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Review of the operability of the Telstra Efficient Access cost model

A Report to the ACCC

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Final Report – Public Version

The TEA Model used in this review is version 1.0, delivered to the ACCC on 3 March 2008; together with a replacement Engineering Main Cable module provided by Telstra to the ACCC on 15 July 2008.

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1. Executive Summary

This report reviews the Telstra Efficient Access (TEA) model, version 1.0, as presented to the ACCC on 3 March 2008; together with a replacement Engineering Main Cable module provided by Telstra to the ACCC on 15 July 2008.

This report examines the operability issues of the Telstra Efficient Access (TEA) model. The model consists of several parts:

- An executable file that manages the user interface and the process flow;
- An Access database that contains the basic data on the Telstra access network;
- An Access database that contains engineering data generated by the model under each scenario;
- Three Excel workbooks that are used for calculating the results of the model and present results to the user;
- Several XML files and a Help file in HTML format.

Ovum has examined the actions of the executable file and the calculations in the Excel workbooks (which are the calculations of the model's modules); and the contents of the Access database. Ovum has examined the documentation for consistency with the model implementation.

In general, the model works as described in the documentation. The skilled user should be able to use the model with ease. An experienced Excel user will be able to navigate his/her way through the output spreadsheets.

The user interface performs some input checks on user-defined data but does not implement range checks (except for checking for non-negative entries, where applicable). This can lead to inappropriate results if the user is not careful.

There is one major computation error in the Main Cable calculation module. This affects all the results concerning the quantities of items calculated for each exchange and overestimates the costs of providing service. The details are described in the accompanying engineering review.

The Access database also contains multiple cable entries in some cases, indicating that shortest-path routing is not used everywhere in the model. The model calculations themselves do no optimisation of cable routes. This issue is also described in more detail in the accompanying engineering review.

There is no documentation for the Access database. As this is a major component of the model, its contents should be described for the user.

There are a number of minor inconsistencies between the model documentation and the model implementation. None of these affects the operability of the model. Both the documentation and the implementation contain typographical errors and other minor issues that should be corrected.

2. Introduction

This report reviews the Telstra Efficient Access (TEA) model, version 1.0, as presented to the ACCC on 3 March 2008; together with a replacement Engineering Main Cable module provided by Telstra to the ACCC on 15 July 2008.

The TEA model as a whole consists of several parts:

- An executable file that manages the user interface and controls the flow of calculations and results; together with a collection of dynamic-linked library files with executable code; and some image files;
- An Access database that contains the input data on Exchange Serving Areas (ESAs) and their component Distribution Areas (DAs);
- An Access database that contains the output data on ESAs generated by the Main and Distribution engineering modules for the relevant scenario;
- Three Excel workbooks that contain the calculations and macros that are used to perform the calculations for each of the engineering and costing modules;
- XML files that store the data input by the user for various scenarios under study;
- A help file in HTML format.

In this report, we consider the operability questions associated with the model by considering each of its user-level features in turn.

In addition, we examine and comment on the documentation that accompanies the model.

We have run the model end-to-end and adjusted input values to see whether the model's reaction to changes in inputs is consistent with expectations following engineering and economic principles. Furthermore, we have run the model under different scenarios and undertaken sensitivity analyses, which we will provide to the ACCC in electronic form separately from this report.

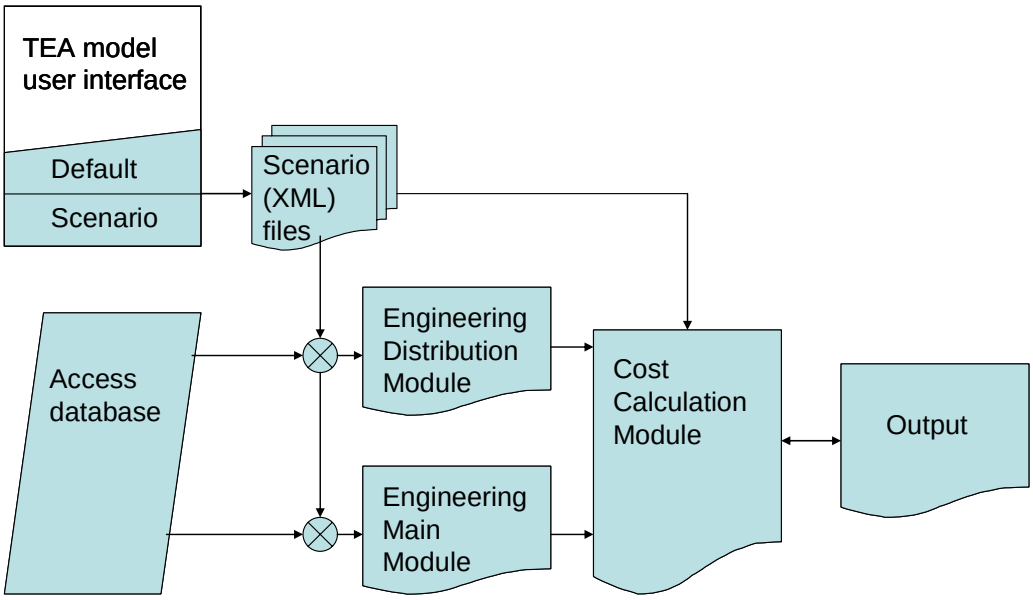
In the following sections we will provide an overview and our assessment of the degree of transparency, flexibility, user-friendliness, general robustness and accompanying documentation of the TEA model including the user manual. In particular, our assessment will be focusing on the user interface, the two engineering input modules for the main and distribution parts of the network, and engineering output modules setting out the costs of network provision.

3 Model Flow

3.1 Overall Flow

The overall process flow of the TEA model is described in Figure 3.1.

Figure 3.1: TEA Model Flow



Source: Ovum

The user has the opportunity to run the Engineering modules before the Cost Calculation module is run. The Engineering modules are only necessary if some engineering data has been changed from the default case.

The TEA model suffers from various programming flow errors. We note, for example, that when activating the model to generate the relevant engineering data, the model hangs and needs a restart if it cannot locate the TEA database access file in the relevant folder. After the relevant error message occurs, the model does not respond to any command.

In addition, there is no program exit from the model: the user must close the model's window to exit the application.

We have noted several typographical errors in the model as well as in the stand-alone modules.

3.2 User friendliness (general assessment)

The TEA model is relatively easy to understand and to navigate, as the graphical user interface is relatively self-explanatory. It uses standard symbols, check and list boxes. The colour

coding of input cells in the model makes it easy to identify which cells are input cells and can be changed by the user. The colour coding, however, is not consistent throughout the model. Input cells in the ESA grouping sheet, for example, determining the percentages of rock in each ESA, are not marked as editable inputs.

Features such as the scenario list box on the upper left hand side in the engineering and costing input sheets are relatively clearly arranged and make it comfortable for the user to create a scenario with changed input values. Another positive feature of the model is the ability to create separate scenarios for the selected number of ESAs, engineering and costing rules.

Comments, notifications and error messages in the form of pop-up windows support a relatively easy handling of the TEA model. The warning message regarding the need for the engineering modules covers the buttons and controls for the engineering data windows and may confuse the first-time user.

The Help screen, accessed from the **?** button, is very brief. It is inadequate for the general user but is superior to the help often provided in regulatory economic models.

4. User Interface

The TEA model leverages the Microsoft .NET Framework and comes with a graphical user interface (GUI). It allows the user of the model to create different scenarios and to modify preset "default" engineering and costing rules as well as input ratios for costing purposes.

There are 6 different input screens in the model. In this chapter, we describe each of these screens and comment on the data inputs shown on them. The initial section includes some comments on the user interface in general.

4.1 Robustness of the model to error values and conditions

The actual graphical user interface featured by the .NET framework application is sensitive to any direct input of negative numbers. Any attempt to enter a number less than zero into a relevant input cell will result in a prompt pop-up window reminding the user to enter values only greater than zero.

However, some of the cells in the costing input sheet are linked to other input cells. The figure below shows an example in the input ratios sheet of the costing tab in the user interface. An entry in the relevant input cells may result in a negative percentage in the cell with the formula linked to other input cells in the same table column.

Figure 4.1: Example of input ratios in the user interface of the TEA model with a negative percentage

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The input sheets in the model generally accept a direct input of greater than 100 per cent in relevant input cells which again, if not noticed by the user, will result in a misleading outcome of the model.

However, any of the issues identified above will not be misleading for an intelligent user, who is familiar with the data. We therefore conclude that the user interface provides an appropriate level of error checks and entries by an intelligent user.

4.2 Screen: Grouping

This is the initial input screen seen by the user at the start-up of the model. It is the only input screen on the Grouping tab.

Table 4.1: List of tables in the ESA grouping input sheet of the model

Input table	Comment
Grouping - Main	Colour coding for input cells is missing.

4.3 Screen: Engineering–Main

This screen is accessed from the Engineering tab and Main control button.

Table 4.2: List of tables in the Engineering Main input sheet of the model

Input table	Comment
Fill Factors at Optimal Engineering Design	No comment.
Normal Gauge .40 mm Conductor-Main	
Cable Cost Heavy Gauge .64 mm Conductor-Main	
Fibre Cables-Main	
Pits, Manholes and Pillars-Design Criteria	

4.4 Screen: Engineering–Distribution

This screen is accessed from the Engineering tab and Distribution control button.

Table 4.3: List of tables in the Engineering Distribution input sheet of the model

Input table	Comment
Fill Factors at Optimal Engineering Design	No comment.
Density Range Characteristics-Ranges Customers / sq. km	
Normal Gauge .40 mm Conductor-Non Tapered Distribution	
Normal Gauge .40 mm Conductor-Tapered Distribution and Building Terminal Connections	Typo in table heading (Buiding).
Pits-Design Characteristics	No comment.
Calculation of the Average Number of 2-Pair Lead-ins Served from a Pit	Typo in the heading of the second column (Occurance).

4.5 Screen: Costing–Main

This screen is accessed from the Costing tab and Main control button.

Table 4.4: List of tables in the Costing Main input sheet of the model

Input table	Comment
General Plant Design Criteria	No comment.
Cable Cost Normal Gauge .40 mm Conductor-Main	
Cable Cost Heavy Gauge .64 mm Conductor-Main	
Fibre Cables-Main	
Fibre Optic Joint Enclosure-Main	
Cable Cost Normal Gauge .40 mm Conductor-Distribution and Building Terminal Connections	
Cost per Wire Connection at Serving Pit-Distribution	
Manhole Cost-Main	
Pit Costs-Main and Distribution	
Pillar Costs	No comment.
Breakout and Reinstatement Costs by Activity	

Input table	Comment
Average Width Breakout and Reinstatement for Trenching Roads, Footpaths, Sidewalks and Drives (cm)-Main & Distribution	
Cost Per Metre for Placing Conduit Runs Including the Cost for Boring and Trenching Lines-Distribution and Main	
Multiplexing Systems-Costs and Design Criteria	
Entrance Facility-Costs and Design Criteria	
Cable Pressurisation System-Dry Air Compressor	
Termination of Optical Fibre at Exchange	
Building Terminal Strip Cost-Installed (Includes Joint)-Terminal Provided By Owner	
Cost of Placing Lead-in	
Cost of Cable	

4.6 Screen: Costing–Input Ratios

This screen is accessed from the Costing tab and Input Ratios control button.

Table 4.5: List of tables in the Costing Input Ratios input sheet of the model

Input table	Comment
Ratios for Developing Composite Breakout and Reinstatement Costs for Concrete and Asphalt-Pits & Manholes	CBD specific data is not used in the Band 2 model version.
Ratios for Developing Composite Breakout and Reinstatement Costs for Pits and Manholes-Main	
Ratios for Developing Composite Breakout and Reinstatement Costs for Pits by Density Zone-Distribution	CBD specific data is not used in the Band 2 model version. The phrase 'Density Zone' is not consistent with 'Density Range' used in the actual input table headings.
Ratios for Developing Composite Breakout and Reinstatement Costs for Concrete and Asphalt-Conduit Configurations	CBD specific data is not used in the Band 2 model version.
Ratios of the Amount of Each Type of Conduit Placement Activity for Areas Outside the CBD-MAIN (Exception for small conduit runs in rocky terrain below)	No comment.
Exception for the Alternate Amount of Each Type of Conduit Placement Activity for Rocky Areas Outside the CBD-MAIN (Small conduit runs only)	
Ratios of the Amount of Each Type of Placement Activity Used in the Model Within the CBD-MAIN	CBD specific data is not used in the Band 2 model version.
Ratios of Composite Breakout and Reinstatement Costs for Conduit Runs-MAIN - MAX NUMBER OF CONDUITS	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 1x50 Conduit Configurations Outside the CBD-DISTRIBUTION	Wrong description of the 'Rocky Terrain' column table headings.

Input table	Comment
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 1x100 Conduit Configurations Outside the CBD-DISTRIBUTION	No comment.
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 2x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 4x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 6x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 8x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 12x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios for Determining the Amount of Each Type of Placement Activity Used in the Model Within the CBD-DISTRIBUTION	CBD specific data is not used in the Band 2 model version.
Ratios for Developing Composite Breakout and Reinstatement Costs for Conduit Runs-DISTRIBUTION	

4.7 Screen: Costing–Capital Costs

This screen is accessed from the Costing tab and Capital Costs control button.

Table 4.6: List of tables in the Costing Capital Costs input sheet of the model

Input table	Comment
Cost of Capital Inputs	No comment.
Customer Access Network	
Indirect Assets	
Interexchange	
Switching	
Conduit Sharing Leasing	
Customer Access Network	
Switching Equipment	
Inter-Exchange Investment	
Other Systems and Equipment	
Indirect Expense Factors	
Indirect Asset Factors	
Network Support Asset Factors	

We have in addition noticed several typographical errors in sentences presented to the user in pop-up window messages. The notification “There are Edits Pending, Do you want to Save changes?” uses a comma rather than a full stop. Some words used in various pop-up

windows, as shown in the example above (Edits, Pending, Save), begin with a capital letter, which is unusual and perhaps misleading.

5. Engineering Main Module

Engineering Main Module Version 1.0

Quantities for the network equipment required in the feeder and distribution network can be retrieved and reviewed for a single exchange by running the macros in each of the two stand-alone engineering modules. However, no mechanism is implemented in the Excel spreadsheets for the engineering distribution and main modules notifying the user in the event of an unreasonable edit of an input.

There are 4 worksheets in the Main Cable module calculations. The following sections review each sheet and comment as appropriate. The description order is the logical flow of the module, starting with the right-most sheet in the module's Excel workbook.

5.1 Sheet: Main-Inputs

Table 5.1: List of tables in the Main-Inputs sheet of the Main Cable Module

Table	Comment
Study Parameters	No comment.
Fill Factors at Optimal Engineering Design	
Normal Gauge .40 mm Conductor-Main	
Cable Cost Heavy Gauge .64 mm Conductor-Main	
Fibre Cables-Main	
Pits, Manholes and Pillars-Design Criteria	
Main Conduit Configurations	
Multiplexing Systems-Design Criteria	
Building Terminal Sizes	
Demand at Fibre Fed Terminals	
Current ESA	
Engineering Scenario	
Current Band	
Input Database	
Scenario Database	

5.2 Sheet: Main-Detail

Table 5.2: List of tables in the Main-Detail sheet of the Main Cable Module

Table	Comment
Base Data	No comment.
Cable Sizing Calculations (Used in Main Collapsed)	Typo in cell R2 (Guage)
Building Terminals Served by Main	No comment.
CMUX System Calculations	

5.3 Sheet: Main-Collapsed

Note that the initial engineering review detected a calculation error in this sheet that was subsequently corrected by Telstra.

Table 5.3: List of tables in the Main-Collapsed sheet of the Main Cable Module

Table	Comment
Base Data	No comment.
Calculation of the Length and Size of Main Cable Runs	
Conduit Quantities	
Calculation of the Quantities and Sizes of Main Cable Pits and Manholes	
Calculation of the Initial and Distance Joint Quantities-Main Cable	

5.3 Sheet: Main-Summary

Table 5.4: List of tables in the Main-Summary sheet of the Main Cable Module

Output table	Comment
Length of Main Conduit Configurations-Metres	No comment.
Number of Main Pits and Manholes	
Number of Joints .40 Gauge Copper Main Cable	
Number of Joints .64 Gauge Main Cable	
Number of Joints Fibre Main Cable	
Count of Fibre MUX Equipment	
Number of Pairs Terminating at ESA	
Count of Building Terminals Served by Main Cables	

6. Engineering Distribution Module

Engineering Distribution Module Version 1.0

As shown in the figure below, in the stand alone Engineering Distribution Module, we have noticed a circular reference error occurring when running the macro in order to import data from the TEA model database. This circular reference error is caused by the formula used in column M in the Distribution-Detail sheet. The module will, however, continue processing once the data is imported into Columns A to K. The circular reference error message is a side-effect of the operation of the formulae; Excel successfully calculates the required quantities.

Figure 6.1: Circular reference error during the process of importing data in the Engineering Distribution module

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Source: Ovum

We also found that, in a few cases, when we were running the macro in order to import relevant information from the TEA model database, the module stops processing and will not respond.

Using the same scheme as the Main Cable module, the Distribution module has 4 worksheets. We describe each of them in the order of logical flow of the module, from right to left.

6.1 Sheet: Distribution-Inputs

Table 6.2: List of tables in the Distribution-Inputs sheet of the Distribution Module

Table	Comment
General Plant Design Criteria-Distribution Network	No comment.
Fill Factors at Optimal Engineering Design	
Density Range Characteristics-Ranges Customers / sq. km	
Normal Gauge .40 mm Conductor-Non Tapered Distribution	
Normal Gauge .40 mm Conductor-Tapered Distribution	
Joint Enclosures-Number 5 Pits	
Pits-Design Characteristics	
Calculation of the Average Number of 2-Pair Lead-ins Served from a Pit	
Pillar-Design Characteristics	
Distribution Conduit Configurations	
Building Terminal Strips Sizes-Terminal Provided By Owner	
Small Lead-in Cable Sizes	
Average Lead-In Length (calculated)	
Current ESA	
Engineering Scenario	

Table	Comment
Current Band	
Input Database	
Scenario Database	
Study Selection - Network Design (from Eng-Main-Engine.xls)	

6.2 Sheet: Distribution-Detail

Table 6.3: List of tables in the Distribution-Detail sheet of the Distribution Module

Table	Comment
Base Data	No comment.
Distribution Cable Length Calculation	
Calculation of the Quantity and Cable Lengths for Building Terminal and 2 Pair Lead-ins	
No. 5 Pit	
Data Used in Distribution Collapsed	

6.3 Sheet: Distribution-Collapsed

Table 6.4: List of tables in the Distribution-Collapsed sheet of the Distribution Module

Table	Comment
Calculation of the Quantity and Sizes of Distribution Pits	No comment.
Calculation of the Quantity and Sizes of Pillars	
Terminal Strips-Pillar	
Conduit	
Density Range	
Length of Conduit Configurations (Metres)	No comment.

6.4 Sheet: Distribution-Summary

Table 6.5: List of tables in the Distribution-Summary sheet of the Distribution Module

Output Table	Comment
Cable Length (metres)	No comment.
Number of Cable Joints (Number Cables)	
Number of Pillars	
Pillar Terminal Strips	
Conduit	
Length of Distribution Conduit Runs in Density Range 1-Metres	
Length of Distribution Conduit Runs in Density Range 2-Metres	
Length of Distribution Conduit Runs in Density Range 3-Metres	
Length of Distribution Conduit Runs in Density Range 4-Metres	
Length of Distribution Conduit Runs in Density Range 5-Metres	
Length of Distribution Conduit Runs in Density Range 6-Metres	

Output Table	Comment
Number of Pits in Density Range 1	
Number of Pits in Density Range 2	
Number of Pits in Density Range 3	
Number of Pits in Density Range 4	
Number of Pits in Density Range 5	
Number of Pits in Density Range 6	
Building Terminal Lead-ins	
2 Pair Lead-ins	

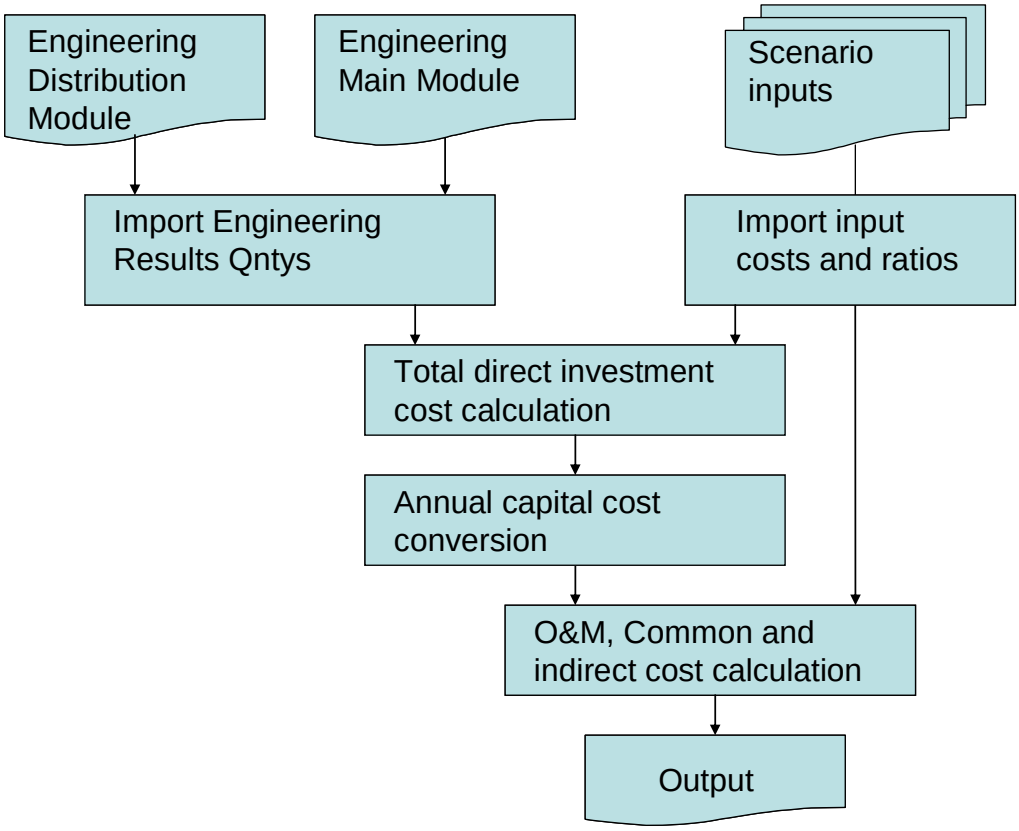
7. Costing Module

Cost Calculation Module Version 1.0

The Cost Calculation Module brings together the quantities calculated in both the Engineering Main and Distribution Modules (the costing inputs) and calculates the total annual costs of the efficient access network and the ULLS. It also provides the template for the output file created by the user when generating relevant outputs.

The following figure shows the high-level process flow in the Costing Module.

Figure 7.1: TEA Model: Costing Module Flow



Source: Ovum

There are twelve worksheets in the Cost Calculation Module. The sections below review the worksheets in the logical flow order, from left to right.

7.1 Sheet: Inputs Cost and Rules

Table 7.1: List of tables in the Inputs Cost and Rules sheet of the Cost Calculation Module

Table	Comment
General Plant Design Criteria	No comment.
Cable Cost Normal Gauge .40 mm Conductor-Main	
Cable Cost Heavy Gauge .64 mm Conductor-Main	
Fibre Cables-Main	
Fibre Optic Joint Enclosure-Main	
Cable Cost Normal Gauge .40 mm Conductor-Distribution and Building Terminal Connections	
Cost per Wire Connection at Serving Pit-Distribution	
Manhole Cost-Main	
Pit Costs-Main and Distribution	
Pillar Costs	
Breakout and Reinstatement Costs by Activity	
Average Width Breakout and Reinstatement for Trenching Roads, Footpaths, Sidewalks and Drives (cm)-Main & Distribution	
Cost Per Metre for Placing Conduit Runs Including the Cost for Boring and Trenching Lines-Distribution and Main	
Multiplexing Systems-Costs and Design Criteria	
Entrance Facility-Costs and Design Criteria	
Cable Pressurisation System-Dry Air Compressor	
Termination of Optical Fibre at Exchange	
Building Terminal Strip Cost-Installed (Includes Joint)-Terminal Provided By Owner	
Cost of Placing Lead-in	
Cost of Cable	

7.2 Sheet: Inputs Ratios

Table 7.2: List of tables in the Inputs Ratios sheet of the Cost Calculation Module

Table	Comment
Ratios for Developing Composite Breakout and Reinstatement Costs for Concrete and Asphalt-Pits & Manholes	CBD specific data is not used in the Band 2 model version.
Ratios for Developing Composite Breakout and Reinstatement Costs for Pits and Manholes-Main	
Ratios for Developing Composite Breakout and Reinstatement Costs for Pits by Density Zone-Distribution	CBD specific data is not used in the Band 2 model version. The phrase ‘Density Zone’ is not consistent with ‘Density Range’ used in the actual input table headings.
Ratios for Developing Composite Breakout and Reinstatement Costs for Concrete and	CBD specific data is not used in the Band 2 model version.

Table	Comment
Asphalt-Conduit Configurations	
Ratios of the Amount of Each Type of Conduit Placement Activity for Areas Outside the CBD-MAIN (Exception for small conduit runs in rocky terrain below)	No comment.
Exception for the Alternate Amount of Each Type of Conduit Placement Activity for Rocky Areas Outside the CBD-MAIN (Small conduit runs only)	
Ratios of the Amount of Each Type of Placement Activity Used in the Model Within the CBD-MAIN	CBD specific data is not used in the Band 2 model version.
Ratios of Composite Breakout and Reinstatement Costs for Conduit Runs-MAIN	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 1x50 Conduit Configurations Outside the CBD-DISTRIBUTION	No comment.
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 1x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 2x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 4x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 6x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 8x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for 12x100 Conduit Configurations Outside the CBD-DISTRIBUTION	
Ratios for Determining the Amount of Each Type of Placement Activity Used in the Model Within the CBD-DISTRIBUTION	CBD specific data is not used in the Band 2 model version.
Ratios for Developing Composite Breakout and Reinstatement Costs for Conduit Runs-DISTRIBUTION	

7.3 Sheet: Inputs Capital Cost

Table 7.3: List of tables in the Inputs Capital Cost sheet of the Cost Calculation Module

Table	Comment
Cost of Capital Inputs	No comment.
Customer Access Network	

Table	Comment
Indirect Assets	No comment.
Interexchange	
Switching	
Cost of Capital Calculation	
Conduit Sharing/Leasing	
Customer Access Network	
Switching Equipment	
Inter-Exchange Investment	
Other Systems and Equipment	
Indirect Expense Factors	
Indirect Asset Factors	
Network Support Asset Factors	

7.4 Sheet: Cost Calculator-Main

Table 7.4: List of tables in the Cost Calculator-Main sheet of the Cost Calculation Module

Table	Comment
Cable Cost Normal Gauge .40 mm Conductor-Main - Fully Loaded Cable Cost	No comment.
Cost Per Joint	
Branch Connection Enclosure Kit	
Cable Cost Heavy Gauge .64 mm Conductor-Main Fully Loaded Cable Cost	
Cost Per Joint	
Branch Connection Enclosure Kit	
Fibre Cables - Fully Loaded Cable Cost	
Cost Per Joint	
Development of Total Loaded Manhole Costs-Main	CBD specific data is not used in the Band 2 model version.
Composite Concrete and Asphalt Breakout and Reinstatement Cost for Manholes and Pits-Main Cables	
Development of Average Breakout Cost Per Metre by Manhole Size-Non CBD Exchanges	No comment.
Development of Average Breakout Cost per Metre-CBD Exchanges	CBD specific data is not used in the Band 2 model version.
Development of Average Reinstatement Cost Per Metre by Manhole Size-Non CBD Exchanges	No comment.
Development of Average Reinstatement Cost per Metre-CBD Exchanges	CBD specific data is not used in the Band 2 model version.
Calculation of the Average Breakout Cost by Manhole Size	
Calculation of the Average Reinstatement Cost by Manhole Size	
Development of the Loaded Cost per Metre of Placing Conduit-Main	
Composite Concrete and Asphalt Breakout and Reinstatement Cost for Conduits-Main Cables	
Development of the Unloaded Cost per Metre of Placing 1x100 mm Conduit-Main	

Table	Comment
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 1x100 mm Conduit-Main	
Development of the Unloaded Cost per Metre of Placing 2x100 mm Conduit-Main	CBD specific data is not used in the Band 2 model version.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 2x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 4x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 4x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 6x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 6x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 8x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 8x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 12x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 12x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 16x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 16x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 20x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 20x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Placing 24x100 mm Conduit-MAIN	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 24x100 mm Conduit-MAIN	
CMUX Remote Unit Costs Including Cards	Two Excel reference errors for the inputs of the capacity lines in the table.
CMUX Exchange Unit Costs	No comment.
Supply/Install Siemens MDF Block to existing racking (MDF)	
Main Frame	
Cable Racking-Installed Cost	
Cost of Installing a Cable Vault	
Cost Per Joint	
Cable Pressurization System-Dry Air Compressor	
Termination of Optical Fibre at Exchange	

7.5 Sheet: Cost Calculator Distribution

Table 7.5: List of tables in the Cost Calculator Distribution sheet of the Cost Calculation Module

Table	Comment
Cable Cost Normal Gauge .40 mm Conductor-Main - Development of the Fully Loaded Cable Cost Per Metre for Copper Cable-Distribution	No comment.
Development of the Fully Loaded Cost Per Wire Joint Including Enclosure-Distribution Including Serving Pit	
Cost per Wire Connection at Serving Pit	
Development of Total Loaded Pit Cost Normal Placement-Distribution	
Development of Total Loaded Pit Cost Rocky Placement-Distribution	
Composite Concrete and Asphalt Breakout and Reinstatement Cost for Pits-Distribution	CBD specific data is not used in the Band 2 model version.
Development of Average Breakout Cost Per Metre by Density Group and CBD	The description of Density Group is not consistent with the use of Density Range elsewhere in the model. CBD specific data is not used in the Band 2 model version.
Development of Average Reinstatement Cost Per Metre by Density Group and CBD	
Development of the Breakout and Reinstatement Area (Square Metres) by Distribution Pit	No comment.
Calculation of the Average Breakout and Reinstatement Cost by Pit Size by Density Group	
Development of the Fully Loaded Terminal Costs	
Development of the Fully Loaded Cost of a Terminal Strip	
Calculation of the Pit Road Extension Costs	
Development of the Loaded Cost per Metre of Placing Conduit in a CBD Environment-Distribution	CBD specific data is not used in the Band 2 model version.
Development of the Loaded Cost per Metre of Placing Conduit in a Non CBD Environment-Distribution	No comment.
Development of the Loaded Cost per Metre of Placing Cable in New Estates	
Composite Concrete and Asphalt Breakout and Reinstatement Cost for Conduits-Distribution Cables	
Development of the Unloaded Cost per Metre of Placing Conduit in a CBD Environment in Non-Rocky Soil-DISTRIBUTION	Description of Soil used interchangeably with Terrain. CBD specific data is not used in the Band 2 model version.
Development of the Unloaded Cost per Metre of Placing Conduit in a CBD Environment in Rocky Soil-DISTRIBUTION	Description of Soil used interchangeably with Terrain. Wrong table sub-heading referring to Normal instead of Rocky terrain. CBD specific data is not used in the Band 2 model version.
Development of the Unloaded Cost per Metre	CBD specific data is not used in the Band 2

Table	Comment
of Breakout and Reinstatement for Conduit in a CBD Environment-DISTRIBUTION	model version.
Development of the Unloaded Cost per Metre of Placing 1x50 mm Conduit in a Non CBD Environment in Normal Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 1x50 mm Conduit in a Non CBD Environment in Normal Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre of Placing 1x50 mm Conduit in a Non CBD Environment in Rocky Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain. Wrong table sub-heading referring to Normal instead of Rocky terrain.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 1x50 mm Conduit in a Non CBD Environment in Rocky Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre of Placing 1x100 mm Conduit in a Non CBD Environment in Normal Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 1x100 mm Conduit in a Non CBD Environment in Normal Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre of Placing 1x100 mm Conduit in a Non CBD Environment in Rocky Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain. Wrong table sub-heading referring to Normal instead of Rocky terrain.
Development of the Unloaded Cost per Metre of Placing 2x100 mm Conduit in a Non CBD Environment in Normal Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 2x100 mm Conduit in a Non CBD Environment in Normal Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre of Placing 2x100 mm Conduit in a Non CBD Environment in Rocky Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain. Wrong table sub-heading referring to Normal instead of Rocky terrain.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 2x100 mm Conduit in a Non CBD Environment in Rocky Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre of Placing 4x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain.
Development of the Unloaded Cost per Metre of Placing 6x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 6x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre	Description of Soil used interchangeably with

Table	Comment
of Placing 8x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	Terrain.
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 8x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	No comment.
Development of the Unloaded Cost per Metre of Placing 12x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	Description of Soil used interchangeably with Terrain
Development of the Unloaded Cost per Metre of Breakout and Reinstatement for a 12x100 mm Conduit in a Non CBD Environment in All Terrain-DISTRIBUTION	No comment.
Development of the Fully Loaded Building Terminal Strip Cost	
Development of the Cost of Placing Lead-ins	
Fully Loaded Cable Cost-Pipe on Property	
Cost Per Lead-in Backhaul Through Distribution Conduit	

7.6 Sheet: Results Main-Qtys

Table 7.6: List of tables in the Results Main-Qtys sheet of the Cost Calculation Module

Table	Comment
Summary Information	No comment.
Total Lines	
Excluded Fibre Fed Demand	
Length of Main Copper Cables-Metres - Size of .40 Gauge Main Cables	
Length of Main Copper Cables-Metres - Size of .64 Gauge Main Cable	
Length of Fibre Main Cables-Metres	
Length of Main Conduit Configurations-Metres	
Number of Main Pits and Manholes	
Number of Joints .40 Gauge Copper Main Cable	
Number of Joints .64 Gauge Main Cable	
Number of Joints Fibre Main Cable	
Count of Fibre MUX Equipment	
Number of Pairs Terminating at ESA	
Count of Building Terminals Served by Main Cables	

7.7 Sheet: Results Distribution-Qtys

Table 7.7: List of tables in the Results Distribution-Qtys sheet of the Cost Calculation Module

Table	Comment
Results by Wire Center Groupings	The description of Wire Center is inconsistent and does not appear in the model documentation or elsewhere in the model.
Cable Length (metres)	No comment.
Number of Cable Joints (Number Cables)	

Table	Comment
Number of Pillars	No comment.
Pillar Terminal Strips	
Conduit	
Length of Distribution Conduit Runs in Density Range 1-Metres	
Length of Distribution Conduit Runs in Density Range 2-Metres	
Length of Distribution Conduit Runs in Density Range 3-Metres	
Length of Distribution Conduit Runs in Density Range 4-Metres	
Length of Distribution Conduit Runs in Density Range 5-Metres	
Length of Distribution Conduit Runs in Density Range 6-Metres	
Number of Pits in Density Range 1	
Number of Pits in Density Range 2	
Number of Pits in Density Range 3	
Number of Pits in Density Range 4	
Number of Pits in Density Range 5	
Number of Pits in Density Range 6	
Building Terminal Lead-ins	
2 Pair Lead-ins	

7.8 Sheet: Results Main-Costs

Table 7.8: List of tables in the Results Main-Costs sheet of the Cost Calculation Module

Table	Comment
Results by Wire Center Groupings	The description of Wire Center is inconsistent and does not appear in the model documentation or elsewhere in the model.
Total Lines	No comment.
Distribution Lines	
Cost of Joints .40 Gauge Copper Main Cable	
Cost of Main Copper Cables-Metres - Size of .64 Gauge Main Cable	
Cost of Fibre Main Cables-Metres	
Cost of Conduit Configuration	
Cost of Main Pits and Manholes	
Cost Joints Normal .40 Gauge Copper Main Cable	
Cost Joints Heavy .64 Gauge Main Cable	
Cost of Joints Fibre Main Cable	
Cost of Fibre MUX Equipment	
Cost of an Entrance Facility	
Cost of an Air Compressor System	
Fibre Terminating Unit	
Cost of Building Terminals Served by Main Cables	

7.9 Sheet: Results Distribution-Costs

Table 7.9: List of tables in the Results Distribution-Costs sheet of the Cost Calculation Module

Table	Comment
Results by Wire Center Groupings	The description of Wire Center is inconsistent and does not appear in the model documentation or elsewhere in the model.
Cost of Cable	No comment.
Cost of Cable Joints (Number Cables)	
Cost of Pillars	
Pillar Terminal Strips	
Conduit	
Cost of Distribution Conduit Runs in Density Range 1	
Cost of Distribution Conduit Runs in Density Range 2	
Cost of Distribution Conduit Runs in Density Range 3	
Cost of Distribution Conduit Runs in Density Range 4	
Cost of Distribution Conduit Runs in Density Range 5	
Cost of Distribution Conduit Runs in Density Range 6	
Cost of Pits in Density Range 1	
Cost of Pits in Density Range 2	
Cost of Pits in Density Range 3	
Cost of Pits in Density Range 4	
Cost of Pits in Density Range 5	
Cost of Pits in Density Range 6	
Building Terminal Lead-ins	
2 Pair Lead-ins	

7.10 Sheet: Capital Cost Calculation

Table 7.10: List of tables in the Capital Cost Calculation sheet of the Cost Calculation Module

Table	Comment
Customer Access Network	Life[times] (row 5) for some categories – Network Management, Support Structures, Building Fitouts, Buildings, Switching Software – not linked correctly to 'Inputs Capital Cost' worksheet.
Indirect Assets	
Switching	

7.11 Sheet: Investment Summary

Table 7.11: List of tables in the Investment Summary sheet of the Cost Calculation Module

Table	Comment
Investment Per Line	No comment.

7.12 Sheet: Annual Cost Summary

This sheet contains the calculated ULLS monthly cost in cell O3.

Table 7.12: List of tables in the Annual Cost Summary sheet of the Cost Calculation Module

Output table	Comment
Annual ULL Costs Per Line Calculation	Several typos in this table (cell A7, A52, A62).

8. Linkages and Formulae

8.1 Correct implementation of linkages

In this chapter, we assess whether the linkages in the model between inputs and outputs are implemented correctly. We also assess whether the linkages at a disaggregated level are obvious to the user of the TEA model and provide the level of transparency required.

The model lacks transparency, particularly when it generates engineering data. During the process of generating engineering data, the model simply states which engineering module it is currently running for which ESA. The linkages between inputs and outputs are therefore not obvious to the user. This leaves doubt as to where and when the process of cable optimisation, according to the model documentation, is taking place.

The model outputs are presented to the user in a separate Excel spreadsheet containing costs and total volumes of plant, labour and equipment calculated for each ESA. Both the main and distribution engineering modules can be run separately in order to calculate the quantities for a single ESA only. The resulting quantities, however, cannot simply be linked to the model's costing module. The model therefore does not provide the level of transparency required in order to properly assess whether the implementation of linkages has been done correctly.

We also note that the model generates engineering data for the main cable network before generating relevant engineering data for the distribution network. This is the reverse of the logical order in aggregating the given customer demands back to each exchange.

The processes of data storage and usage of the Access database are not obvious to the user and are not documented in the appropriate level of detail. According to the documentation, however, the model uses "[…] base data extracted, translated and loaded from Telstra's Cable Plant Records for each of Telstra's Band 2 exchanges to determine an optimised network design for the distribution and main networks".[1] The model documentation further states that existing network serving structure points are used in designing efficient cable routes in the replacement network and that all of Telstra's existing distribution cable routes in each ESA are examined to select a single, efficient set of distribution cable routes minimising trench lengths.[2] In looking at the data in more detail when imported from the TEA model database into each of the engineering modules, we note that, in a significant number of cases, one structure point has multiple predecessors. We also note in several other cases the same combination of structure points appears a second time in the reverse order in the base data used in the model. This suggests that the model allows for duplicated cable routes instead of a single, efficient set of cable routes in the distribution network.

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[1] Telstra, Telstra Corporation Limited, Telstra's Efficient Access Model, Model Documentation, 3 March 2008, page 1, paragraph 3.

[2] Telstra, Telstra Corporation Limited, ULLS Undertaking, Telstra Efficient (TEA) Model Overview, 21 December 2007, page 9.

These are inefficiencies which not only contradict Telstra's approach as outlined in the model documentation as part of its ULLS undertaking; it also overstates the ULL cost of an efficient operator.

We also identified missing links in the model with the result that changes in the TEA model user interface may not feed through to the formulae in the TEA model. This is discussed in more detail in Ovum's review of the economic principles of the TEA model.

The effect of the errors listed above is that the monthly ULLS charge is misrepresented and the figure may be higher than it otherwise would be.

8.2 Correct implementation of formulae

We changed the values of key inputs and ran the model under a range of different scenarios. We found that the overall reactions of the model are consistent with our experience, economic intuition and financial principles. A more detailed discussion can be found in Ovum's review of the economic principles, capital cost and expense calculations of the Telstra Efficient Access cost model.

We will also provide the ACCC with a set of scenarios providing a sensitivity analysis relevant to key inputs.

We have gone through each formula in both engineering modules and found that in most cases the underlying assumptions are appropriate for Telstra's network.

We found that the formulae in the TEA model are correctly implemented except for the errors identified in Ovum's review of the economic principles and the lack of optimised network design.

9. Flexibility to Adjust Parameters

In this section we review whether the TEA model provides the appropriate level of flexibility for the user to change parameters. The tables below list all parameters used in the TEA model. We indicate for each parameter listed in the table if it is an input cell editable by the user or is not editable but is pre-set by Telstra assumptions. The input ranges, listed in the table for each parameter, provide an overview of the range of numbers accepted by the model user interface.

The TEA model provides the user with the ability to change and adjust input variables for both the engineering and costing parts of the model. However, the rules and assumptions used in the model are not all visible (i.e. editable). This lack of flexibility of the TEA model hinders a full sensitivity analysis.

A significant cost driver for an efficient operator to completely rebuild an access network is the trenching and ducting of cables underground and manholes required. The model does not allow for the alternative of aerial transmission with cables on poles where appropriate. We agree, however, that this option should not be included for Band 2, as local councils do not accept aerial cables in the suburban environment.

Another legitimate but critical simplification of the TEA model is the density zones to differentiate between different areas. The differentiation is relevant for determining the types of placement activities for a new network, such as ratios for developing composite placement costs. This issue is discussed in the accompanying engineering review.

The following tables list all engineering and costing parameters used in the TEA model, noting whether each is an editable input, which can be changed by the user, and the input range, where applicable.

9.1 Engineering Parameters

Table 9.1: ESA grouping inputs

Input Values/Worksheet/Cell	Editable input	Input range
Percentage of Rock for each ESA	Yes	0 - 1
Exchange Service Area Grouping sheet in TEA model application	Yes	Band 2 ESAs only (584)

In the TEA model user interface, the user can change the percentage of rock for each individual ESA. As discussed in the engineering review, the ESA specific terrain really is fixed by the geography of the ESA and should not be changeable.

Table 9.2: Engineering Distribution module inputs

Input Values/Worksheet/Cell	Editable input	Input range	Comments
Average Large Lead-In Length Inputs D108	Not editable	N/A	Both parameters appear in the model documentation as input parameters. However, in the model they are both calculated.
Average Small Lead-In Length Inputs D107	Not editable	N/A	

Input Values/Worksheet/Cell	Editable input	Input range	Comments
Conduit Configuration Range Inputs B83-88	Not editable	N/A	No comment.
Conduit Configuration Size Range Inputs C98-88	Not editable	N/A	
Density Range Inputs C24-29	Editable / Range of cells	Non-negative real numbers	
Density Range 1 Inputs C24	Not editable	N/A	
Density Range 2 Inputs C25	Editable	Non-negative real numbers	
Density Range 3 Inputs C26	Editable	Non-negative real numbers	
Density Range 4 Inputs C27	Editable	Non-negative real numbers	
Density Range 5 Inputs C28	Editable	Non-negative real numbers	
Distribution Copper Cable Fill Inputs A15	Editable	Non-negative real numbers	
Distribution Copper Cable Length Range (for cable size: 10, 30, 50, 100) Inputs B41-44	Editable / Range of cells	Non-negative real numbers	
Distribution Copper Cable Size Range Inputs A41-44	Not editable	N/A	
Distribution Max Copper Cable Length (100 pairs cable) Inputs B41	Editable	Non-negative real numbers	
Distribution Max Copper Cable Length (50 pairs cable) Inputs B42	Editable	Non-negative real numbers	
Distribution Max Copper Cable Length (30 pairs cable) Inputs B43	Editable	Non-negative real numbers	
Distribution Max Copper Cable Length (10 pairs cable) Inputs B44	Editable	Non-negative real numbers	
Distribution Max Copper Cable Size Inputs A41	Not editable	N/A	
Lead-In Max Size Inputs A95	Not editable	N/A	
Lead-In Size Range Inputs A95-98	Not editable	N/A	
Max Distance between Pits (No. 9 Pit) Inputs B60	Editable	Non-negative real numbers	
Max Distance between Pits (No. 6 Pit) Inputs B61	Editable	Non-negative real numbers	

Input Values/Worksheet/Cell	Editable input	Input range	Comments
Max Distance between Pits (No. 5 Pit) Inputs B62	Editable	Non-negative real numbers	
Max Pillar Capacity Inputs C77	Not editable	N/A	
Max Pillar Size Inputs B77	Not editable	N/A	
Max Serving Pit Cable Inputs A49	Not editable	N/A	
Min Lead-In Inputs B103	Not editable	N/A	
Min Pillar Capacity Inputs C78	Not editable	N/A	
Min Pillar Size Inputs B78	Not editable	N/A	
Non Taper Max Copper Cable Length Inputs B36	Editable	Non-negative real numbers	
Occurrence 4 Pairs per Pit Inputs B67	Editable	Non-negative real numbers	
Occurrence 3 Pairs served by Pits Inputs B68	Editable	Non-negative real numbers	
Occurrence 2 Pairs served by Pits Inputs B69	Editable	Non-negative real numbers	
Occurrence 1 Pair served by Pits Inputs B70	Editable	Non-negative real numbers	
Pit Spacing Range Inputs B60-62	Editable / Range of cells	Non-negative real numbers	
Serving Pit Cable Range Inputs A49-53	Not editable / Range of cells	N/A	
Taper Selection Inputs A11	Editable	Tapering, Non-Tapering	
Terminal Strip Sizing Range Inputs D77-78	Not editable / Range of cells	N/A	
Weighted Lead-Ins Per Pit Inputs C71	Not editable	N/A	

Table 9.3: Engineering Main module inputs

Input Values/Worksheet/Cell	Editable input	Input range	Comments
Building Terminal Max Size Inputs A88	Not editable	N/A	No comment.
Building Terminal Size Range Inputs A88-92	Not editable / Range of cells	N/A	
CMUX System Range Inputs B78-79	Not editable / Range of cells	N/A	Parameters should not be used for ULLS cost calculation.
CMUX Fibre Range Inputs F78-79	Not editable / Range of cells	N/A	
Conduit Configuration	Not editable / Range	N/A	

Input Values/Worksheet/Cell	Editable input	Input range	Comments
Range Inputs B65-73	of cells		
Crossover Code Inputs A12	Not editable	N/A	
Feeder Fill Inputs A16	Editable	Non-negative real numbers	
Fibre Cable Length Range Inputs B45-51	Editable / Range of cells	Non-negative real numbers	Parameters should not be used for ULLS cost calculation.
Fibre Cable Range Inputs A54-51	Not editable / Range of cells	N/A	
Heavy Copper Feeder Cable Range Inputs A36-40	Not editable / Range of cells	N/A	No comment.
Heavy Feeder Cable Length Range Inputs B36-40	Editable / Range of cells	Non-negative real numbers	
Manhole Maximal Distance MH28 Inputs C56	Editable	Non-negative real numbers	
Manhole Maximal Distance MH20 Inputs C57	Editable	Non-negative real numbers	
Manhole Maximal Distance MH12 Inputs C58	Editable	Non-negative real numbers	
Manhole Maximal Distance MH4 Inputs C59	Editable	Non-negative real numbers	
Manhole Maximal Distance No.9 Pit Inputs C60	Editable	Non-negative real numbers	
Manhole Sizing Range Inputs B56-60	Not editable / Range of cells	N/A	
Manhole Spacing Range Inputs C56-60	Editable / Range of cells	Non-negative real numbers	
Max CMUX Inputs E78	Not editable	N/A	Parameters should not be used for ULLS cost calculation.
Max Heavy Feeder Cable Length 1200 pairs cable Inputs B36	Editable	Non-negative real numbers	No comment.
Max Heavy Feeder Cable Length 800 pairs cable Inputs B37	Editable	Non-negative real numbers	
Max Heavy Feeder Cable Length 400 pairs cable Inputs B38	Editable	Non-negative real numbers	
Max Heavy Feeder Cable Length 200 pairs cable	Editable	Non-negative real numbers	

Input Values/Worksheet/Cell	Editable input	Input range	Comments
Inputs B39			
Max Heavy Feeder Cable Length 100 pairs cable Inputs B40	Editable	Non-negative real numbers	
Max Number of Conduits Inputs B65	Not editable	N/A	
Max CMUX Fibre Inputs F78	Not editable	N/A	Parameters should not be used for ULLS cost calculation.
Max CMUX Services Inputs C78	Not editable	N/A	
Max Fibre Cable Length 120 Inputs A45	Not editable	N/A	
Max Fibre Cable Length 60 Inputs A46	Not editable	N/A	
Max Fibre Cable Length 48 Inputs A47	Not editable	N/A	
Max Fibre Cable Length 36 Inputs A48	Not editable	N/A	
Max Fibre Cable Length 24 Inputs A49	Not editable	N/A	
Max Fibre Cable Length 12 Inputs A50	Not editable	N/A	
Max Fibre Cable Length 6 Inputs A51	Not editable	N/A	
Max Heavy Feeder Cable Inputs A36	Not editable	N/A	No comment.
Max Normal Feeder Cable Inputs A25	Not editable	N/A	
Normal Copper Feeder Cable Range Inputs A25-30	Not editable / Range of cells	N/A	
Normal Copper Feeder Maximal Length 2400 pairs cable Inputs B25	Editable	Non-negative real numbers	
Normal Copper Feeder Maximal Length 1200 pairs cable Inputs B26	Editable	Non-negative real numbers	
Normal Copper Feeder Maximal Length 800 pairs cable Inputs B27	Editable	Non-negative real numbers	
Normal Copper Feeder Maximal Length 400	Editable	Non-negative real numbers	

Input Values/Worksheet/Cell	Editable input	Input range	Comments
pairs cable Inputs B28			
Normal Copper Feeder Maximal Length 200 pairs cable Inputs B29	Editable	Non-negative real numbers	
Normal Copper Feeder Maximal Length 100 pairs cable Inputs B30	Editable	Non-negative real numbers	
Normal Copper Feeder Length Range Inputs B25-30	Editable / Range of cells	Non-negative real numbers	
Study Selection Inputs Inputs A11	Editable	ULL / Basic Service	
System Capacity Range Inputs E78-79	Not editable / Range of cells	N/A	
System Max Capacity Inputs E78	Not editable	N/A	

The majority of engineering assumptions and rules listed above are editable by the user of the model. There are a few parameters which the user cannot change. We assume that these parameters show the specifications of equipment available to Telstra from relevant vendors.

9.2 Costing Parameters

Table 9.4: Main Cost and Rules

Input Values	Editable input	Input range	Comments
Loading Factor for Indirect Overheads	Editable	Non-negative real numbers	No comment.
Loading Factor-Reserved	Not editable	N/A	
Conduit Sharing Between Main and IEN	Editable	Non-negative real numbers	
New Estates Ratio	Editable	Non-negative real numbers	
Average Width of Road Crossings-Metres	Not editable	N/A	
Cable Cost Normal Gauge .40 mm Conductor-Main for cable sizes (pairs) 100, 200, 400, 800, 1200, 2400			
Cost of Cable (per metre)	Editable	Non-negative real numbers	No comment.
Hauling Rate (per metre)	Editable	Non-negative real numbers	
Jointing Rate (per pair)	Editable	Non-negative real numbers	
Joint Enclosure Cost	Editable	Non-negative real numbers	
Branch Enclosure (Connection)	Editable	Non-negative real numbers	

Input Values	Editable input	Input range	Comments
Cable Cost Normal Gauge .64 mm Conductor-Main for Cable Sizes (pairs) 100, 200, 400, 800, 1200			
Cost of Cable (per metre)	Editable	Non-negative real numbers	No comment.
Hauling Rate (per metre)	Editable	Non-negative real numbers	
Jointing Rate (per pair)	Editable	Non-negative real numbers	
Joint Enclosure Cost	Editable	Non-negative real numbers	
Branch Enclosure (Connection)	Editable	Non-negative real numbers	
Fibre Cables-Main for Number of Fibres 6, 12, 24, 36, 48, 60, 120			
Material & Placing (per metre)	Editable	Non-negative real numbers	Parameters should not be used for ULLS cost calculation.
Hauling Rate (per metre)	Editable	Non-negative real numbers	
Jointing Rate (per pair)	Editable	Non-negative real numbers	
Fibre Optic Joint Enclosure-Main			
Optical Fibre enclosure 24 Fibre	Editable	Non-negative real numbers	Parameters should not be used for ULLS cost calculation.
Egerton 24/72 single ended closure	Editable	Non-negative real numbers	
Corning UCNCP 9-24 MAX (494/509)-w/ uncut loose tubes	Editable	Non-negative real numbers	
Corning UCNCP 9-24 MAX (494/509)-w/o uncut loose tubes	Editable	Non-negative real numbers	
Corning UCNCP 9-28 MAX (494/510)-w/ uncut loose tubes	Editable	Non-negative real numbers	
Corning UCNCP 9-28 MAX (494/511)-w/o uncut loose tubes	Editable	Non-negative real numbers	
Maximum Number of Fibres			
Optical Fibre enclosure 24 Fibre	Not editable	N/A	Parameters should not be used for ULLS cost calculation.
Egerton 24/72 single ended closure	Not editable	N/A	
Corning UCNCP 9-24 MAX (494/509)-w/ uncut loose tubes	Not editable	N/A	
Corning UCNCP 9-24 MAX (494/509)-w/o uncut loose tubes	Not editable	N/A	
Corning UCNCP 9-28 MAX (494/510)-w/ uncut loose tubes	Not editable	N/A	
Corning UCNCP 9-28 MAX (494/511)-w/o	Not editable	N/A	

Input Values	Editable input	Input range	Comments
uncut loose tubes			
Cable Cost Normal Gauge .40 mm Conductor-Distribution and Building Terminal Connections for Cable Sizes (pairs)			
Material (per metre)	Editable	Non-negative real numbers	No comment.
Hauling Rate (per metre)	Editable	Non-negative real numbers	
Jointing Rate (per pair)	Editable	Non-negative real numbers	
Joint Enclosure Cost	Editable	Non-negative real numbers	
Branch Enclosure (Connection)	Editable	Non-negative real numbers	
Cost per Wire Connection at Serving Pit-Distribution for Cable Sizes (pairs) 2			
Connecting Wires (Per Pair)	Editable	Non-negative real numbers	No comment.
Joint Enclosure Cost	Editable	Non-negative real numbers	
Manhole Cost-Main for Manhole Sizes PF28, PF20, PF12, PF4, and No.9 Pit			
Cost Normal Placement	Editable	Non-negative real numbers	No comment.
Cost Rocky Placement	Editable	Non-negative real numbers	
Width (Metres)	Editable	Non-negative real numbers	
Length (Metres)	Editable	Non-negative real numbers	
Margin on Sides Pit/MH	Editable	Non-negative real numbers	
Margin at Ends Pit/MH	Editable	Non-negative real numbers	
Pit Costs-Main and Distribution for Pit Sizes No. 5, 6 and 9			
Cost Normal Placement	Editable	Non-negative real numbers	No comment.
Cost Rocky Placement	Editable	Non-negative real numbers	
Width (Metres)	Editable	Non-negative real numbers	
Length (Metres)	Editable	Non-negative real numbers	
Margin on Sides Pit/MH	Editable	Non-negative real numbers	
Margin at Ends Pit/MH	Editable	Non-negative real numbers	
Pillar Costs - Cost (per unit)			
Pillars (Size 1800)	Editable	Non-negative real numbers	No comment.
Pillars (Size 900)	Editable	Non-negative real numbers	
Terminal Strips (Size 1800)	Editable	Non-negative real numbers	
Terminal Strips (Size 1800)	Editable	Non-negative real numbers	
Breakout Costs for Manholes, Pits and Conduits (/ Sq Metre)			
Concrete (< 75 mm	Editable	Non-negative real	No comment.

Input Values	Editable input	Input range	Comments
thick)		numbers	
Concrete (75 to 100 mm thick)	Editable	Non-negative real numbers	
Concrete (Over 100 mm thick)	Editable	Non-negative real numbers	
Reinforced (< 75 mm thick)	Editable	Non-negative real numbers	
Reinforced (75 to 100 mm thick)	Editable	Non-negative real numbers	
Reinforced (100 to 150mm thick)	Editable	Non-negative real numbers	
Asphalt (25 mm thick)	Editable	Non-negative real numbers	
Asphalt (50 mm thick)	Editable	Non-negative real numbers	
Asphalt (75 mm thick)	Editable	Non-negative real numbers	
Brick Pavers	Editable	Non-negative real numbers	
Kerbing	Editable	Non-negative real numbers	
Turf	Editable	Non-negative real numbers	
Reinstatement Costs for Manholes, Pits and Conduits (/ Sq Metre)			
Concrete (< 75 mm thick)	Editable	Non-negative real numbers	No comment.
Concrete (75 to 100 mm thick)	Editable	Non-negative real numbers	
Concrete (Over 100 mm thick)	Editable	Non-negative real numbers	
Reinforced (< 75 mm thick)	Editable	Non-negative real numbers	
Reinforced (75 to 100 mm thick)	Editable	Non-negative real numbers	
Reinforced (100 to 150mm thick)	Editable	Non-negative real numbers	
Asphalt (25 mm thick)	Editable	Non-negative real numbers	
Asphalt (50 mm thick)	Editable	Non-negative real numbers	
Asphalt (75 mm thick)	Editable	Non-negative real numbers	
Brick Pavers	Editable	Non-negative real numbers	
Kerbing	Editable	Non-negative real numbers	
Turf	Editable	Non-negative real numbers	
Average Width Breakout and Reinstatement for Trenching Roads, Footpaths, Sidewalks and Drives (cm)-Main & Distribution for Conduit Sizes 1 x 50, 1 x 100, 2 x 100, 4 x 100, 6 x 100, 8 x 100, 12 x 100, 16 x 100, 20 x 100, 24 x 100 mm			
Width Trench-Road Crossing	Editable	Non-negative real numbers	No comment.

Input Values	Editable input	Input range	Comments
Width Trench-Drives	Not editable	N/A	
Ave Width Replaced Footpath	Editable	Non-negative real numbers	
Cost Per Metre for Placing Conduit Runs Including the Cost for Boring and Trenching Lines-Distribution and Main for Soil Type Normal and Rocky, Conduit Sizes 1 x 50, 1 x 100, 2 x 100, 4 x 100, 6 x 100, 8 x 100, 12 x 100, 16 x 100, 20 x 100, 24 x 100 mm (Cost/Metre)			
Trench-Turf	Editable not editable for 12 x 100, 16 x 100, 20 x 100, 24 x 100 mm	Non-negative real numbers	No comment.
Trench-Road Xing	Editable	Non-negative real numbers	
Trench-Footpaths & Drives	Editable	Non-negative real numbers	
Boring-Footpath & Drives	Editable only for 1 x 50, 1 x 100, 2 x 100 mm	Non-negative real numbers	
Boring-Under Roads	Editable only for 1 x 50, 1 x 100 and 2 x 100 mm	Non-negative real numbers	
New Estates-Open Trench	Editable only for 1 x 50, 1 x 100 and 2 x 100 mm	Non-negative real numbers	
Multiplexing Systems-Costs			
Alcatel CMUX (Identification Number 1)	Editable	Non-negative real numbers	Parameters should not be used for ULLS cost calculation.
Alcatel CMUX (Identification Number 2)	Editable	Non-negative real numbers	
Alcatel CMUX NU	Editable	Non-negative real numbers	
Entrance Facility-Costs and Design Criteria for up to a 12 conduit Requirement			
Cost Cable Vault per Exchange	Editable	Non-negative real numbers	No comment.
Cost Cable Racking per Exchange	Editable	Non-negative real numbers	
% Vault Assigned to CAN	Editable	Non-negative real numbers	
% Racking Assigned to CAN	Editable	Non-negative real numbers	
Entrance Facility-Costs and Design Criteria for 13 to 23 conduit Requirement			
Cost Cable Vault per Exchange	Editable	Non-negative real numbers	No comment.
Cost Cable Racking per Exchange	Editable	Non-negative real numbers	
% Vault Assigned to CAN	Editable	Non-negative real numbers	
% Racking Assigned to CAN	Editable	Non-negative real numbers	
Entrance Facility-Costs and Design Criteria for 24 to 35 conduit Requirement			
Cost Cable Vault per Exchange	Editable	Non-negative real numbers	No comment.
Cost Cable Racking per Exchange	Editable	Non-negative real numbers	
% Vault Assigned to CAN	Editable	Non-negative real numbers	
% Racking Assigned to CAN	Editable	Non-negative real numbers	

Input Values	Editable input	Input range	Comments
Entrance Facility-Costs and Design Criteria for 36 or Greater Conduit Requirement			
Cost Cable Vault per Exchange	Editable	Non-negative real numbers	No comment.
Cost Cable Racking per Exchange	Editable	Non-negative real numbers	
% Vault Assigned to CAN	Editable	Non-negative real numbers	
% Racking Assigned to CAN	Editable	Non-negative real numbers	
Cost per System			
Siemens MDF Block	Editable	Non-negative real numbers	No comment.
MDF Ironwork	Editable	Non-negative real numbers	
Joint at Mainframe Block	Editable	Non-negative real numbers	
Cable Pressurization System-Dry Air Compressor Basic System			
Compressor & infrastructure	Editable	Non-negative real numbers	No comment.
Flow Panel	Editable	Non-negative real numbers	
Cable Pressurization System-Dry Air Compressor Per Cable Components			
Air Access Point (RTAP)	Editable	Non-negative real numbers	No comment.
Initial Infrastructure	Editable	Non-negative real numbers	
Termination of Optical Fibre at Exchange			
Optical Fibre Termination Unit (Cost per System)	Editable	Non-negative real numbers	Parameters should not be used for ULLS cost calculation.
Type 92 Rack (Cost per System)	Editable	Non-negative real numbers	
Capacity System # Fibres	Not editable	N/A	
Building Terminal Strip Cost-Installed (Includes Joint)-Terminal Provided By Owner for Building Terminal Sizes 10, 30, 50, 100	Editable	Non-negative real numbers	No comment.
Lead-in Cost for 2 Pair Lead-Ins Excluding Cable	Editable	Non-negative real numbers	
Cost of Cable for Cable Size (pairs) 2			
Material & Placing (per metre)	Editable	Non-negative real numbers	
Hauling Rate (per metre)	Editable	Non-negative real numbers	

Table 9.5: Developing Composite Breakout and Reinstatement Costs allocation ratios

Input Values	Editable input	Input range	Comments
Concrete and Asphalt-Pits & Manholes for CBD and other (non-CBD) Bands			
Concrete (< 75 mm thick)	Editable	Non-negative real numbers	No comment.
Concrete (75 to 100 mm thick)	Editable	Non-negative real numbers	
Concrete (Over 100 mm thick)	Editable	Non-negative real numbers	
Reinforced (< 75 mm thick)	Editable	Non-negative real numbers	
Reinforced (75 to 100 mm thick)	Editable	Non-negative real numbers	
Reinforced (100 to 150mm thick)	Editable	Non-negative real numbers	
Asphalt (25 mm thick)	Editable	Non-negative real numbers	
Asphalt (50 mm thick)	Editable	Non-negative real numbers	
Asphalt (75 mm thick)	Editable	Non-negative real numbers	
Pits and different types of Manholes-Main for CBD and non-CBD Bands			
Breakout Concrete	Editable	Non-negative real numbers	No comment.
Breakout Asphalt	Editable	Non-negative real numbers	
Breakout Pavers	Editable	Non-negative real numbers	
Breakout Kerbing	Editable	Non-negative real numbers	
Reinstate Turf	Editable	Non-negative real numbers	
No Activity	Editable	Non-negative real numbers	
Pits by Density Zone-Distribution			
Breakout Concrete	Editable	Non-negative real numbers	No comment.
Breakout Asphalt	Editable	Non-negative real numbers	
Breakout Pavers	Editable	Non-negative real numbers	
Breakout Kerbing	Editable	Non-negative real numbers	
Reinstate Turf	Editable	Non-negative real numbers	
No Activity	Editable	Non-negative real numbers	
Concrete and Asphalt-Conduit Configurations			
Concrete (< 75 mm thick)	Editable	Non-negative real numbers	No comment.
Concrete (75 to 100 mm thick)	Editable	Non-negative real numbers	
Concrete (Over 100 mm thick)	Editable	Non-negative real numbers	

Input Values	Editable input	Input range	Comments
Reinforced (< 75 mm thick)	Editable	Non-negative real numbers	
Reinforced (75 to 100 mm thick)	Editable	Non-negative real numbers	

Table 9.6: Ratios of the Amount of Each Type of Conduit Placement Activity for Normal and Rocky Areas Outside the CBD-MAIN (Editable for the following numbers of 100mm conduit: 2, 4, 6, 8, 12, 16, 20, 24)

Input Values	Editable input	Input range	Comments
Trench-Turf	Editable/Not applicable for 8, 12, 16, 20, 24	Non-negative real numbers	No comment.
Trench-Road Xing	Editable	Non-negative real numbers	
Trench-Footpaths & Drives	Editable	Non-negative real numbers	
Boring-Footpath & Drives	Editable/Not applicable for 4, 6, 8, 12, 16, 20, 24	Non-negative real numbers	
Boring-Under Roads	Editable/Not applicable for 4, 6, 8, 12, 16, 20, 24	Non-negative real numbers	

Table 9.7: Ratios of the Amount of Each Type of Placement Activity Used in the Model within the CBD-MAIN

Input Values	Editable input	Input range	Comments
Trench-Road Xing	Editable	Non-negative real numbers	No comment.
Trench-Footpaths & Drives	Editable	Non-negative real numbers	

Table 9.8: Ratios of Composite Breakout and Reinstatement Costs for Conduit Runs-MAIN (Parameters are categorised in the following: Turf (Non-CBD), Roads (CBD, Non-CBD), Footpaths/Drives (CBD, Non-CBD), Boring and New Estates)

Input Values	Editable input	Input range	Comments
Breakout & Reinstate Concrete	Editable	Non-negative real numbers	No comment.
Breakout & Reinstate Asphalt	Editable	Non-negative real numbers	
Breakout & Reinstate Pavers	Editable	Non-negative real numbers	
Breakout & Reinstate Kerbing	Editable	Non-negative real numbers	
Reinstate Turf	Editable	Non-negative real numbers	
No Reinstatement	Editable	Non-negative real numbers	

Table 9.9: Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for each density zone Outside the CBD-DISTRIBUTION with Normal and Rocky Terrain for 1x50, 1x100, 2x100 Conduit Configurations

Input Values	Editable input	Input range	Comments
Trench-Turf	Editable	Non-negative real numbers	No comment.
Trench-Road Xing	Editable	Non-negative real	

Input Values	Editable input	Input range	Comments
		numbers	
Trench-Footpaths & Drives	Editable	Non-negative real numbers	
Boring-Footpath & Drives	Editable	Non-negative real numbers	
Boring-Under Roads	Editable	Non-negative real numbers	

Table 9.10: Ratios of the Amount of Each Type of Conduit Placement Activity Used in the Model for each density zone Outside the CBD-DISTRIBUTION with all Terrain for 4x100, 6x100, 8x100, 12x100 Conduit Configurations

Input Values	Editable input	Input range	Comments
Trench-Turf	Editable	Non-negative real numbers	No comment.
Trench-Road Xing	Editable	Non-negative real numbers	
Trench-Footpaths & Drives	Editable	Non-negative real numbers	

Table 9.11: Ratios for Determining the Amount of Each Type of Placement Activity Used in the Model within the CBD-DISTRIBUTION

Input Values	Editable input	Input range	Comments
Trench-Turf	Not Editable	N/A	
Trench-Road Xing	Editable	Non-negative real numbers	No comment.
Trench-Footpaths & Drives	Editable	Non-negative real numbers	
Boring-Footpath & Drives	Not Editable	N/A	
Boring-Under Roads	Not Editable	N/A	

Table 9.11: Ratios for Developing Composite Breakout and Reinstatement Costs for Conduit Runs-DISTRIBUTION (Parameters are categorised in the following: Trenching Turf (Non-CBD), Trenching Roads (CBD, Non-CBD), Trenching Footpaths/Drives (CBD, Non-CBD), Boring and New Estates)

Input Values	Editable input	Input range	Comments
Breakout & Reinstate Concrete	Editable/ Not applicable for Trenching Turf, Boring and New Estates	Non-negative real numbers	No comment.
Breakout & Reinstate Asphalt	Editable/ Not applicable for Trenching Turf, Boring and New Estates	Non-negative real numbers	
Breakout & Reinstate Pavers	Editable/ Not applicable for Trenching Turf, Boring and New Estates	Non-negative real numbers	
Breakout & Reinstate Kerbing	Editable/ Not applicable for Trenching Turf, Boring and New	Non-negative real numbers	

Input Values	Editable input	Input range	Comments
	Estates		
Reinstate Turf	Editable/ Not applicable for Trenching Roads, Trenching Footpaths/Drives, Boring and New Estates	Non-negative real numbers	
No Reinstatement	Editable/ Not applicable for Trenching Roads and Trenching Footpaths/Drives	Non-negative real numbers	

Table 9.12: Capital Cost and Factors

Input Values	Editable input	Input range	Comments
Cost of Capital Inputs			
Cost of Equity	Editable	Non-negative real numbers	No comment.
Cost of Debt	Editable	Non-negative real numbers	
Equity Ratio	Editable	Non-negative real numbers	
Debt Ratio	Editable	Non-negative real numbers	
Tax Rate	Editable	Non-negative real numbers	
Book Depreciation Life			
Ducts and Pipes-Main	Editable	Non-negative real numbers	No comment.
Copper Cables-Distribution	Editable	Non-negative real numbers	
Ducts & Pipes-Distribution	Editable	Non-negative real numbers	
Copper Cables-Main	Editable	Non-negative real numbers	
Lead-Ins	Editable	Non-negative real numbers	
Multiplexing Systems	Editable	Non-negative real numbers	
Radio Equipment-CAN	Editable	Non-negative real numbers	
Network Management	Editable	Non-negative real numbers	Parameter is not linked properly in the model.
Power Systems	Editable	Non-negative real numbers	No comment.
Network Buildings	Editable	Non-negative real numbers	
Other Indirect (Fleet, etc.)	Editable	Non-negative real numbers	
Information Technology	Editable	Non-negative real numbers	
Software	Editable	Non-negative real	

Input Values	Editable input	Input range	Comments
		numbers	
Buildings	Editable	Non-negative real numbers	
Optical Fibre Cables	Editable	Non-negative real numbers	Parameters should not be used for ULLS cost calculation.
SDH Transmission Equipment	Editable	Non-negative real numbers	No comment.
IEN Software	Editable	Non-negative real numbers	
Radio Transmission	Editable	Non-negative real numbers	
Radio Spectrum	Editable	Non-negative real numbers	
Misc. Transmission	Editable	Non-negative real numbers	
Local Switching	Editable	Non-negative real numbers	
Switching Software	Editable	Non-negative real numbers	
Indirect & Network Support Factors Inputs			
Conduit Sharing Annual CAN Revenue	Editable	Non-negative real numbers	No comment.
Number of Lines in Band 2	Not editable	N/A	
Percent CAN	Editable	Non-negative real numbers	
Percent Band 2	Editable	Non-negative real numbers	
O & M Factors			
Customer Access Network			
Ducts and Pipes	Editable	Non-negative real numbers	No comment.
Copper Cables	Editable	Non-negative real numbers	
Multiplexing Systems	Editable	Non-negative real numbers	
Other	Editable	Non-negative real numbers	
Switching Equipment			
Switching Equipment-Local	Editable	Non-negative real numbers	No comment.
Switching Equipment-Trunk	Editable	Non-negative real numbers	
Switching Equipment-Other	Editable	Non-negative real numbers	
Inter-Exchange Investment			
Inter-Exchange Cables	Editable	Non-negative real numbers	No comment.
Other Cables-CAN	Editable	Non-negative real	

Input Values	Editable input	Input range	Comments
		numbers	
Transmission Equipment	Editable	Non-negative real numbers	
Radio Bearer Equipment-CAN	Editable	Non-negative real numbers	
Radio Bearer Equipment	Editable	Non-negative real numbers	
Other Systems and Equipment			
Data Equipment	Editable	Non-negative real numbers	No comment.
Mobile Network and Terminating Equipment	Editable	Non-negative real numbers	
Customer Equipment	Editable	Non-negative real numbers	
Satellite Equipment	Editable	Non-negative real numbers	
International Network-Cables	Editable	Non-negative real numbers	
International Network-Other Systems	Editable	Non-negative real numbers	
Other Communications Plant & Equipment	Editable	Non-negative real numbers	
Accommodation & Property			
Product and Customer	Editable	Non-negative real numbers	No comment.
General Administration	Editable	Non-negative real numbers	
Information Technology	Editable	Non-negative real numbers	
Accommodation & Property	Editable	Non-negative real numbers	
Other Non Communications Asset Costs	Editable	Non-negative real numbers	
Other Organisational Costs	Editable	Non-negative real numbers	
Indirect Asset Factors			
Land	Editable	Non-negative real numbers	No comment.
Buildings	Editable	Non-negative real numbers	
Building Improvements	Editable	Non-negative real numbers	
Information Technology	Editable	Non-negative real numbers	
Other Indirect (Fleet, etc.)	Editable	Non-negative real numbers	
Software	Editable	Non-negative real numbers	
Intangibles	Editable	Non-negative real numbers	

Input Values	Editable input	Input range	Comments
Network Support Asset Factors			
Network Land	Editable	Non-negative real numbers	No comment.
Network Buildings	Editable	Non-negative real numbers	
Network Building Improvements	Editable	Non-negative real numbers	
Network Power Systems	Editable	Non-negative real numbers	
Network Management Systems	Editable	Non-negative real numbers	
Support Structures	Editable	Non-negative real numbers	Parameter is not linked properly in the model.

Most parameters listed above are editable and can be changed by the user. Other parameters are legitimately set by the equipment available to Telstra. The percentage of rock for the terrain in each ESA should be fixed and set specifically for each ESA.

As outlined in Ovum's review of the economic principles of the TEA model, we identified missing linkages in the model, with the result that the relevant inputs are not feeding through the model properly. Changing the relevant parameters in the TEA model user interface has therefore no impact on the monthly ULLS costs.

10. Documentation

10.1 Review of manual description of model structure

The accompanying model documentation provides some insights about the model structure in the form of a high level description of the TEA model process.[3] A brief overview of the model structure is also provided in the TEA Model Documentation, together with a figure of the TEA model structure on a separate page.[4]

However, in neither of the documents is the data flow of the model clearly described. It is therefore not obvious for the user of the model how the different components of the TEA model interact with each other and how the data flow is managed. An in-depth analysis of the model proves that the figure of the model structure as presented in the model documentation does not represent a comprehensive and complete overview of the actual interaction between the TEA model database, the engineering and costing modules, the network design rules specified in the graphical user interface and the output file.

10.2 Review of completeness of documentation – all processes explained?

The Telstra Efficient Access Model Overview provides a short step-by-step description of the model's network provisioning process.[5] According to the description of the base data extraction and compilation process, however, the model optimises main cable routes for the replacement CAN in the example of the Blackburn ESA. We found that this is clearly not the case. The details are given in the accompanying engineering review report.

The documentation is also missing a comprehensive description of the contents of the Base Data stored in a Microsoft Access database file and the related but separate scenario database file. This is critical, since it is the main source of predetermined inputs as well as the storage file for all processed data within the TEA model.

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[3] Telstra Corporation Limited, ULLS Undertaking, Telstra Efficient Access (TEA) Model Overview, 21 December 2007, page 4, chapter F

[4] Telstra Corporation Limited, ULLS Undertaking, Telstra Efficient Access (TEA) Model Documentation, 3 March 2008, page 1, chapter A

[5] Telstra Corporation Limited, ULLS Undertaking, Telstra Efficient Access (TEA) Model Overview, 21 December 2007, page 8 to 10

11. Conclusion

We have reviewed all aspects of the TEA model and its process flows. In general, the model works as described in the documentation and is relatively easy to understand. However, the documentation is misleading in that it suggests a cable optimisation process, which is missing in the actual model calculations. This is not only an inconsistency between the description of the model processes in the documentation and the implementation, it is also a significant weakness of the TEA model (discussed further in the engineering review).

There are several process flow questions that could be addressed, including better error recovery when the model cannot find components. However, the user can work around these deficiencies.

The user interface would be improved by more comprehensive error checking of input values. While non-negativity is checked, where appropriate, the relevant upper limit of numerical values is generally not checked. This can lead to negative values calculated elsewhere and hence misleading results.

There are a number of typographical errors in the implementation and the documentation. These should be fixed but are not misleading for the intelligent user.

The results of the Engineering Main Module and the Engineering Distribution Module are affected by the structure of the input data in the Access database. This contains the details of the Telstra network. There are errors in its structure, as described in the accompanying engineering review. These must be fixed if the model is to produce efficient results.

The Costing Module is large and complicated, compared to the engineering modules. Its logic in the workbook operates left-to-right through the worksheets, the opposite direction from the engineering modules. The linkages between the worksheets works as described, except for the linkage of lifetimes for some items. The economics review has also indicated that some capital items related to fibre placements are included in the overall costing, which affects the result of the Costing Module.

One potentially misleading feature of the Costing Module is that it includes data for Band 1 (CBD) areas as well as Band 2 ESAs. This may be an indication of future developments of the model. It can be distracting, in that CBD-related data is not used for Band 2 calculations.

For all the engineering and costing parameters, we have reviewed their logical input ranges and found that the TEA model provides the user with an appropriate level of flexibility to change specific parameters.

There is no documentation for the Access database: it should be included.