Statistics

	A	B	C	D	E	F
2		Entry ID	Program	Subsystem Name	IETM Serial Number	Category
3	Units	none	none	none	none	none
4	Data Sheet Var?	No	No	No	No	No
35		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
36		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
37		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
38		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
39		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
40		3	TUTORIAL Feed System	Main Feedwater Pump	MFP01-IV-S	Hull-Mechanical-Electrical
41		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
42		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
43		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
44		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
45		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
46		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
47		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
48		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
49		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
50		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
51		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical
52		4	Tutorial	Em. Fill Pump	EFP01-II-S	Hull-Mechanical-Electrical

6. In the "Dev. Cost" column, replace the current values in each of the first three rows of the new program with values from the cost estimate generated in the previous tutorial: In the January 1997 row, enter the value 161.86; in the April 1997 row, enter the value 162.57; and in the July 1997 row, enter the value 162.85. You must divide the values provided by the conversion cost utility by 1,000 to give them the proper units for the Programs sheet.

7. Because both the original and the new program are software-based, assume that the "Period Maintenance/Revisions Cost" column should remain unchanged.

8. Assume a nominal cost to train personnel on how to use the new Class IV IETM: In the "IETM Orientation Training" column, enter $10,000 in each of the rows for October 1997, January 1998, and April 1997.

9. For those same three rows, assume a $10,000 cost for converting the C-school curriculum and classrooms from the old ETM to the new Class IV IETM. (Note that the cost is expressed in $1,000 units, so enter *10.0*, not 10,000.)

10. Assume no changes in training overhead cost, student pay, instructor pay, and student-instructor multiple. The changes in steps 6–9 should make affected columns appear as shown in Figure 3-26.

Figure 3-26. Modifications from Tutorial Steps 6–10

H	I	J	K	L	M
	Initial Costs		Upkeep Costs		
Report Date	Procurement Cost	Dev. Cost	Period Maintenance / Revisions Cost	IETM Orientation Training	C-School Conversion
none	$1000	$1000	$1000	$1	$1000
No	Yes	Yes	Yes	Yes	Yes
Jul-1995	0.00	0.00	10.00	3287.50	0.00
Oct-1995	0.00	0.00	12.00	0.00	0.00
Jan-1996	0.00	0.00	12.00	0.00	0.00
Apr-1996	0.00	0.00	12.00	0.00	0.00
Jul-1996	0.00	0.00	12.00	0.00	0.00
Oct-1996	0.00	0.00	12.00	0.00	0.00
Jan-1997	70.00	161.86	9.00	0.00	0.00
Apr-1997	0.00	162.57	11.00	0.00	0.00
Jul-1997	0.00	162.85	11.00	0.00	0.00
Oct-1997	0.00	0.00	11.00	10000.00	10.00
Jan-1998	0.00	0.00	14.00	10000.00	10.00
Apr-1998	0.00	0.00	14.00	10000.00	10.00
Jul-1998	0.00	0.00	14.00	0.00	0.00
Oct-1998	0.00	0.00	14.00	0.00	0.00
Jan-1999	0.00	0.00	17.00	0.00	0.00
Apr-1999	0.00	0.00	17.00	0.00	0.00
Jul-1999	0.00	0.00	17.00	0.00	0.00
Oct-1999	0.00	0.00	17.00	0.00	0.00

11. Assume that the passing rate and the number of graduates remain the same. Assume that exploiting the enhanced capabilities of the new manual allows the school to condense the curriculum by two weeks: In every row of the new program, change the value in the "Course Length" column from 13 to 11.

12. In the upper-left corner of the Programs sheet, click the "Update Data" button. You have just added a new program to the tool. Click the "Return to Start" button.

13. Now set up the start sheet to compare the baseline program (Program 2) with the new program (Program 4). In the Baseline pull-down box, select *2*. In the Alternative I pull-down box, select *4*. In the pull-down boxes for Alternatives II–IV, select *0* (this selection will make those alternatives empty). In the fiscal year ("Use _____ dollars") pull-down box, select 2000. Click the "Load" button.

The following steps set up and run a simulation analysis that compares the baseline program (Program 2) to the Alternative I program (Program 4):

14. Go to the Variants page. Our Alternative I development costs are uncertain because we used an estimation tool to compute them. Assume that this estimate might be off by ±30 percent: Enter 70 percent/130 percent as the low/high variants for the development costs.

15. Recall that we chose to keep the costs associated with periodic maintenance and revisions unchanged between Programs 2 and 4. Assume that we believe that we can save up to 10 percent of these costs with the new manual because its software is easier to work with: Enter 90 percent/100 percent as the low/high variants for periodic maintenance and revisions costs.

16. Suppose that the figures for IETM Orientation training are very uncertain. Perhaps personnel won't need any additional training on how to use the IETM; perhaps costs will be twice as much as originally anticipated: Enter 0 percent/200 percent as the low/high variants for IETM orientation training costs.

17. Suppose there is a possibility that the new IETM will allow the training school to enlarge the average classroom size by 15 percent without harming the quality of instruction: Enter 100 percent/115 percent as the low/high variants for the student/instructor multiple.

18. Finally, LMI's research has found that some sources believe a Class IV IETM will help reduce maintenance costs by improving troubleshooting. Others feel that, especially among experienced technicians, maintenance costs may go up slightly because the layout of Class IV IETMs makes it difficult for experienced users to skip directly to the information that they need. Therefore, enter 95 percent/105 percent as high/low variants for the maintenance cost per system variable.

After steps 14–18, the Variants worksheet should look as it does in Figure 3-27.

Figure 3-27. Variants Sheet Following Tutorial Steps 14–18

Alternative 1 --->

Report Date	Procurement Cost	Dev. Cost	Period Maintenance/ Revisions Cost	IETM Orientation Training	C-School Conversion	Training OH Cost	Avg. Student Hourly Pay	Avg. Instructor Hourly Pay	Student/ Instructor Multiple	Pass Rate	Course Length	Grads	Maint. Cost/ System	Sy in Se
MM/DD/YYYY	$1000	$1000	$1000	$1	$1000	$1000	$1/hr	$1/hr	none	none	weeks	none	$1	no
		70	90	0					100				95	
		130	100	200					115				105	

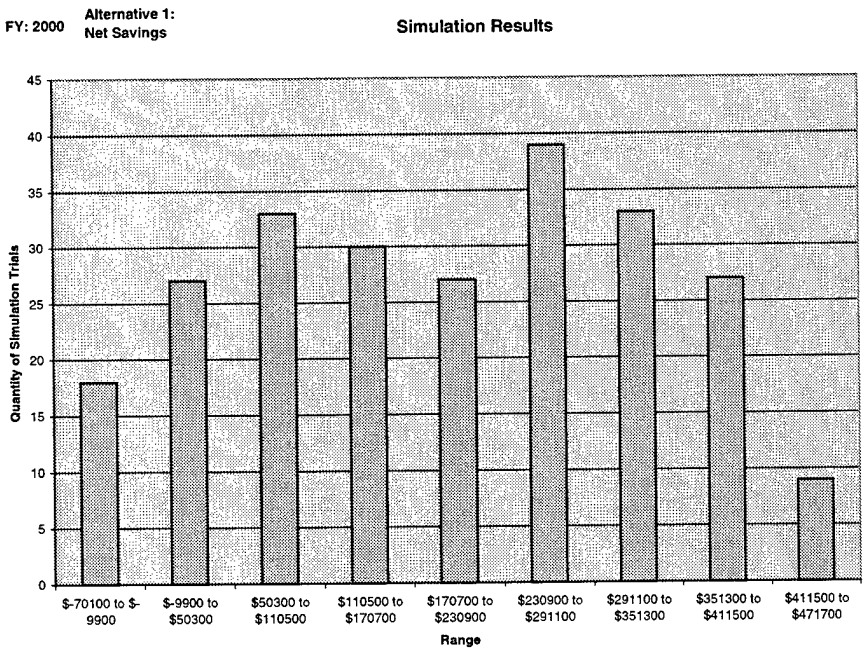
19. At the upper left corner of the Variants sheet, click the "Return to Start" button.

20. Click the "Run" button under the "Simulation Analysis" heading (but read the note below first).

Note: The Sensitivity Analysis isolates the effect of changing a variant by changing only one variable per run. The Simulation Analysis runs every combination of variations possible, and can therefore take considerably longer to complete. This example uses 243 runs and takes 12 minutes of run-time on a Compaq 266 MHz Pentium II laptop computer.

21. Click the "Graphs" button under "Simulation Analysis" in the Start sheet. Select the Net Savings Graph. It should look like Figure 3-28.

Figure 3-28. Net Savings Results of Simulation

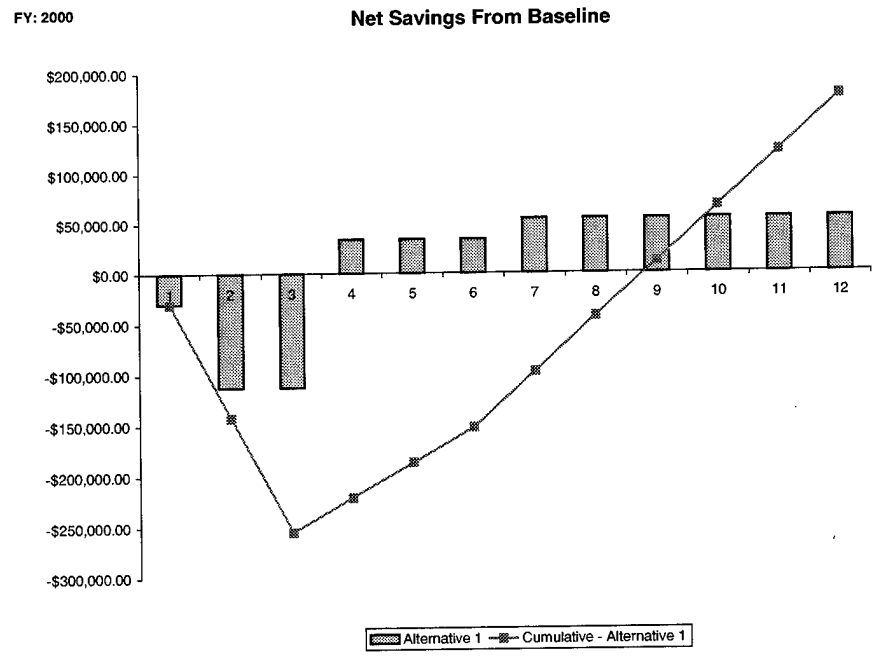


The graph shows a roughly Gaussian distribution. The mean net savings appears to be between $170,000 and $230,000. The median appears to be between $230,000 and $260,000. The simulation shows the potential for much larger net savings; it also shows a small but not insignificant probability of negative net savings.

22. The simulation analysis, like the sensitivity analysis, reruns the standard analysis after it is complete. This procedure allows the user to evaluate the nominal net savings. Return to the start page, click on the Standard Analysis's "Chart" button, and choose the net savings chart at the bottom of the menu (Figure 3-29).

This chart shows nominal net savings of approximately $175,000 after the first 12 quarters. A review of the other graphs from the standard analysis menu shows that the net savings is very negative in the first three quarters because of the development costs. Eventually, it becomes positive because the two weeks of reduced course length create significant savings over the baseline.

Figure 3-29. Net Savings of Nominal Case



PROGRAM STATISTICS UTILITY

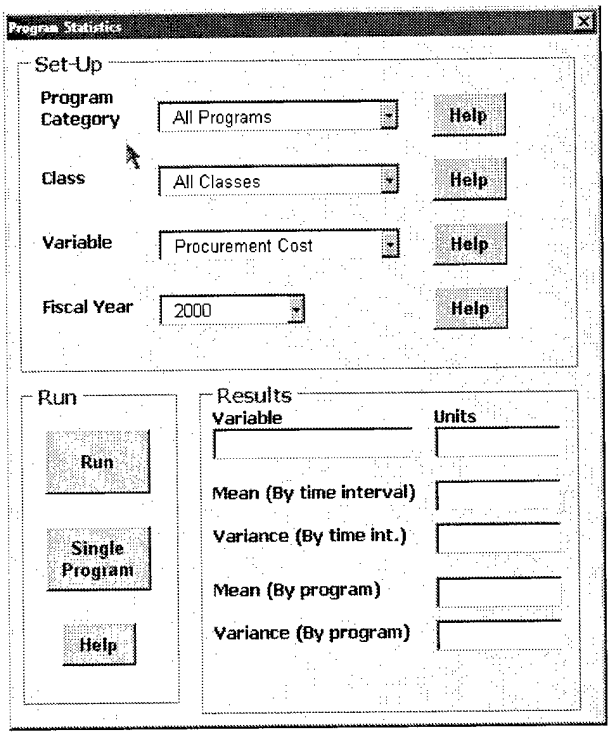
The Program Statistics utility computes, for a given program or subset of programs, the mean and variance of a user-requested variable. The utility will not be very useful unless sufficient data exist in the Programs sheet to provide a meaningful amount of variation across IETM classes and categories. Therefore, this tutorial is limited to showing the user how to activate the utility and make a query. The tutorial discusses the types of queries that the tutorial can make and then steps you through a single-program example.

1. Go to the Programs sheet.

2. Click the "Generate Statistics" button (the third button at the top left corner of the Programs sheet). You should see the Programs Statistics form appear, as in Figure 3-30.

3. Click the "Program Category" pull-down menu; the choices read "All Programs," "Hull-Mechanical-Electrical," "Information Technology," and "Weapons Systems." Click the "Class" pull-down menu; the choices read "All Classes," "0," "1," "2," "3," "4," "5."

Figure 3-30. Program Statistics Utility



The utility allows users to calculate statistics on a subset of programs, based on the program category and IETM class. Selecting "All Programs" in the "Program Category" pull-down menu and "All Classes" in the "Class" pull-down menu will ensure that all programs are selected. Selecting "All Programs" and "4" will ensure that all Class IV programs are selected. Selecting "Information Technology" and "3" will ensure that all Class III programs of Information Technology systems are selected. More advanced queries—such as "Select all Information Technology systems at or above Class III"—are not possible. By the time sufficient data exist to make such queries useful, the tool should be enhanced so that the program data come directly from a database. The database would provide the capability to perform advanced queries for statistical or other calculations.

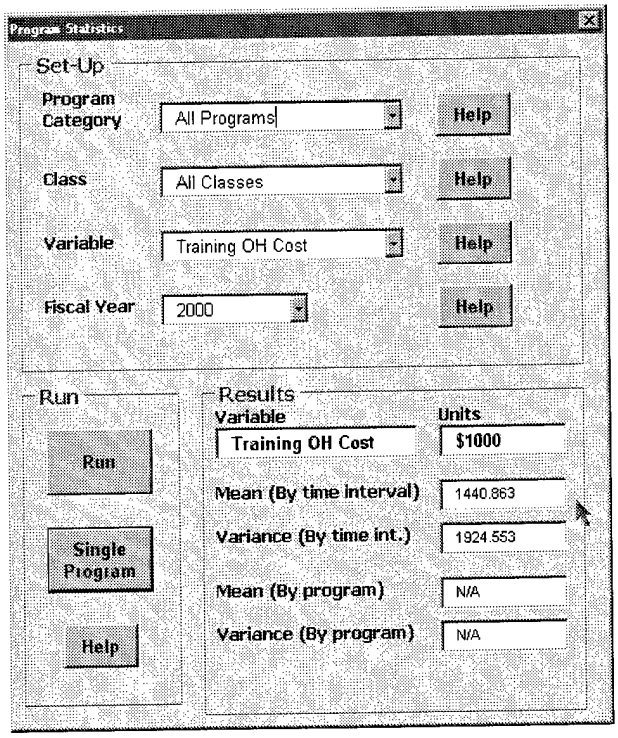
4. Select "Training OH Cost" from the "Variables" pull-down menu. Leave the default value (2,000) in the "Fiscal Year" pull-down menu.

5. Click the "Single Program" button. When you are prompted for a unique program ID, enter *1*.

Selecting "Single Program" instructs the utility to compute the mean and variance of the specified variable for one program only; in this case, the statistics provided show the mean and variance of the 12 quarters of training overhead costs for the first program on the programs sheet. In single program mode, the utility ignores the "Program Category" and "Class" program values.

6. Review the results, which should appear as in Figure 3-31.

Figure 3-31. Calculation Results



Appendix
Description of Variables

This appendix describes each of the 23 variables that are characteristic of a program cost report. A cost report is a row of data in the Programs sheet. Each variable makes up a column of the Programs sheet. When the variable name differs from its column heading as it appears in the Program sheet, we list the column heading in parentheses after the variable name.

- *Entry ID.* This is a unique number, similar to a database key, that uniquely identifies a set of cost reports as belonging to a single program. Every cost report in a program should have the same entry ID. Each entry ID must correspond to exactly one program.

- *Program Name.* The overall system for which the technical manual has been created. In other words, a manual that describes the avionics package on an F-18 might have "F-18" as its program name. A manual that describes the F-18's landing gear would have the same program name. Each cost report must include a program name.

- *Subsystem Name.* The specific piece of equipment that the technical manual describes. For example, the F-18 avionics system would use the name of the avionics system as the subsystem name. Each cost report must include a subsystem name.

- *IETM Serial Number.* This is a unique number or string that uniquely identifies the IETM (or ETM or paper manual). The tool does not use this variable to identify a technical manual; it is included to provide users with an opportunity to identify the manual with a familiar number.

- *Program Category* (Category). The classification of system to which the technical manual applies: Hull/Mechanical/Electrical, Information Technology, or Weapons Systems. The tool does not use this variable directly in the analysis but may use it to gather statistics on a subset of the data.

- *IETM Class* (actually, applies to any technical manual). The class of the manual as given in Jorgensen (1994). This value is an integer from 0 to 5: 0 corresponds to a paper manual; 1–5 corresponds to a Class 1–5 electronic technical manual. The tool does not use this variable directly in the analysis but may use it to gather statistics on a subset of the data.

- *Report Date.* The date of an individual cost report. The time interval between consecutive reports must be consistent within each program and

across all of the programs used in an analysis. See Chapter 2 for a more detailed explanation of cost report time intervals.

- *Procurement Cost.* The cost associated with purchasing the manual from a developer. These costs should be fees that are not specified elsewhere in this sheet.

- *Development Cost* (Dev. Cost). The cost associated with developing the manual—any original authoring, plus costs related to converting an ETM from a paper manual or lower class of ETM. In some cases, the user may consider the development cost to be a part of the procurement cost; in this case, the user should not list the development cost separately. (The procurement cost should include the total value, and the development cost should be zero.)

- *Periodic Maintenance and Revisions Costs* (Period Maintenance/Revisions Cost). Costs related to periodically revising the manual to reflect changes in content, as well as any patches/fixes to ETM software.

- *C-School Conversion.* Costs associated with upgrading a C-school to accommodate the use of the technical manual. These costs are restricted to funds required to bring a new manual into the classroom and display it in that setting. It does not include the general costs of converting the entire classroom environment to an electronic, multimedia format. If the C-school curriculum and classroom format are not modified to accommodate using the manual, these costs should be set to zero.

- *Training Overhead Cost* (Training OH Cost). Overhead costs associated with running a C-school that uses the technical manual. This cost is difficult to define and therefore is not used in the analysis at this time. (The variable is a placeholder.) If the user is unsure of these costs, they should be set to zero.

- *Average Student Hourly Pay* (Avg. Student Hourly Pay). Average total hourly compensation of a student undergoing training on the subsystem that the manual describes. This figure includes per diem, housing allowance, and other allowances.

- *Average Instructor Hourly Pay* (Avg. Instructor Hourly Pay). Average total hourly compensation of an instructor on the subsystem that the manual describes. This figure includes per diem, housing allowance, and other allowances.

- *Student/Instructor Multiple.* Number of students per instructor (i.e., average class size) in the training course for the subsystem that the manual describes. This number must be greater than zero.

- *Pass Rate.* The ratio of graduates to enrolled students in the current class of the course. This number must be a percentage greater than zero and less than or equal to 100.

- *Course Length.* The length of the training course for the subsystem that the manual describes. The course length should be the total time from the start of the course to the end, not the number of weeks in the current time interval when classes were in session.

- *Number of Graduates* (Grads). The total number of graduates in the current time interval from the training course for the subsystem that the manual describes. This number must be a positive integer.

- *Maintenance Cost Per System or Unit* (Maint. Cost/System). The average cost of maintenance on all units of the equipment that the manual describes. (For example, if 100 pumps required a total of $50,000 for maintenance in the current time interval, this value should be $500.)

- *Systems or Units in Service* (Systems in Service). The total number of units in service during the time interval. This number, multiplied by the Maintenance Cost Per System or Unit, should give the total dollars spent on maintaining these units in the given time interval. This value includes units that are in a reduced status or out-of-commission. This number must be a positive integer.

- *IETMS in Service.* The total number of manuals in service for the appropriate subsystem during the current time interval. This figure applies to paper manuals and noninteractive ETMs as well. This number must be a positive integer.

- *Readiness.* The percent readiness of the units in service for this time interval. This variable is not used in the analysis; it is a placeholder. However, you must enter a number between zero and 100.