

# Total Cost Model User Guide

Revised June 12, 2020 for version number 1.5

Some portions from the paper:  
*The Economics of Open Source Software*  
*A Model for Total Cost Analysis*

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Richard Barnes  
rlbcontractor@gmail.com  
rlbcontractor.com

**This is a preliminary edition of the User Guide. Final editing for content and grammar has not been completed to the author's satisfaction.**

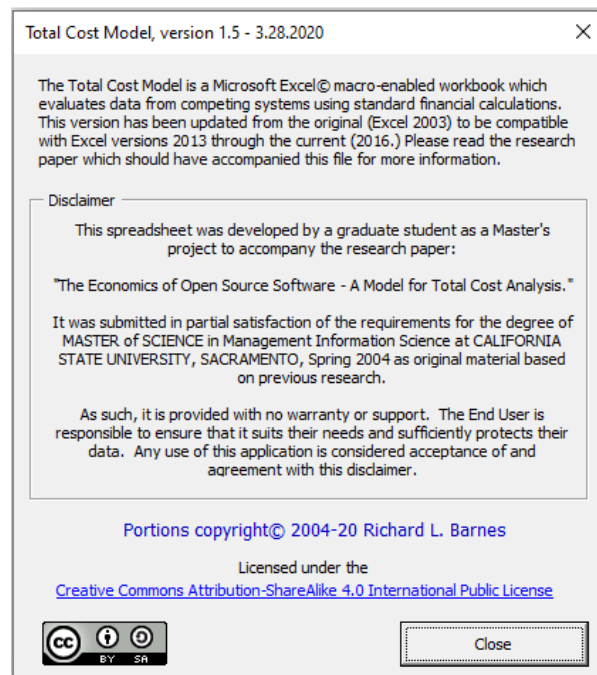
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## The Total Cost Model

Whether you call the Total Cost Model a financial model, a workbook or a spreadsheet, it is nothing more than a tool for comparing input data and showing possible numerical relationships. All of its results can be interpreted in different ways, just as the same statistics can be used to validate opposing opinions.

The Total Cost model is a spreadsheet (or workbook) that consists of eight worksheets, or tabbed pages (see Table 1.) It was originally created in 2004 using Microsoft Excel© 2003, version 11, but updated in 2017 to be compatible with Excel 2016. Since it allows the simultaneous comparison of three alternative projects, it required a good deal of programming code to provide logical flow, error checking, data validation and arithmetic calculations to be significant. The workbook is protected without a password so viewing the underlying Visual Basic for Applications (VBA) programming code used to control the workbook is available to anyone. The Total Cost model is contained in the file named “Cost\_Model – “*version number*”.xslm”. All screenshots in the following text were captured on a Windows 10 system running Microsoft Excel 2016; however, the workbook was also tested using Excel 2010 running under the Windows 7 operating system with no problems or anomalies noted. ***No guarantee is made that the workbook will perform as described on older versions of Excel, so care should be taken to further insure that the results obtained on such systems are accurate.*** Once the workbook has been opened on a newer version of Excel it will not work with an older one due to library references incompatibility (this is how Microsoft has planned it.) Many of the programmed functions are interdependent, thus it is recommended that the spreadsheet be used without any modifications. A pristine copy of the Cost Model should be kept before you enter any data.



Worksheets		
Order	Name	Purpose
1	Common Data	Current, general and common organization data
2	Alternative System Costs	Cost data for each Alternative (3 total worksheets)
3	Cost Analysis	Cost analysis based on data from worksheets 1 & 2
4	Graphical Analysis	Graphical display of the cost data from worksheet 3
5	Concepts and Instructions	General model user help

**Table 1** - Description of the worksheets within the Total Cost Model.

In an effort to protect users from macro (or programming code) viruses embedded within workbooks, Excel employs a *Macro Security* scheme which has four levels of protection. The two highest levels only permit macros from “trusted” sources to be run. Since the model will not function as designed without the use of its macros, Excel’s Macro Security level should be set to the Low setting to ensure that the model works properly. It is also important to remember that Excel cannot detect any specific virus, and all of its warnings about macro viruses are general warnings about a possible problem which may or may not exist.

The Total Cost model provides the following features:

- The model supports results and income of up to \$999,999,999,999.99 (One cent less than one trillion dollars).
- Study lengths can be customized as needed (one, two, three, four or five years).
- One to three alternative systems can be evaluated simultaneously.
- Each system can add up to five user defined cost fields.
- Worksheets can easily be printed to serve as a hard copy worksheet or scratchpad
- Four charts are predefined, though the user can add more using Excel’s built-in charting capabilities
- A user Options or Preferences interface that allows customizing the following settings:
  - Automatic workbook backup at startup
  - Display of the workbook in full screen mode
  - Show the splash dialog during startup
  - Show row and column headers
  - Screen display percentage (ZOOM)

Many calculated cells have been placed in “hidden” columns to protect them from unintended manipulation. These cells are essentially scratchpad calculations and values. For a better understanding of how the Total Cost Model collects and calculates its values, unhide columns J through P on the Proposed System Data sheets; and columns L through P on the Cost Analysis sheet to view these cells.

## **How the Model Works**

The true beauty of the Total Cost model is that the input can be continually refined and updated as the user acquires new information or means of stating their accounting data. The main concern when preparing your accounting data for input into the model should always be: The output is only as reliable as the input.

There are six basic steps to using the Total Cost model:

1. Determine what data you will use and how that data will be acquired.
2. Assemble the data as required by the model.
3. Enter the general organization data on the first worksheet, "Common Data".
4. When a name is entered in a "Proposed System" cell on the Common Data worksheet a new worksheet will be displayed to contain the cost values of that alternative system.

The new worksheet will be named after the value entered into the Proposed System cell.

5. On each Proposed System worksheet, enter the system specific costs; each worksheet defines the cost variables for one system.
6. Finally, view the worksheet "Cost Analysis" for the results of the analysis. This worksheet is automatically updated when all of the appropriate data is entered. Since some calculations do not require every piece of data that can be entered into the model, results will be presented once there is sufficient data to calculate that value. Charts are displayed on the worksheet "Graphical Analysis" which becomes visible as soon as there are results to plot.

Each worksheet has help information specific to it below the input areas. More comprehensive help is available on the "Concepts and Instructions" worksheet (Figure 7.) Further assistance is available through Excel's commenting feature, which is used extensively throughout the model (Figure 7.)

## **Acquiring the Data**

Before using the Total Cost Model, you should familiarize yourself with capital investment analyses such as ROI, IRR, and NPV.

Once you understand how to use this model and the information it provides, the first and most important step is the acquisition of input data. Though this information may come from an organization's accounting records, some users may find it easier to take the standard accounting data and conform it to the needs of the model.

It is best to use revenue cash flows that represent the difference between the "business as usual" figures and those achieved with the implementation of the proposed project (investment.) Thus, the revenues should represent the benefits provided by the new system and the expenses, the costs directly assignable to it. However, if cash flows cannot be attributed directly to computer systems or other IT managed resources, use the company's total revenues. Though this may not be as accurate, it will provide a valid comparison since each alternative will have the same revenue. As with any projected cost model such as this, there will always be some disagreement in its execution. Another important question to answer when deciding on which accounting figures to use is; should you use only marginal (additional) or total costs.

The idea behind capturing capital investment metrics is exposing and identifying the added or marginal costs behind a proposed investment. For example, should the complete expense for all the organization's employee end-user training be used or just the amount of change required by the proposed project? This is up to the user to decide, however, consider the data collection and usage as a whole and be consistent. Total expenses should include any marginal costs so they would be acceptable. To provide accurate results the same type of numbers should be used throughout the analysis, this includes the Common organization data on the first worksheet.

<b>Metric</b>	<b>Required Data</b>
Total Cost of Ownership (TCO)	Cash outflows, project expenses, or cash outlays
Simple Return on Investment (ROI)	Evenly spaced (regular intervals) series of periodic cash flows (incremental inflows and outflows)
Discounted Return on Investment (ROI)	Evenly spaced (regular intervals) series of periodic Discounted cash flows (incremental inflows and outflows)
Payback Period	Evenly spaced (regular intervals) series of periodic cash flows (incremental inflows and outflows)
Discounted Payback Period	Evenly spaced (regular intervals) series of periodic Discounted cash flows (incremental inflows and outflows)
Internal Rate of Return (IRR)	Evenly spaced (regular intervals) series of periodic cash flows (incremental inflows and outflows)
Modified Internal Rate of Return (MIRR)	Evenly spaced (regular intervals) series of periodic cash flows (incremental inflows and outflows), and a cost of capital and reinvestment interest rate (MARR)
Net Present Value (NPV)	An interest rate required by the organization, and a evenly spaced (regular intervals) series of periodic cash flows incremental inflows and outflows)
NPV - Sum of Discounted Net Cash flows	An interest rate required by the organization, and a evenly spaced (regular intervals) series of periodic Discounted cash flows (incremental inflows and outflows)
Profitability Index (PI)	Evenly spaced (regular intervals) series of periodic cash flows (incremental inflows and outflows)

**Table 2** - Data requirements for the metrics as calculated by the Total Cost Model

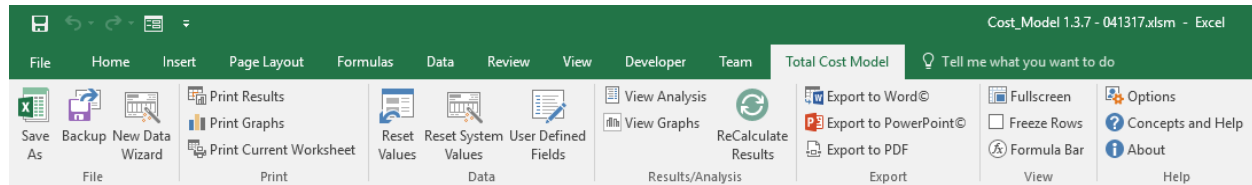
Some of the model's calculations require that the cash flow be stated as incremental flows; however, the insertion of total data is supported, though it will return a lesser set of resulting metrics. Regardless of the manner of selecting data, the model will produce valid metrics based on the data. The model simply provides the user with financial metrics calculated using the data supplied to it; all results are based on the input data.

## Navigating through the Model

Other than the VBA programming code (macros) which provides structured data entry and advanced error control, the Total Cost Model functions as any Excel workbook. It is a collection of tabbed worksheets displayed in a multiple document interface (MDI.) Each worksheet is activated and brought to the front of the other worksheets by clicking on its tab. Most every standard Excel navigation technique is supported, though some actions may either be disallowed or hampered by macros. This is especially evident as all of the worksheets are "protected" by default using Excel's worksheet level protection, which prevents changes them. In the case of the Total Cost model, the worksheet protection prevents a user from changing its formatting and

underlying formulas. This feature can be over-ridden, but it is best to leave it activated, as any user can inadvertently damage the model's structure, thus rendering its results unreliable.

Access to the extended functionality of the Total Cost model is afforded by the selection of either a menu item or a command button (see Figure 1.) Each worksheet has hyperlinks or buttons that will provide services or run processes. Most every navigation aid and function provided by buttons located on the worksheets is also available from Excel's main menu. The "Total Cost Model" ribbon menu is located at the end of the standard Excel menu. It supports many functions and is context based, so only menu items which are relevant to your current activity are available.

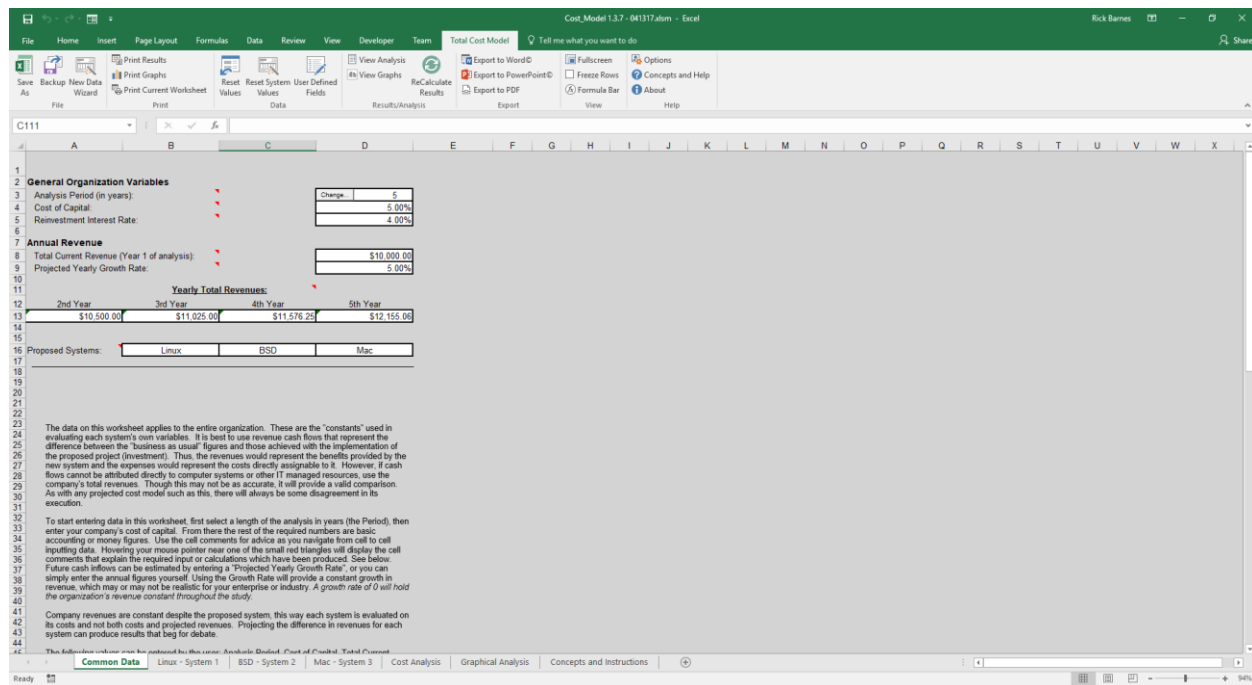


**Figure 1** – The Total Cost Model's Ribbon tab design.

## Entering Data into the Model

The variables on the Common Data worksheet apply to the entire organization and are applied throughout the model. These are the constants used in evaluating each system's own cost variables. To start entering data in this worksheet, first select a length of the analysis in years (the Period), then, enter the organization's cost of capital. From this point on the required numbers are basic accounting or money figures. Hover the mouse pointer near the small red triangles located in some of the cells to display the cell comments that explain the required input or the calculations that have been produced (see Figures 4 and 5.)

See the section "Using the New Data Wizard" for help entering data with a simplified dialog box.



**Figure 2 – Common Data worksheet**

Although most of the Common Data input is straightforward, the model's data validation routines will catch many types of input errors that may occur. The following input data are required by the Total Cost model (see Table 3):

**Analysis Period** - Choose the number of years for the cost analysis; one, three, four, or five years only. A one-year period works well when only one set of inflows and outflows are available.

**Cost of Capital** - The organization's cost for borrowing investment capital. If there are several rates available, use an average. Remember that this is a *future* interest rate.

**Reinvestment Interest Rate (MARR)** - This value is the interest rate paid to the organization for reinvested cash. This could be bank interest or the required rate of return for investing in other projects. This value is also known as the MARR, or the Minimum Accepted Rate of Return.

**Total Current Revenue (Year 1 of analysis)** – This value is the organization's Total Revenue for the first year of the study. This should be the total of all revenue attributable to the proposed system for the first year, however if this number is not available use the organization's total revenue. As long as comparable figures are used, there should be an accurate comparison between the competing systems. Future cash inflows (revenues) can be estimated by entering a "Projected Yearly Growth Rate", or the annual figures can be manually entered. Using the Growth Rate will provide a constant growth in revenue, which may or may not be realistic for the organization or industry. Holding the revenue constant will make for easier interpretation of the TCO results. Revenue numbers weigh heavier in the ROI, IRR, NPV and Payback calculations.



**Projected Yearly Growth Rate (optional)** - Use this variable instead of providing values separately for each year under "Yearly Total Revenues". This value will be used to compound each year's revenue to produce the "Yearly Total Revenues" values. The starting value for these calculations is the "Total Current Revenue", which is the first year's revenue within the analysis.

**Yearly Total Revenues** – These values are either automatically calculated by compounding them using the growth rate as previously entered, or by manually entering values into the cells.

**Proposed Systems** - These values will only be used to "label" the results. They have no meaning to the financial metrics and can be anything alphanumeric, the shorter and more informative the better. For the proper display within the model, the names should be twenty characters or less.

Worksheet	Required input
Common Data	Analysis Period Cost of Capital Reinvestment Interest Rate (MARR) Total Current Revenue (Year 1 of analysis) Projected Yearly Growth Rate Yearly Total Revenues Proposed System Names
Alternative System Costs	System costs by Year, then by Cost category User defined costs as needed (optional)

**Table 3** – Input data requirements by worksheet

Other than entering cost values within the cells of the Alternative System Costs worksheet, the only other feature to note is the use of user-defined cost fields. Up to five custom system cost fields can be added to the Proposed System worksheets. Each user-defined field will allow itemizing expenses by each Period in the study, just as with the other fields. Once added on one worksheet, every proposed system will have the same fields available on their respective worksheet, so this only needs to be done once for the entire study. After the rows have been added both the field label and all of the values for each year can be changed.

Adding, modifying or deleting user-defined cost fields is performed by clicking the Add/Edit Fields button, at the end of the static cost categories (next to the label "User Defined Costs" category label.) This opens a dialog box from which you can add, modify or delete up to five custom fields. The interface is very simple to master, however, for safety's sake it should be tried before entering any critical data into the model.

Microsoft Excel - Cost\_Model.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Type a question for help

C6

Reset Values

Year	1	2	3
<b>Software</b>			
Initial Purchase Cost:	\$0.00	\$0.00	\$0.00
Additional Licenses and Subscriptions:	\$0.00	\$0.00	\$0.00
Upgrade and Maintenance Fees:	\$0.00	\$0.00	\$0.00
Add-on or Utility Application Licenses:	\$0.00	\$0.00	\$0.00
System Management Software:	\$0.00	\$0.00	\$0.00
License Management:	\$0.00	\$0.00	\$0.00
Other Software Expense:	\$0.00	\$0.00	\$0.00
<b>Hardware</b>			
Original Purchase Cost:	\$0.00	\$0.00	\$0.00
Additional Hardware required:	\$0.00	\$0.00	\$0.00
Data Storage and Storage Systems:	\$0.00	\$0.00	\$0.00
Telecommunication Infrastructure and Systems:	\$0.00	\$0.00	\$0.00
Other Hardware Expense:	\$0.00	\$0.00	\$0.00
<b>Personnel</b>			
System Design and Engineering:	\$0.00	\$0.00	\$0.00
Project Management:	\$0.00	\$0.00	\$0.00
Temporary Employees (Design & Implementation):	\$0.00	\$0.00	\$0.00
Vendor and Contract Management:	\$0.00	\$0.00	\$0.00
System Design and Engineering:	\$0.00	\$0.00	\$0.00
Ongoing System Administration:	\$0.00	\$0.00	\$0.00
Application development (in-house):	\$0.00	\$0.00	\$0.00
Specialized Contract Personnel:	\$0.00	\$0.00	\$0.00
Other Personnel Expense:	\$0.00	\$0.00	\$0.00
<b>Contract Services</b>			
Design and Implementation Contracts:	\$0.00	\$0.00	\$0.00

Common Data OpenOffice - System 1 StarOffice - System 2 Microsoft Office - System 3 Cost Analysis

Ready NUM

**Figure 3 – Alternative System Costs worksheet (3 analysis year period shown)**

## Viewing the Results of the Analysis

All of the financial metrics calculated by the Total Cost model come from cash flows that occur at the year's end and are not uniform (uneven.) This is important to remember as metrics such as the NPV and the Payback period, for example, can be calculated both with uniform and uneven cash flows. Any study of the model's results should take the input data into account. More insight into how the model calculates its values can be obtained by examining the formulas it uses. These formulas, as copied directly from the workbook's cells.

Microsoft Excel - Cost\_Model.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

Type a question for help

E38

	A	B	C	D	E	F	G	H	I	J
1										
2	Proposed Systems:		OpenOffice	StarOffice	Microsoft Office	<a href="#">Help with the Results</a>				
3	Software		\$1,000.00	\$0.00	\$300,050.00	<button>View Graphs...</button>				
4	Hardware		\$0.00	\$0.00	\$0.00	<button>Print the Results...</button>				
5	Personnel		\$5,000.00	\$0.00	\$0.00	<button>Mail the Results...</button>				
6	Contract Services		\$4,700.00	\$0.00	\$0.00	<button>ReCalculate the Results...</button>				
7	Support and Training		\$24,300.00	\$54,500.00	\$11,900.00					
8	Additional Costs		\$0.00	\$0.00	\$0.00					
9	User Defined Costs		\$0.00	\$0.00	\$0.00					
10	Total System Costs		(\$35,000.00)	(\$54,500.00)	(\$311,950.00)					
11										
12	System Cash Flows by Year:		Year 1	Year 2	Year 3	Year 4	Year 5	Totals		
13	OpenOffice		Expenses (Outflows)	(\$35,000.00)	\$0.00	\$0.00	N/A	N/A	(\$35,000.00)	
14			Revenues (Inflows)	\$500,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,568,512.50	
15			Cumulative Incremental Cash Flow	\$465,000.00	\$987,500.00	\$1,533,512.50	N/A	N/A		
16			Net Incremental Cash Flow	\$465,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,533,512.50	
17	StarOffice		Expenses	(\$54,500.00)	\$0.00	\$0.00	N/A	N/A	(\$54,500.00)	
18			Revenues	\$500,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,568,512.50	
19			Cumulative Incremental Cash Flow	\$445,500.00	\$968,000.00	\$1,514,012.50	N/A	N/A		
20			Net Incremental Cash Flow	\$445,500.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,514,012.50	
21	Microsoft Office		Expenses	(\$311,250.00)	(\$350.00)	(\$350.00)	N/A	N/A	(\$311,950.00)	
22			Revenues	\$500,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,568,512.50	
23			Cumulative Incremental Cash Flow	\$188,750.00	\$710,900.00	\$1,256,562.50	N/A	N/A		
24			Net Incremental Cash Flow	\$188,750.00	\$522,150.00	\$545,662.50	N/A	N/A	\$1,256,562.50	
25										
26	Financial Metrics		OpenOffice	StarOffice	Microsoft Office	Best Performing System:		Best Result		
27	Total Cost of Ownership (TCO)		\$35,000.00	\$54,500.00	\$311,950.00	OpenOffice		\$35,000.00		
28	Simple Return on Investment (ROI)		4381.46%	2778.00%	402.81%	OpenOffice		4381.46%		
29	Discounted Return on Investment (ROI)		4020.41%	2546.13%	362.42%	OpenOffice		4020.41%		
30	Payback Period (years)		1.0	1.0	1.0	3-way Tie		1.0		
31	Discounted Payback Period (years)		1.0	1.0	1.0	3-way Tie		1.0		
32	Internal Rate of Return (IRR)		1426.38%	912.15%	132.73%	OpenOffice		1426.38%		
33	Modified Internal Rate of Return (MIRR)		451.94%	342.31%	85.06%	OpenOffice		451.94%		

Common Data / OpenOffice - System 1 / StarOffice - System 2 / Microsoft Office - System 3 / Cost Analysis / Graphical Analysis

Ready

NUM

Figure 4 – Cost Analysis worksheet

Attempting to make generalized interpretations of the results produced by the Total Cost model would be futile, and in fact misleading. Capital budgeting requires that the decision makers predict the future, and there will always be differing visions. Additionally, the selection of alternative investments relies on both intuition and a knowledge of the specific situations being studied, which makes financial analyses just a portion of the complete decision process.

The descriptions of the financial analyses used by the Total Cost model should be sufficient for any user to draw elementary conclusions based on the calculated metrics. The Cost Analysis worksheet provides a minimal analysis of the “Best Performing System” which simply selects the alternative that meets or exceeds the decision rule as stated on both the worksheet and in the previous discussion. This evaluation is provided as a convenience and may not be accurate considering the total scope of the decision in question.

The results of the Total Cost model are displayed numerically on the Cost Analysis worksheet (Figures 4 and 5) and graphically using charts on the Graphical Analysis worksheet (Figure 6.)

The Cost Analysis worksheet contains information in three distinct areas:

- Itemized Total System Costs by cost category – This listing shows the totals of each cost category for each alternative (or proposed) system, and the total cost for the systems.
- System Cash Flows by Year - This section displays each alternative system’s Expenses (Outflows), Revenues (Inflows), Cumulative Incremental cash flow, and the Net

Incremental cash flow by year. Totals of all these yearly figures are also calculated, with the exception of the Cumulative Incremental cash flow, which by definition has no total.

- Financial Metrics – The ten resulting metrics, or financial analyses, are presented with a comparison against each alternative using the decision rule as a basis. The best performing metric, according to the decision rule as previously stated, is noted.

System Cash Flows by Year:							
	Year 1	Year 2	Year 3	Year 4	Year 5	Totals	
<b>OpenOffice</b>							
Expenses (Outflows)	(\$35,000.00)	\$0.00	\$0.00	N/A	N/A	(\$35,000.00)	
Revenues (Inflows)	\$500,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,568,512.50	
Cumulative Incremental Cash Flow	\$465,000.00	\$987,500.00	\$1,533,512.50	N/A	N/A		
Net Incremental Cash Flow	\$465,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,533,512.50	
<b>StarOffice</b>							
Expenses	(\$54,500.00)	\$0.00	\$0.00	N/A	N/A	(\$54,500.00)	
Revenues	\$500,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,568,512.50	
Cumulative Incremental Cash Flow	\$445,500.00	\$968,000.00	\$1,514,012.50	N/A	N/A		
Net Incremental Cash Flow	\$445,500.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,514,012.50	
<b>Microsoft Office</b>							
Expenses	(\$311,250.00)	(\$350.00)	(\$350.00)	N/A	N/A	(\$311,950.00)	
Revenues	\$500,000.00	\$522,500.00	\$546,012.50	N/A	N/A	\$1,568,512.50	
Cumulative Incremental Cash Flow	\$188,750.00	\$710,900.00	\$1,256,562.50	N/A	N/A		
Net Incremental Cash Flow	\$188,750.00	\$522,150.00	\$545,662.50	N/A	N/A	\$1,256,562.50	

Financial Metrics	OpenOffice	StarOffice	Microsoft Office	Best Performing System:	Best Result
Total Cost of Ownership (TCO)	\$35,000.00	\$54,500.00	\$311,950.00	OpenOffice	\$35,000.00
Simple Return on Investment (ROI)	4381.46%	2778.00%	402.81%	OpenOffice	4381.46%
Discounted Return on Investment (ROI)	4020.41%	2546.13%	362.42%	OpenOffice	4020.41%
Payback Period (years)	1.0	1.0	1.0	3-way Tie	1.0
Discounted Payback Period (years)	1.0	1.0	1.0	3-way Tie	1.0
Internal Rate of Return (IRR)	1426.38%	912.15%	132.73%	OpenOffice	1426.38%
Modified Internal Rate of Return (MIRR)	451.94%	342.31%	85.06%	OpenOffice	451.94%
Net Present Value (NPV)	\$866,572.20	\$847,072.20	\$590,026.26	OpenOffice	\$866,572.20
NPV - Sum of Discounted Net Cashflows			333.49	OpenOffice	\$1,293,924.55
Profitability Index (PI)			4.62	OpenOffice	41.20

Profitability Index (PI) – This ratio is a measure of a proposal's profitability per dollar invested. A value of 1 or higher indicates an investment yield greater than the required rate of return (discount rate).  
 PI = discounted cash inflows / discounted cash outflows

**Figure 5** – Cost Analysis worksheet, results detail with comment

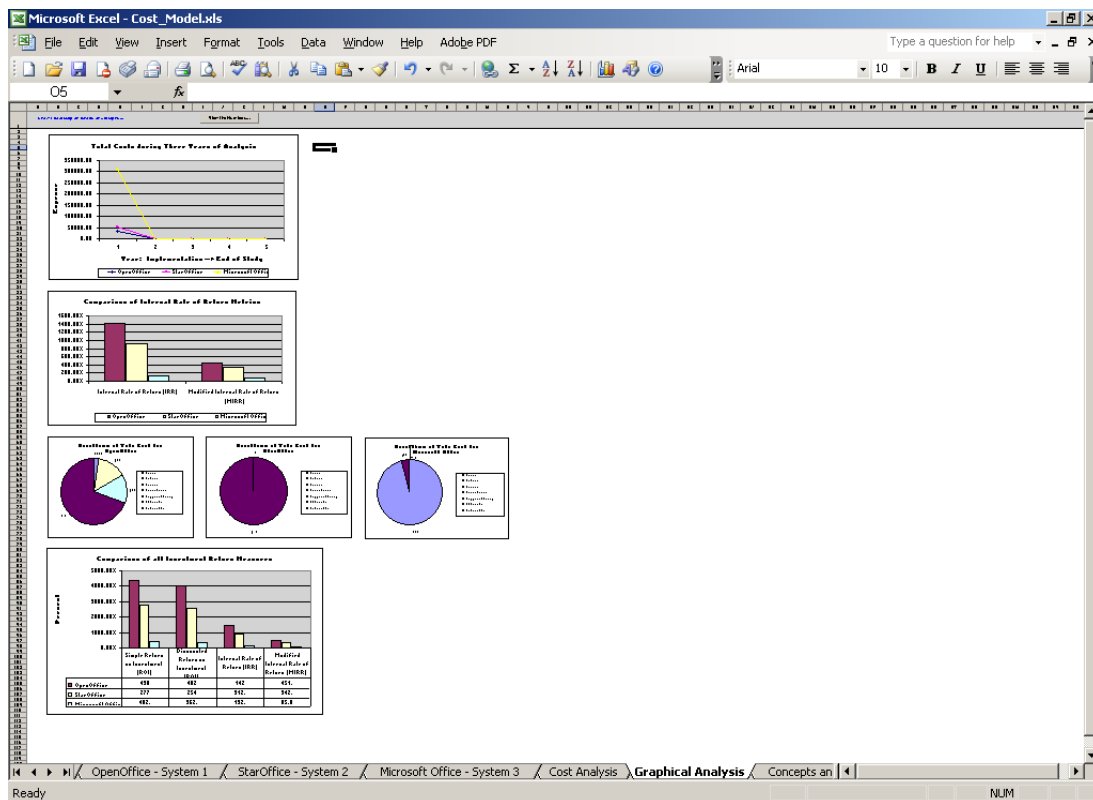
The Cost Analysis worksheet also includes several command buttons that provide the following additional functionality beyond the calculation of the financial metrics:

**View Graphs** – Moves the focus to the Graphical Analysis worksheet, which shows the analysis' results plotted on Charts.

**Print the Results** - Opens the Cost Analysis worksheet in an Excel Print Preview window. The worksheet is ready to print with margins and page breaks already set, however these settings can be changed to match both your printer and your preferences.

**ReCalculate the Results** – This button forces the Cost Analysis worksheet to refresh by recalculating it's values.

## Graphical Analysis



**Figure 6 – Graphical Analysis worksheet (display reduced to 35%)**

The last analysis page, "Graphical Analysis", provides four predefined charts of the model's resulting metrics. Though the results are presented in clearly defined and generally accepted financial metrics, graphical representations may enhance the users understanding of these numerical values. Figure 6 shows the Graphical Analysis worksheet reduced to a screen display of thirty-five percent to show the entire chart on one screenshot. As with any Excel workbook the user can add or modify charts as they wish. The charts are provided as a sample of ways to contrast the results of the model.

Briefly explained, the four predefined charts are:

**Total Costs during "x" Years of Analysis** - This chart plots the total costs for each system on a line chart. The chart changes dynamically to represent the different available analysis periods. Since a line chart does not provide any valid information for a one-year analysis, it is not available in this case.

**Comparison of Internal Rate of Return Metrics** – This is a comparison of the IRR with the MIRR for each alternative system displayed as a column (vertical bar) chart.

**Breakdown of Total Cost for...** - The percentages breakdown of each cost category for the alternative systems is displayed in pie charts.

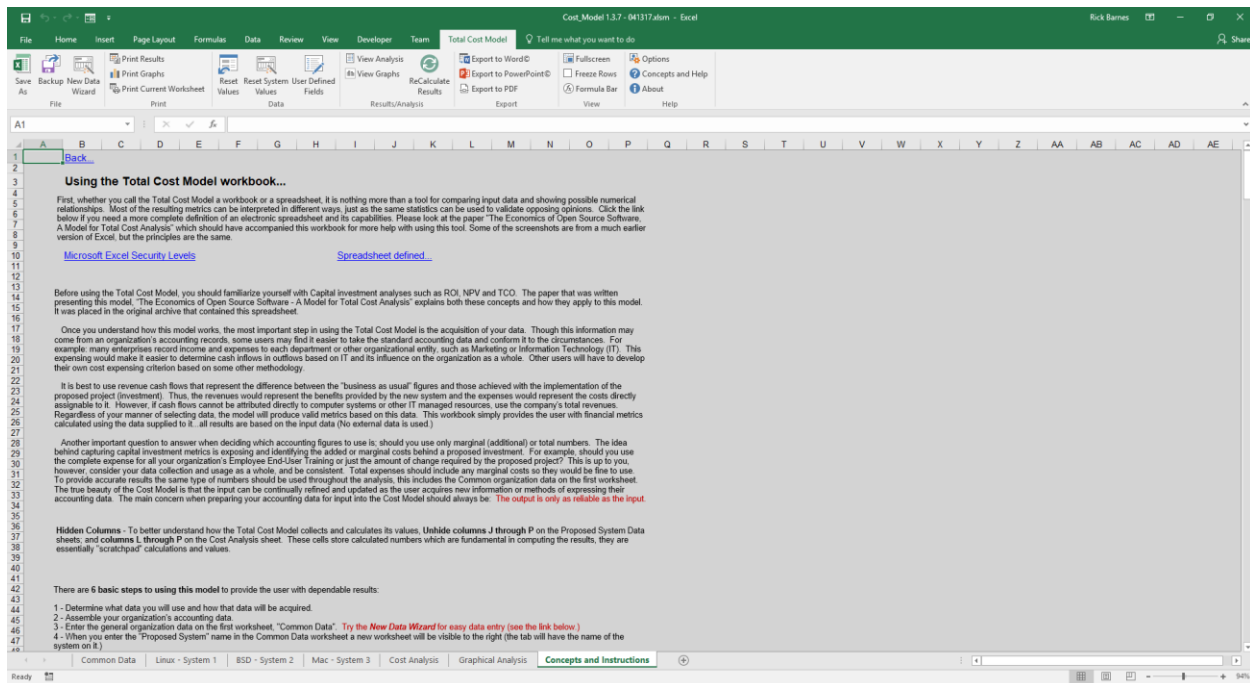
**Comparison of all Investment Return Measures** – This is a column chart comparing the rate of return metrics for each alternative. The values displayed on the chart are:

- Simple Return on Investment (ROI)
- Discounted Return on Investment (ROI)
- Internal Rate of Return (IRR)
- Modified Internal Rate of Return (MIRR) by system
- 

## Getting Help

Online help is available on the “Concepts and Instructions” worksheet which is the last tab (figure 7.) While this should be sufficient to use the model, you may also want to look at the paper, “The Economics of Open Source Software”, that is distributed as the “Total Cost Model.pdf”. The paper may be dated, but the concepts are timeless.

Each worksheet also has help at the end of the data entry portions. This help is mainly to support the function of the specific sheet, but some general help is included.



**Figure 7** – Concepts and Instructions worksheet

## Options

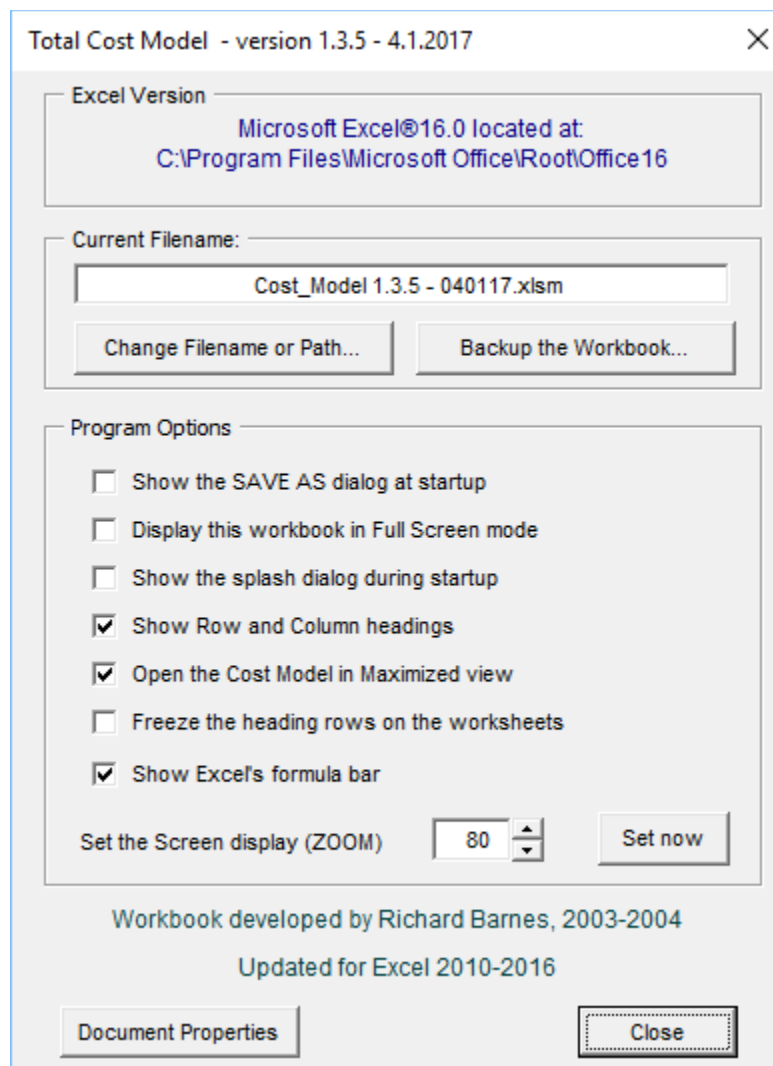
The Workbook Options form is a central location for performing several routine configuration or file maintenance procedures. It is accessed by selecting the “Options...” menu item from the Total Cost Model menu.

The Options form offers the following features:

The **Excel Version** section provides a display of the version of Microsoft Excel and the operating system currently running on the PC.

The **Program Options** section configures several features that can be set using Excel's controls. However, these are made available here and the settings are saved as Custom Document Properties. By using the Custom properties feature of an Excel document, these settings are guaranteed to be employed, no matter where the file is opened (as long as a compatible version of Microsoft Excel is used).

The first 7 settings are toggle settings, meaning they are either on or off. The last one, the **Screen Display Zoom** value, is changed by either entering a value or clicking the spinner buttons at the right side of the input box.



**Figure 8** – Preferences / Workbook options dialog

**Show the Save As dialog at startup** – This prompts for permission to backup the workbook file when you open it.

**Display this workbook in Full Screen mode** – This toggles between full screen and standard view. Full Screen mode may hide your favorite toolbar and the worksheets tabs so be aware that navigating through the workbook may be cumbersome when using this setting. Pressing the Escape key will exit Full Screen mode, *but it won't change this setting!*

**Show the splash dialog during startup** – Prevents the Splash dialog box with the disclaimer from showing when you open the Cost Model workbook

**Show Row and Column headings** – This setting toggles the display of the row and column headings, which may give you some much needed viewing area on a small display.

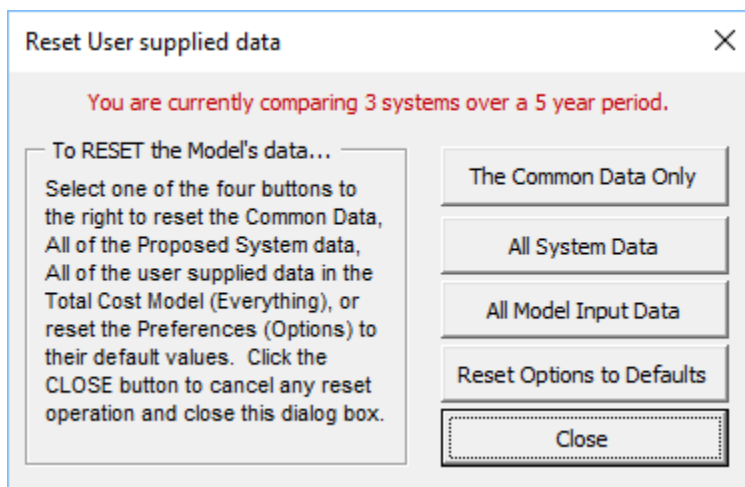
**Open the Cost Model in Maximized view** - Sets the Cost Model to open in a Maximized window (not to be confused with Excel's Full screen mode.)

**Freeze the heading rows on the worksheets** - Sets the worksheets to open with specific rows "frozen" to provide headings.

**Show the Formula bar** - This toggles between showing and hiding Excel's Formula Bar.

**Set the Screen display (ZOOM)** – The values entered here must be between 10 and 400 and increase or decrease the display size of the workbook view. The values are percentages, so a value of 100 is twice the size of 50. The Cost Model's default setting is 90.

## Resetting the Model



In order to reuse the Total Cost model or “zero-out” all of the settings of a proposed system, a user could simply edit the values themselves. However, this can be time consuming, and, leaving only one orphaned cost variable could skew the results of the next analysis, providing erroneous data. To facilitate the accurate resetting of the values within the workbook several routines are available. All of these procedures will reset the input values of the selected component changing the

current values to the default values, either zero or a blank (an empty cell.) The only exception to this is that the value of the analysis period is set to five as its default value. Resetting the Common Data worksheet will remove all of the Alternative System Costs worksheets since they are the product of having a Proposed System name entered on that sheet.

To reset the entire model, or just the Common Data or Proposed System worksheets click the “Reset Values...” button at the top of the input area of the Common Data worksheet or from the Total Cost menu. This will display the “Reset User supplied data” dialog box (see Figure above.) From this form, you can select to reset:



**The Common Data Only** – resets only the data on the Common Data worksheet

**All System Data** – resets the Proposed System worksheets data to zero and removes any user-defined fields.

**All Model Input Data** – this will reset ALL of the data in the Cost model to their defaults.

**Show the splash dialog during startup...** – toggles the display of the Total Cost Model's Splash dialog that is shown while the workbook loads.

## Using the New Data Wizard

The **New Data Wizard** is a simple tool for inputting your starting data into the Cost Model. Although you can use the Common Data worksheet for your data entry, this form allows you to enter (or change) the information and view it all at once prior to inserting that data into the model. Once the model has been in use you can use this form to edit your previous entries, except for the System names.

Once the System names have been entered into the model and the worksheets created, you must edit them from the Common Data worksheet to maintain the overall integrity of the model. The systems worksheets are added or deleted base on these entries, so their consistency is vital. The current system name textboxes will not be enabled for change if the corresponding worksheets exist. (See the image to the right.)

From the form you can enter or change:

The Analysis time period

The Proposed System names

The Organization's Financial Information

Cost of Capital

Reinvestment Rate

Current (Year 1) Revenue

Expected Growth Rate

**New Data Wizard**

Enter, or change, the data for your Cost Model. Then click the "Insert Data" button to enter the values into the model, or click Close to exit without making any changes.

Analysis period

Select an analysis period... 5

Proposed Systems

System 1	Linux
System 2	Mac
System 3	BSD

Organization Financial Information

Cost of Capital %	3.34%
Reinvestment Interest Rate %	1.20%
Total Current Revenue (Year 1)	\$1,000,000.00
Projected Yearly Growth Rate %	4.25%

Insert Data Close

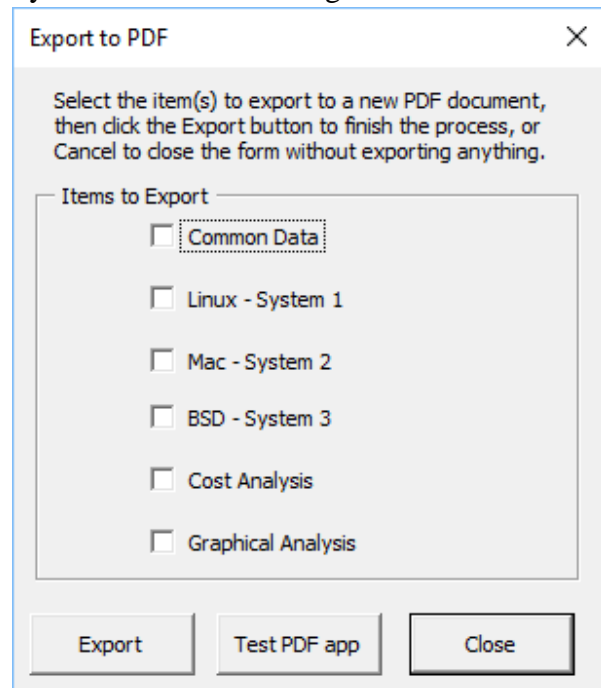
## Exporting the Data

*Due to library incompatibilities, the PowerPoint export tool does not work with Excel versions earlier than 2013.*

The cost model has three built-in export tools, Export to Microsoft Word®, Microsoft PowerPoint® and to PDF. Of course, you could copy and paste what you want to export yourself, or use Excel's export to PDF tool, but the Cost model's worksheet protection makes that somewhat more difficult without disabling the worksheet protection. You can disable the worksheet protection from the File menu, but that may allow you to also make changes to the worksheets which would influence the correct results.

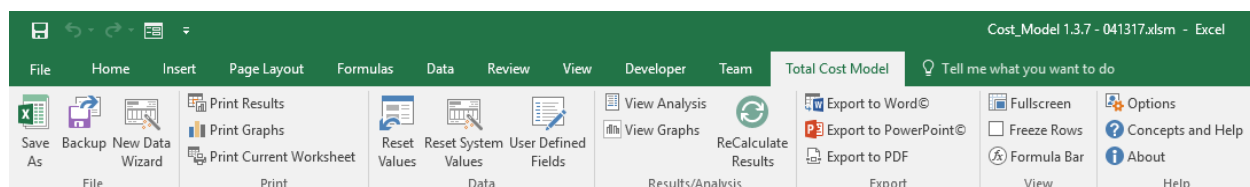
The Cost Model offers three export options:  
 Export to Microsoft Word®  
 Export to a Microsoft PowerPoint® presentation  
 Export to the Portable Document Format (PDF)

You must have Microsoft Word and PowerPoint installed for the first two to work, but if you have Excel, chances are you have them, too. The PDF export tool requires that you have a PDF reader installed (such as the Adobe Reader), however most modern Windows systems have a default reader that will work fine. Both Google Chrome and Microsoft Edge can open PDF files. The PDF exporter has a feature to check for the existence of a valid reader. Click the "Test PDF app" button to find out what reader you have.



To export your data, click one of the buttons on the Ribbon menu from the Export group.

## Using the Ribbon Menu

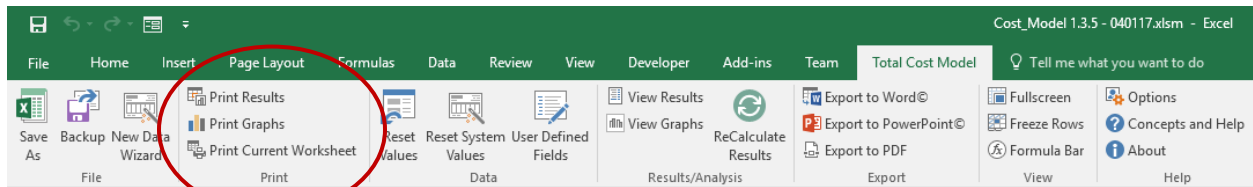


Every Cost Model function is available from Excel's **Ribbon menu** as shown above. The "Total Cost Model" tab is located at the right end of the Ribbon. Tooltips are available for each tab item. The Ribbon opens to the Cost Model tab when the workbook is first opened.

The menu items should be self-explanatory...use the tooltips for a better explanation. Most of the menu functions which will change your data or the model will have a warning prompt to protect you from yourself.

## Printing the Data

**Printing Worksheets** – Printing of the data and result worksheets can easily be done either with Excel's Print tools or by selecting one of the 3 print options from the Ribbon menu. To use one of the Cost Model's print routines, click one of the buttons on the menu. This will then open the selected worksheet in printable form in a Print Preview window ready to send to your printer.



## Note about Revenues

The Yearly Revenue numbers that you use can be anything you find the most appropriate. For example, you could use the entire organization's revenue, however using a number that is directly affected by the new system might be more valuable. Numbers such as a department's revenue or other more specific number that would be directly influenced by the new system, such as anticipated revenue gained by the competing systems might serve you better. One of the best features of the Total Cost Model is its ability to easily change these fundamental numbers.

Complete entries must be made on each system expense worksheet before you rely on any of the Cost Model's results. Regardless of complete entries on the Common Data worksheet, until expenses are entered for each system the Cost Analysis results will be misleading and inaccurate.

The data on this worksheet applies to the entire organization. These are the "constants" used in evaluating each system's own variables. It is best to use revenue cash flows that represent the difference between the "business as usual" figures and those achieved with the implementation of the proposed project (investment). Thus, the revenues would represent the benefits provided by the new system and the expenses would represent the costs directly assignable to it. However, if cash flows cannot be attributed directly to computer systems or other IT managed resources, use the company's total revenues. Though this may not be as accurate, it will provide a valid comparison. As with any projected cost model such as this, there will always be some disagreement in its execution.

To start entering data in this worksheet, first select a length of the analysis in years (the Period), then enter your company's cost of capital. From there the rest of the required numbers are basic accounting or money figures. Use the cell comments for advice as you navigate from cell to cell inputting data. Hovering your mouse pointer near one of the small red triangles will display the cell comments that explain the required input or calculations which have been produced. See below.

Future cash inflows can be estimated by entering a "Projected Yearly Growth Rate", or you can simply enter the annual figures yourself. Using the Growth Rate will provide a constant growth in