The Capital Cost Database
Quick Guide
(2023 June Update)

OVERVIEW

The Capital Cost Database (CCD) is intended to support the following primary uses:

Explore Database
- Document "as-built" costs for a sample of FTA-funded transit projects completed within the last 40 years

Cost Model
- Develop conceptual, "order-of-magnitude" cost estimates for a potential transit construction project

The Capital Cost Database is **NOT** intended for detailed cost estimation.

Standard Cost Category (SCC) Format
All historical costs reported in the database, as well as the cost model, document costs using a slightly modified version of FTA's Standard Cost Categories (SCC). Use of this format facilitates comparisons between the cost data in the database with the actual SCC worksheets submitted for projects approved into the Capital Investment Grant (CIG) program.

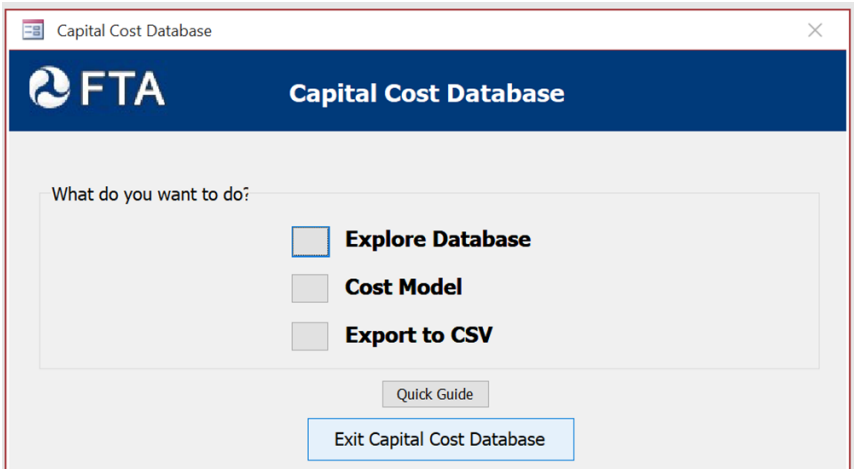
Approved As-built Costs
This database contains capital costs for a group of completed FTA-funded transit projects. The as-built cost information for each project was reviewed by the project Sponsor or obtained from Sponsor generated Before and After Study reports.

Mid-Point vs. Analysis Year
In this database, each project element is tied to a specific year identified as the year of the "Mid-Point of Construction." When the User inserts an "Analysis Year" into the cost model or into an input form to generate a report, those element level costs will be inflated or deflated from the Mid-Point to the User selected Analysis Year.

Main Menu

At the main menu (Figure 1), the User is presented with a few options, "Explore Database," "Cost Model," "Export to CSV," open the "Quick Guide" (this document), and "Exit Capital Cost Database." The "Explore Database" option allows the User to run various reports and learn more about the as-built costs for the transit projects documented in the database. The "Cost Model" option allows the User to create a cost basis and an Excel export of their custom cost model. The "Export to CSV" option compiles a summary listing of Total Cost at Mid-point of Construction, quantity and unit of measure for each project by SCC element in a .csv format. Click the square beside the option you want to select.

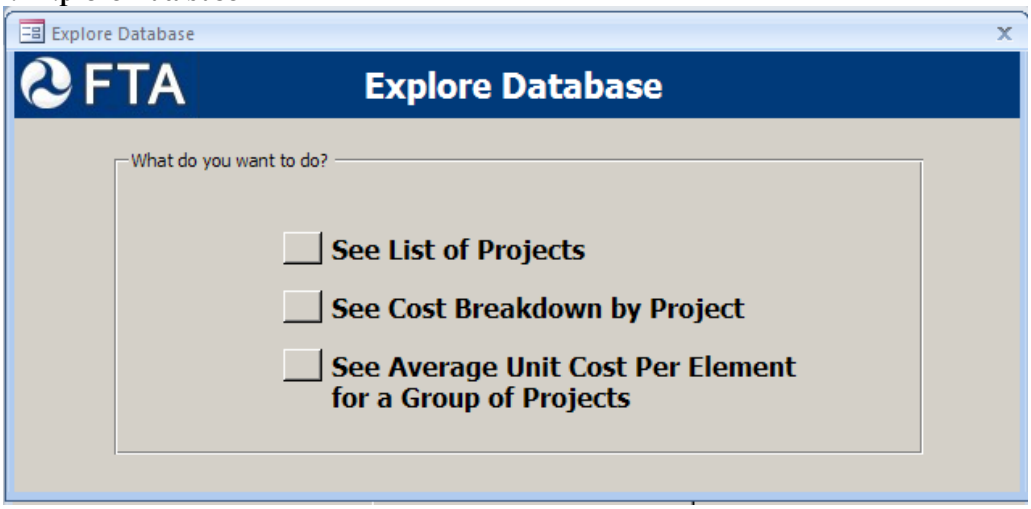
Figure 1: Main Menu



EXPLORE DATABASE

From the "Explore Database" menu (Figure 2) the User has the option to run three reports, each of which is intended to support analysis and understanding of the costs of a large sample of completed transit projects. Each of these reports allows the User to filter the projects by mode, grade (meaning the "predominate" grade for the guideway alignment) and year of revenue operations. Filtering and selecting the "check" boxes, the User can run each report using only those projects of interest; alternatively, the User can "select all." Some reports require the User to enter an "Analysis Year" such that costs can be inflated/deflated to a common dollar-year value.

Figure 2: Explore Database



The listing of Explore Database reports includes the following:

- See List of Projects – this report provides a listing of the selected projects including the project name, location, mode, miles of alignment by grade, mid-point of construction, total cost (in mid-point of construction $), and a description of the project. Project descriptions provide a brief discussion of the alignment location and key dates in the project CIG lifecycle. (Review of this descriptive data is helpful in the identification of peer projects for inclusion in a cost basis – see Cost Basis below).

- See Cost Breakdown by Project (requires input of an analysis year) – this report provides a breakdown of the costs of the selected project(s) at the SCC cost element top summary level and at the sub-category level. This includes:
  - SCC and element name
  - Unit of measure
  - Unit quantity
  - Mid-point of construction year
  - Total element cost at mid-point of construction
  - Unit cost at mid-point of construction
  - Unit cost converted to a US national average cost value (from the project city location to the average costs for the largest 30-year urban areas) and to the User selected analysis year dollars
  - Category level summary of project costs, unit costs and share of total project cost

- See Average Unit Cost Per Element for a Group of Projects (requires input of an analysis year) – this report lists the average of the unit costs by SCC element for a User selected group of projects. This report is intended to help address questions such as "what the average cost per mile for LRT projects completed within the past ten years?" or "what is a typical cost for trackwork per track foot?" Specifically, this report lists:

  Report Header
  - Listing of selected projects
  - Total project cost per mile for selected projects (average, minimum and maximum)
  - Range of alignment lengths for selected projects
  - User selected analysis year
  - User selected inflation index

  Main Body of Report:
  - SCC and element name
  - Units
  - Number of selected projects with cost data for each element
  - Average unit quantity for each element across the selected sample of projects (e.g., the average vehicle procurement size across the selected projects)
  - Average unit cost converted to a US national average cost value (from the project city location to the average costs for the largest 30-year urban areas) and to the User selected analysis year dollars

Export to Excel or .csv Format: Note that the raw data behind these reports can be exported for further analysis by clicking the "Export to Excel" button or the "Export to CSV."

COST MODEL

The cost model function is designed to:

- Develop conceptual, "order-of-magnitude" cost estimates for a potential transit project and not intended for detailed cost estimation

While cost model use is initiated from MS Access, the User should be aware that the actual cost model resides in an MS Excel workbook and is generated using the export function from the "Cost Model" menu.

Cost Model Menu

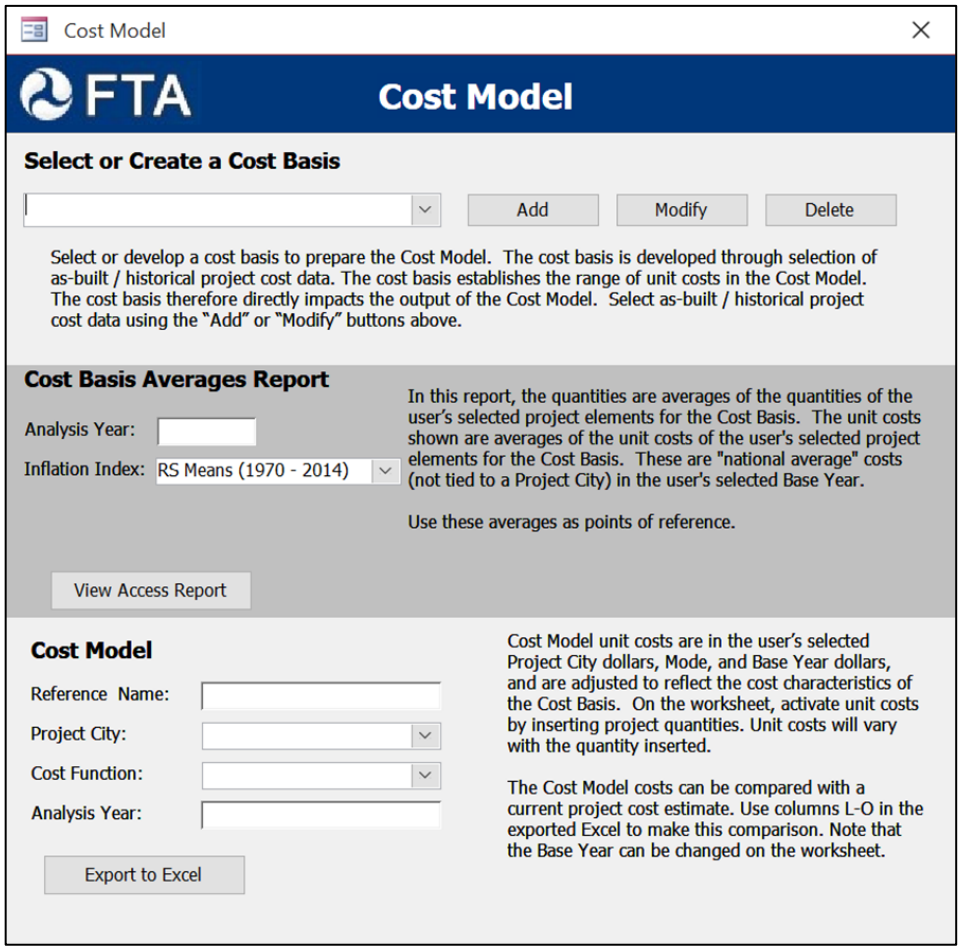
The "Cost Model" menu is accessed via the Main menu (Figure 1). From the

Cost Model menu the User has several options. The User can:

- Select and /or create a cost basis
- Generate a cost basis report
- Export a cost model to MS Excel

Important! The User must select or develop a cost basis before using the cost model function. The cost basis effectively establishes which unit cost data the cost model will draw on from the database in assessing the cost of proposed projects.

Figure 3: Cost Model Menu



Cost Basis: What is it? Why do I need it?

The cost model is designed to use "as-built" cost data from the cost database to develop rough, order-of-magnitude cost estimates for conceptual projects in early phases of design (note: the cost model is not designed or intended to produce detailed cost estimates). By developing a cost basis, the User can

determine which costs are obtained from the database (including some, excluding others) for use in modeling the costs of the proposed project. For example, the User can choose to select costs from a limited set of light rail projects documented in the database, projects which are believed to have characteristics (e.g., mix of grades, station design, etc.) that are similar to that of the project for which costs are being modeled.

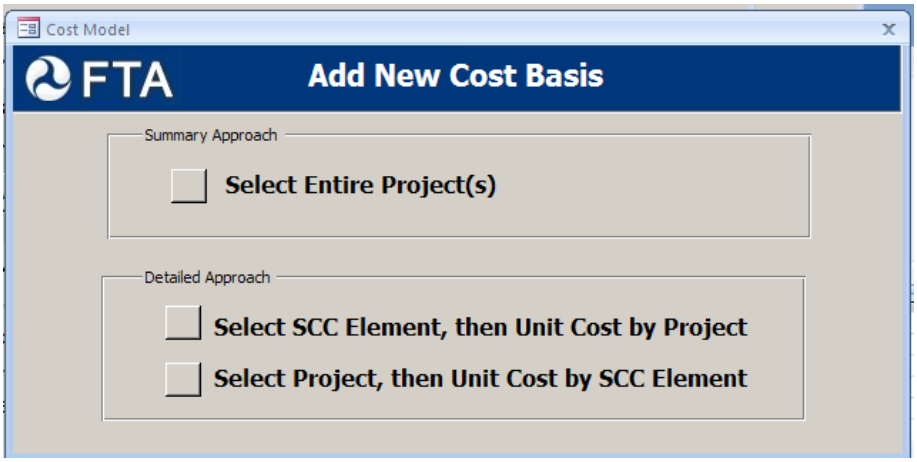
Important! It is up to the User to assess the appropriateness of project costs to include in their cost basis. Depending on the level of desired analysis accuracy, the User may wish to carefully review the characteristics of the projects in the database prior to developing a cost basis. *Cost basis selection can have a significant impact on the cost estimates produced by the cost model.*

How to Develop Cost Basis

The cost basis is developed through selection of as-built/historical project cost data. Select as-built/historical project cost data using the "Add" or "Modify" buttons as shown in Figure 3 above.

Clicking the "Add" button will open the Add New Cost Basis menu (Figure 4).

Figure 4: Add New Cost Basis Menu

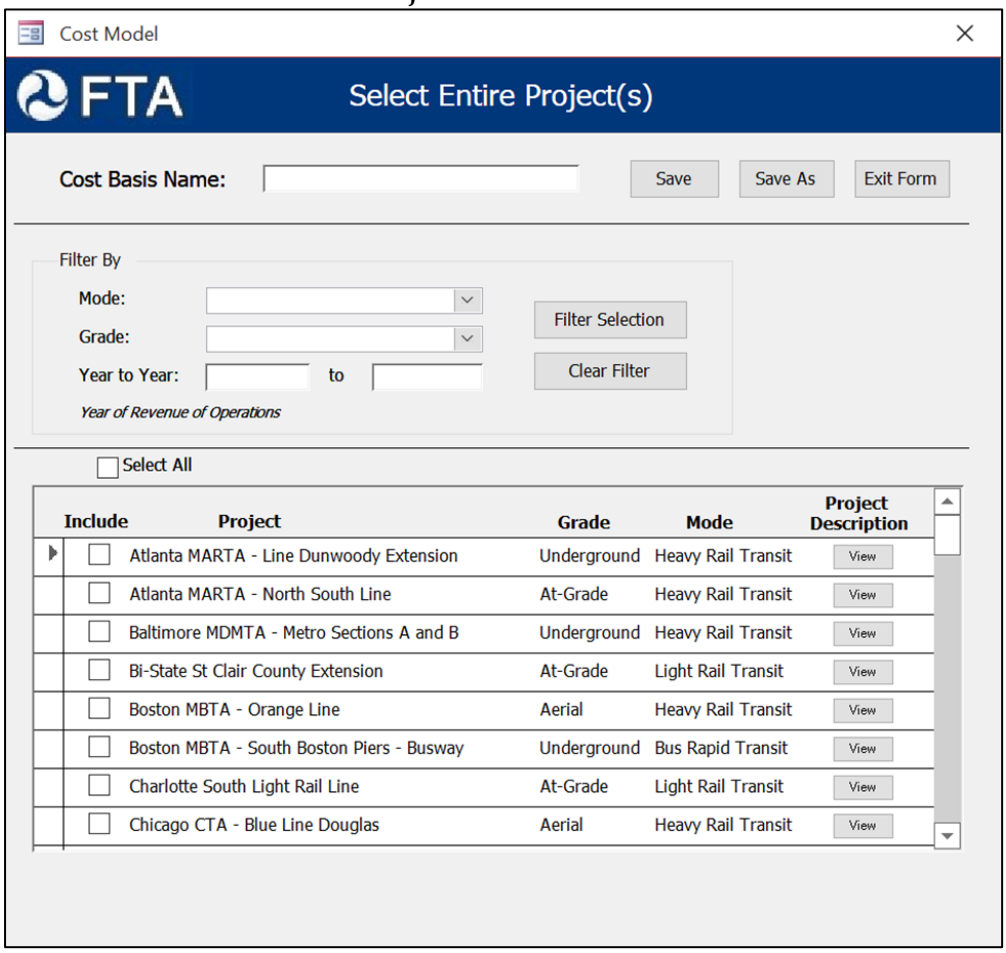


From this point, there are three types of cost basis that a User can create and use:

Summary Cost Basis Development

1. **Select Entire Project(s)** – Allows Users to filter and select all costs from the projects they would like to include in their cost basis (Figure 5). Note: a link to each project description is provided to allow the User the opportunity to better understand a project before selecting it as part of a cost basis.

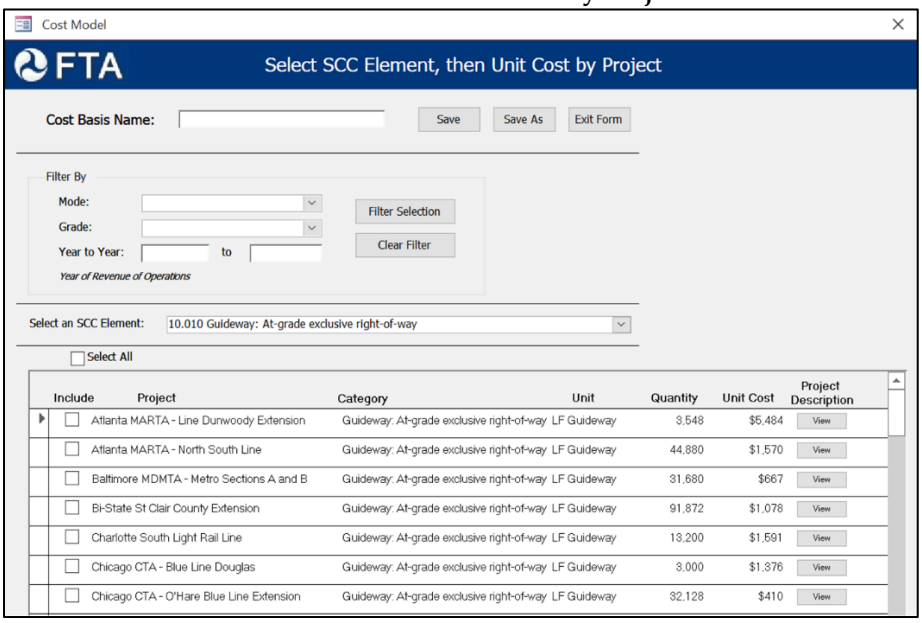
Figure 5: Cost Basis: Select Entire Projects Menu



Selected Cost Basis Development

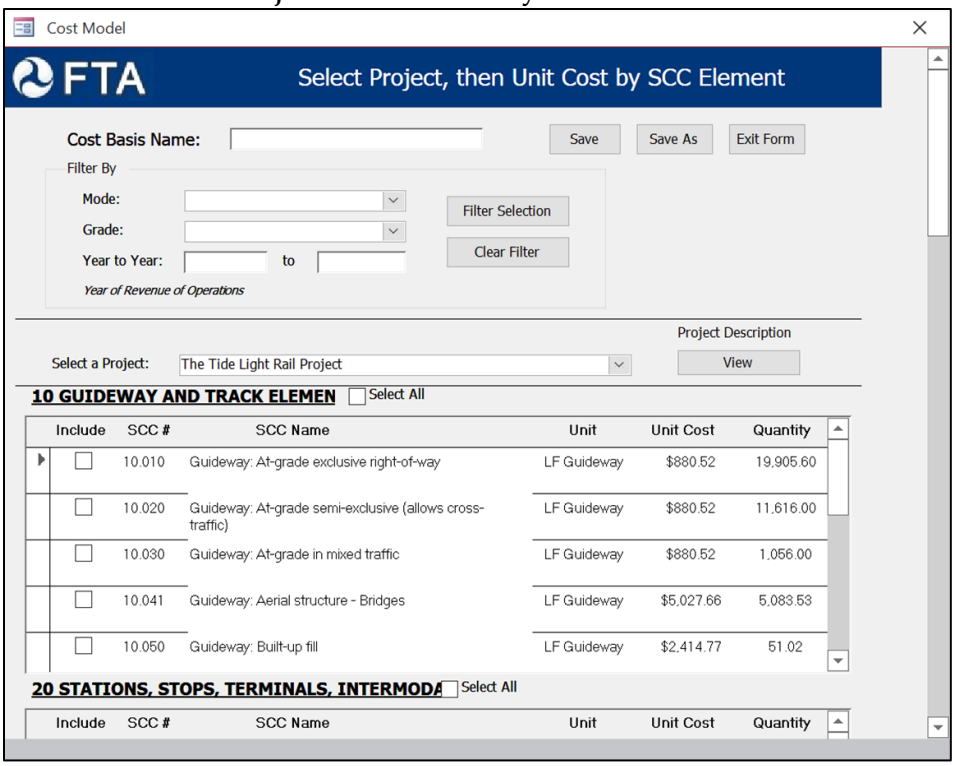
2. **Select SCC Element, then Unit Cost by Project –** Allows Users to develop a cost basis by selecting an individual SCC Element. The User can then review the costs for that element by project and select only those specific projects the User wants to include in the cost basis (Figure 6).

Figure 6: Cost Basis: Select SCC Element then Unit Cost by Project Menu



3. **Select Project, then Unit Cost by SCC Element** – Allows Users to select individual database projects and then choose specific SCC element costs from that project to include in the model. This process can be repeated for multiple database projects to develop a complete cost basis (Figure 7).

Figure 7: Cost Basis: Select Project then Unit Cost by SCC Element Menu



Saving, Selecting and Modifying a Cost Basis
From the Add New Cost Basis menu, select the preferred method of developing a cost basis and complete the selected cost basis development form as outlined above. When the form is fully populated, click the "Save" button to save your cost basis and then return to the Cost Model menu. The name of your newly developed cost basis should now appear in the "Select or Create a Cost Basis" drop-down box. The named cost basis is saved in the database and is available to the User whenever the Access application is opened.

To *modify* an existing cost basis, select the cost basis name from the "Select or Create a Cost Basis" drop-down box and then click the "Modify" button. This action will open the appropriate cost basis selection menu and the User can modify the cost basis as desired. Similarly, to *delete* an existing cost basis, select the cost basis name from the "Select or Create a Cost Basis" drop-down box and then click the "Delete" button. This action will remove the appropriate cost basis from the Cost Model and the database.

Important! Developing a cost basis using the summary approach 1 above ("Select Entire Projects") requires significantly less effort than other two methods. In contrast, methods 2 and 3 provide significantly more flexibility in designing a cost but also require the User to make more careful selections of unit costs (i.e., better understand the characteristics of projects in the database) and also to spend considerably more time in developing a cost basis. With careful selections of cost elements, a more accurate and beneficial cost model will result from methods 2 and 3.

Cost Basis Averages Report
After creating or selecting a cost basis, the User can generate the "Cost Basis Averages Report" by clicking the "View Access Report" button on the Cost Model menu. This report provides the SCC element level averages of the unit quantities and unit costs for the User selected cost basis. The unit costs are shown as "national average" costs (not tied to a Project City) and in the User selected Analysis Year.

The inflation and escalation adjustments are made based on the User selected inflation index. The default index is the RS Means Construction Cost Index. Other index options are the Engineering News Record (ENR) Construction Cost Index or the US Bureau of Economic Analysis (BEA) Producer Price Index for Transportation, State and Local Index (Line 38).

The intention of this report is to provide the User with an understanding of the characteristics of their selected cost basis.

Cost Model Export to Excel

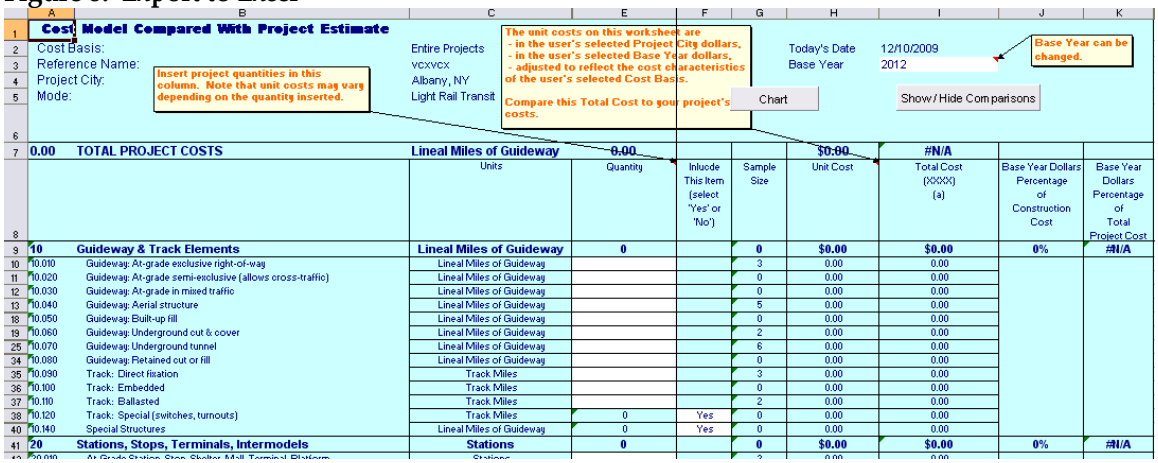
Having developed/selected a cost basis for the cost model to use, the User must next prepare the cost model for export to Excel. To prepare the cost model for export, the User must complete the bottom portion of the Cost Model menu. Specifically, the User must enter each of the following:

- Reference Name – for example, the name of the project you which to model or a specific scenario to model
- Project City – enter the location name for the project to be modeled. This selection ensures that all of the unit costs included in the cost basis (taken from projects built in a variety of US urban locations) are adjusted to account for differences in regional cost levels between the locations of the selected cost basis projects to the specific location of the project to be analyzed using the cost tool. This regional cost adjustment is calculated based on the User selected inflation index.
- Cost Function – enter the mode of the project to model. This choice will ensure that the costs for the project under analysis are most reflective of the specific mode for that project.
- Analysis Year – select an analysis year for the project (this can be changed later). This selection ensures that the unit costs included in the cost basis (taken from projects built at different points of time) are inflated to the analysis year selected by the User.

After clicking the "Export to Excel" button, the User will be prompted to save the exported cost model as an Excel file (Figure 8) to the computer.

Why Export to Excel? The cost database was developed in MS Access to be able to hold cost data for a large number of projects and to facilitate query analysis of that data. For ease of use, the cost model was developed in Excel to (1) allow the User to work and customize their analysis within the Excel environment, an application more Users are familiar with and (2) to facilitate sharing cost model work with other Users who may not be familiar with the CCD or who may not have MS Access.

Figure 8: Export to Excel



Cost Model Compared With Project Estimate

Cost Basis: Entire Projects
Reference Name: vcxvcx
Project City: Albany, NY
Mode: Light Rail Transit

Insert project quantities in this column. Note that unit costs may vary depending on the quantity inserted.

The unit costs on this worksheet are
- in the user's selected Project City dollars,
- in the user's selected Base Year dollars,
- adjusted to reflect the cost characteristics of the user's selected Cost Basis.

Compare this Total Cost to your project's costs.

Chart

Today's Date 12/10/2009
Base Year 2012

Base Year can be changed.

Show / Hide Comparisons

0.00	TOTAL PROJECT COSTS	Lineal Miles of Guideway	0.00			$0.00	#N/A		
		Units	Quantity	Inlucde This Item (select 'Yes' or 'No')	Sample Size	Unit Cost	Total Cost (XXXX) (a)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10	Guideway & Track Elements	Lineal Miles of Guideway	0		0	$0.00	$0.00	0%	#N/A
10.010	Guideway: At-grade exclusive right-of-way	Lineal Miles of Guideway			3	0.00	0.00		
10.020	Guideway: At-grade semi-exclusive (allows cross-traffic)	Lineal Miles of Guideway			0	0.00	0.00		
10.030	Guideway: At-grade in mixed traffic	Lineal Miles of Guideway			0	0.00	0.00		
10.040	Guideway: Aerial structure	Lineal Miles of Guideway			5	0.00	0.00		
10.050	Guideway: Built-up fill	Lineal Miles of Guideway			0	0.00	0.00		
10.060	Guideway: Underground cut & cover	Lineal Miles of Guideway			2	0.00	0.00		
10.070	Guideway: Underground tunnel	Lineal Miles of Guideway			6	0.00	0.00		
10.080	Guideway: Retained cut or fill	Lineal Miles of Guideway			0	0.00	0.00		
10.090	Track: Direct fixation	Track Miles			3	0.00	0.00		
10.100	Track: Embedded	Track Miles			0	0.00	0.00		
10.110	Track: Ballasted	Track Miles			2	0.00	0.00		
10.120	Track: Special (switches, turnouts)	Track Miles	0	Yes	0	0.00	0.00		
10.140	Special Structures	Lineal Miles of Guideway	0	Yes	0	0.00	0.00		
20	Stations, Stops, Terminals, Intermodels	Stations	0		0	$0.00	$0.00	0%	#N/A

Excel Cost Model Use – Getting Started

To get started, open the exported Excel file that was saved to the computer hard drive. This file contains a version of the cost model customized to the cost basis developed/selected. The name of the cost basis selected, as well as the file reference name, city location, mode, date the cost model was exported and the analysis year selected are all presented at the top of the excel worksheet (note that the city location and analysis year can still be changed – the cost basis cannot be changed without returning to Access selecting a new cost basis, and re-exporting to Excel).

Excel Cost Model Use – Cost Estimation

To develop a cost estimate for any project, the User populates the white (un-shaded) cells in columns E (Quantity) and F (Include This Item) of the exported Excel workbook. The estimated project costs – including element level and total costs – are reported in column I (Total Cost, $000).

Populate Unit Quantities: Enter a quantity in the column E white (un-shaded) cells for each SCC element of the proposed project. Note that these un-shaded cells only appear in cost categories:

- 10 Guideway & Track Elements, excludes 10.12, 10.13, and 10.14
- 20 Stations, Stops, Terminals, Intermodal
- 40 Sitework & Special Conditions – only for elements
  - 40.071 Surface Parking Lot
  - 40.072 Auto Access
- 70 Vehicles

The values used to populate these cells will automatically sum and appear in the top level SCC quantity cells (green shaded). The User can enter fractional values elements if needed. (**Caution**: The unit cost values of several SCC cost elements are modeled using non-linear cost functions that yield decreasing unit cost

estimates as larger quantities are entered – effectively capturing economies of scale in the acquisition of these cost elements. Because of their non-linear nature, Users should be cautions of the cost estimates for these cost elements when entering very small unit quantities.)

Populate "Yes/No" Fields: Column F includes a series of "Yes/No" values that allow the User to determine whether costs for these elements will be included in the overall project cost estimate. While the default value is set to "Yes" for each of these element types, at least some of these are unlikely to apply to the project under analysis; therefore, it is up to the User to determine which to include and which to "turn off."

Overwriting Formulas: None of the worksheet cells are locked or protected. Hence the User has the option of overwriting any unit quantities, unit costs or total costs as desired. This absence of cell protection is intentional to provide the User with as much flexibility as possible in conducting the cost analysis. Note, however, that the User may need to re-export the Excel file should they wish to reactivate any formula that has been overwritten.

Cost Categories 40 and 60: The cost estimates for Cost Categories 40 (Sitework and Special Conditions) and 60 (ROW, Land, Existing Improvements) should only be considered broadly representative of the "expected" costs for these elements based on the experience of the group of projects selected in the cost basis. A more accurate assessment of the costs for these elements requires a thorough understanding of the specific characteristics of a specific project alignment. The cost database does not include detailed data on the quantities of land purchased for ROW or the number and characteristics of the related "takes" to accurately assess these costs for any specific corridor. Rather, the estimates represent an average cost per length of guideway for these types of project expenses.

Excel Cost Model Use – Cost Reasonability Checks

To assess the reasonability of an existing cost estimate, first populate the project quantities as described above. Next, enter the costs estimated for the project under analysis (e.g., obtained from an SCC worksheet or other source) into the yellow-shaded column L (Total Cost, $000). An analysis comparing the proposed project cost estimates (e.g., from the SCC worksheets) with the model's cost estimate appear in columns M through O. These analytic results are also available in chart form by clicking the "Chart" button.

Interpretation of Analysis Results: The User should next review the analysis in columns M through O and in the associated charts. Specifically, the User should locate those cases where there is a significant difference between the two cost

estimates (especially those elements that provide a significant contribution to the total cost variance between the two cost estimates). Having identified elements with significant cost estimate differences, it is up to the User to determine the reason for the cost difference. A significant difference does not indicate that the cost estimate for that element is "wrong." Rather, it suggests that the User should better understand the reason for the cost difference and whether the proposed project cost estimate "makes sense" given the characteristics of the project. If the User ultimately determines that the selected cost basis was not representative of the cost characteristics of the project under analysis, the User may want to develop a revised cost basis and re-export the new cost basis to Excel.

TROUBLESHOOTING

Excel Export

If difficulties arise when exporting to Excel, please validate that the installation of MS Access does not have any missing references. To check this within MS Access 2007, find the "Visual Basic" icon and click on it. Now go to Tools → References, verify that there are no References with the word "Missing". If there is a missing reference, you should uncheck the missing reference and you should be able to scroll down the list and find a similar reference to check.

Problems Running the CCD in MS Access: "References"

The Capital Cost Database relies on Access Objects to provide a rich experience using forms and reports. If you are experiencing error messages when trying to access the features within the database, please make sure the correct Access "references" are selected so that Access functions and objects used by the CCD are properly recognized. Unfortunately, the default references listing can vary from one version of Access to the next (even within Access versions with the same edition year, hence not all versions of Access 2007 have the same references). The following provides the steps required to ensure that the CCD utilizes the correct references to run on your computer.

MS Access 2007: To check your current references selection within MS Access 2007, first select "Database Tools" from the ribbon, find the "Visual Basic" icon and click on it. Next, go to Tools > References, verify the appropriate references are checked.

Exhibit 11 Accessing the Visual Basic in MS Access 2007

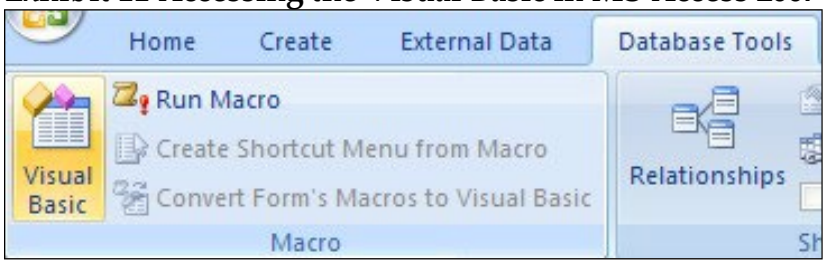
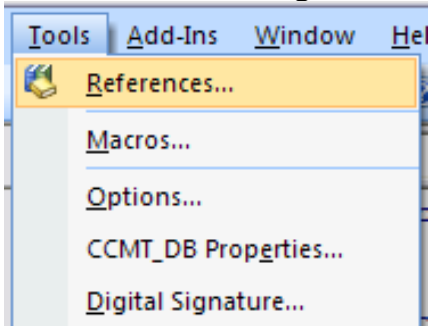
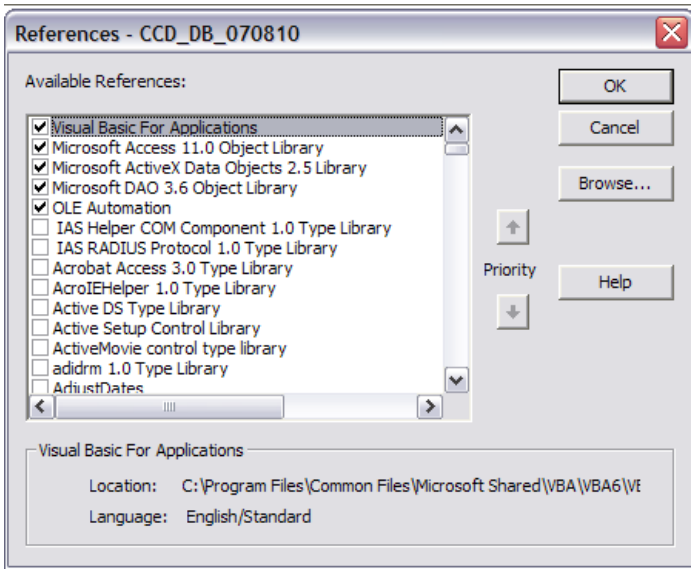


Exhibit 12: Accessing References from Visual Basic in MS Access 2007



To run the CCD in either MS Access 2003 or MS Access 2007, the following references should be checked:

Exhibit 13: Access References Window in MS Access 2003



Listing Of References that Should Be Selected to Run the CCD in MS Access

- Visual Basic for Applications (C:\Program Files\Common Files\Microsoft Shared\VBA\VBA6)
- Microsoft Access XX.0 Object Library (C:\Program Files\Microsoft Office\OFFICE11\msacc.olb or C:\Program Files\Microsoft Office\OFFICE12\msacc.olb)
- Microsoft ActiveX Data Objects X.X Library (C:\Program Files\Common Files\System\ado\msadoXX.tlb – XX will correspond the library version)
- Microsoft DAO X.X Object Library (C:\Program Files\Common Files\Microsoft Shared\DAO\dao360.dll)
- OLE Automation (C:\WINDOWS\system32\stdole2.tlb)

Library Numbers: Note that the library number for the Access Object Library will correspond to your version of Access. For Access 2003, the object library is 11.0. For Access 2007, the object library is 12.0.

ADVANCED USERS

All of the functionality of MS Access remains available to Users of the CCD tool. Therefore, Users with experience using MS Access are free to use the full functionality of Access to review the underlying data tables and write queries and reports as needed to perform customized analyses.