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Transport Infrastructure Ireland

# TII Publications



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## Project Appraisal Guidelines Unit 6.4 – Guidance on using COBALT

PE-PAG-02023  
December 2023

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## TII Publications



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<b>TII Publication Title:</b>	Project Appraisal Guidelines Unit 6.4 – Guidance on using COBALT
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# 1. Introduction

COBALT (Cost and Benefit to Accidents – Light Touch) is a computer program developed by the UK Department for Transport (DfT) to assess and quantify the change in the number of collisions and casualties as a direct result of a new road scheme<sup>1</sup>. The outputs of COBALT are used to inform both the economic and safety impacts of a scheme as part of the multi-criteria appraisal framework.

Until 2013, the economic and safety impacts of road schemes were calculated, amongst other aspects, in a program called COBA. COBALT is a smaller version of this, carrying out only the collision-appraisal parts.

An Irish specific version of the COBALT program has now been developed by Transport Infrastructure Ireland (TII) for use on schemes in the Republic of Ireland and is referred to as COBALT-Ireland. COBALT-Ireland has been developed to undertake analysis based on combined link and junction collision rates and does not provide options to conduct link only or junction only analysis as per the UK version.

The COBALT assessment is based on a comparison of collisions by severity and associated costs across an identified network in a 'Without-Scheme' and 'With-Scheme' scenario, using details of link characteristics, collision rates, casualty costs and projected traffic volumes.

## 1.1 Overview

This PAG Unit provides information on the processes required to undertake a COBALT assessment. It deals with data collection, the relevant inputs from the traffic model and the parameter values that should be used for the assessment.

The structure of the COBALT input file and economic parameter file and how they may be prepared and edited for input into the COBALT program is also addressed in this unit.

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<sup>1</sup> COBALT has been primarily designed for the assessment of the collision impact of changes to the road network and this PAG Unit refers primarily to road schemes. However it can also be used to assess the changes in volume and routing of traffic in response to schemes for other modes or other measures such as demand management or variable demand responses

## 2. Collision Data

For road collisions, standard methodologies exist for calculating the projected number of collisions, the types of collisions and associated casualties in the Do-Minimum (without-scheme) and Do-Something (with-scheme) scenarios. The methods relate the traffic on a road (measured by vehicle-kilometres) to the number of collisions via the application of a collision rate per million vehicle-kilometres travelled.

Collision rates (and casualty rates) for different road types are set out in PAG Unit 6.11 - National Parameter Values Sheet and are adopted in COBALT. The rates are however adjusted prior to use in the COBALT program to account for the phenomenon of under-reporting.

Collision rates and collision severity rates are predicted to change over time irrespective of whether or not a specific intervention is being considered. Reduction (Beta) factors for both collision and casualty rates are provided in PAG Unit 6.11 - National Parameter Values Sheet.

Standard cost values are attributed to fatal, serious and slight casualties allowing the monetisation of collisions in the without and with scheme scenarios, and hence the calculation of the benefits or otherwise of a proposal.

The standard costs per casualty, are given in PAG Unit 6.11 - National Parameter Values Sheet, which also provides costs per collision for insurance administration, damage to property and Gardaí costs for different types of collisions on different types of roads.

Local collision data can be used in place of national values for selected links where such data is considered to be reliable.

## **3. Under-Reporting of Collisions**

### **3.1 Overview**

Under-reporting of road collisions is a well-recognised problem in official (road) collision statistics. Therefore, official figures are likely to underestimate the true number of collisions. The EU HEATCO<sup>2</sup> report 'Developing Harmonised European Approaches for Transport Costing and Project Assessment' recommends that the numbers of reported serious and slight collisions are increased by a factor of 1.5 and 3 respectively to account for under-reporting.

These collision under-reporting factors were first introduced to the Irish version of COBA in 2011 and are carried forward into COBALT. The various collision and casualty rates presented in PAG Unit 6.11 - National Parameter Values Sheet are adjusted to account for under-reporting prior to their use in COBALT.

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<sup>2</sup> European Union - Harmonised European Approaches for Transport Costing (2006)



## 4. Installation of COBALT-Ireland

COBALT is downloadable free of charge from the “Downloads” section of the TII Publications website under section PE-PAG-02023\_Unit 6.4. Two versions of the tool are provided as downloads, COBALT\_Ireland\_UF, where the user can edit the relevant files paths each time to run the tool or COBALT\_Ireland\_PF, where the user can save the relevant files path (via a .txt file also provided as a download) and the tool automatically runs on opening.

COBALT is a tool written in Visual Basic for Applications (VBA), based within Microsoft Excel. All the calculations are undertaken within a single Excel file. As such, the file can be stored anywhere on a hard drive or network drive.

Two separate external files need to accompany COBALT. The first is a parameter file, supplied with the program, which contains TII assumptions about items such as default collision and casualty rates.

This parameter file may be updated from time to time, with the latest version being available from the TII Publications website. It is the user’s responsibility to check that they are using the latest version of the economic parameter file when undertaking a COBALT assessment.

The second file required for COBALT is a scheme-specific input file, containing details of all links in the study network, such as road type and traffic flow in the base and forecast years. Users are responsible for creating this file and ensuring its accuracy.

Both the economic parameter file and an example scheme-specific input file are available on the TII Publications website.



## 5. Running COBALT

### 5.1 Overview

COBALT is controlled via two input files and produces one output file. The two input files are:

1. **Parameter Input File (.cbp)** - This file contains data such as collision rates, costs of casualties by severity and cost growth rates. A standard file, called COBALT\_Ireland\_Parameters, is available for download from the TII Publications website and in PAG Unit 6.5 - TUBA & COBALT Standard Input Files. In order to remain consistent with TII guidance, users should not edit this file.
2. **Scheme-Specific Input File (.cbi)** - This file contains data specific to the scheme being assessed, such as the scheme network and traffic flows. It can also be used to input local collision rates at a site; these can be excluded and national default rates (as defined in the parameter file) will be used. An example of a scheme-specific file is provided on the TII Publications website and in PAG Unit 6.5 - TUBA & COBALT Standard Input Files.

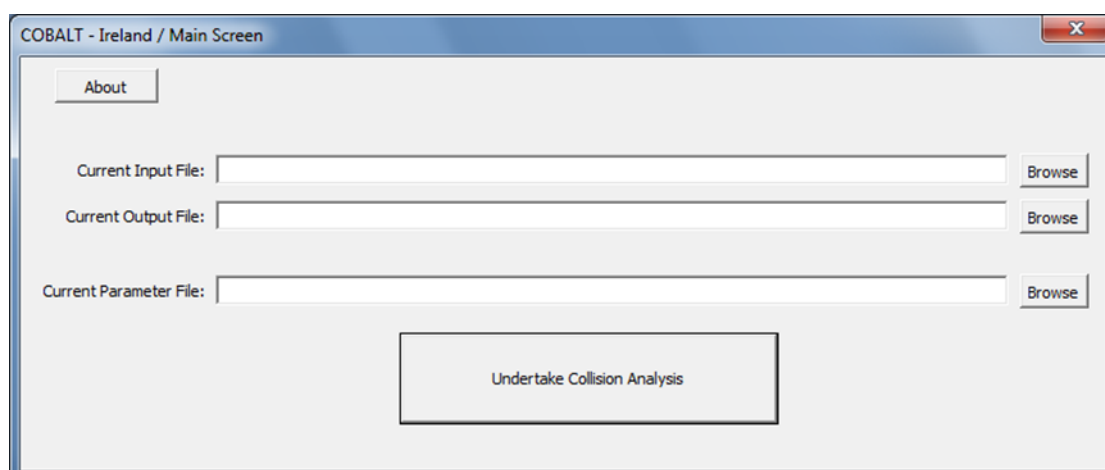
A **Standard Output File (.cbo)** is produced containing the following information:

- Number and cost of collisions and on the study network under the 'Without-scheme' scenario
- Numbers and costs of collisions on the study network under the 'With-Scheme' scenario
- A comparison of costs between the two scenarios
- Details of errors and warnings generated during the program execution
- A summary of input information (both scheme-specific input and economic parameter files)

### 5.2 Starting COBALT

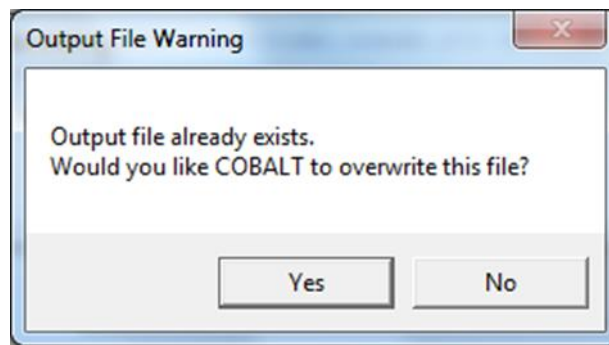
COBALT can be started as any Excel file. The security settings in Excel must be set to Medium or lower before Excel is opened. If prompted, you must Enable Macros. Once opened, many of the usual features of Excel may not be visible (such as toolbars, worksheets, sheet tabs).

On starting COBALT, there will be an initial introduction screen, and then the user is presented with the main screen shown in the Figure below.



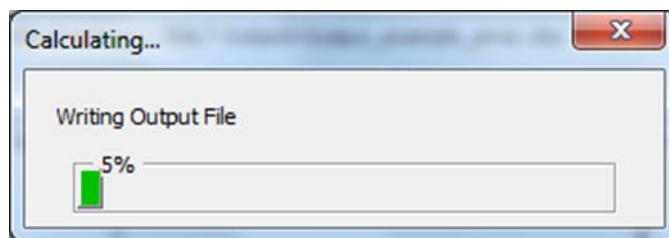
Users should 'Browse' to find the relevant input and parameter files. Users can also specify an output file. If this is left blank, the program will create an output file in the same location as the input file with the same name (with a .cbo rather than .cbl file extension). If the Excel file is saved on exit, it will save the locations of the input file, parameter file and output file. The user should then click 'Undertake Collision Analysis'.

If the output file already exists, the program will ask if it should be overwritten. If there is no need to keep a copy of the previous output, click 'Yes'. Otherwise click 'No' and either alter the output filename or create a backup of the original output and then restart the collision analysis.

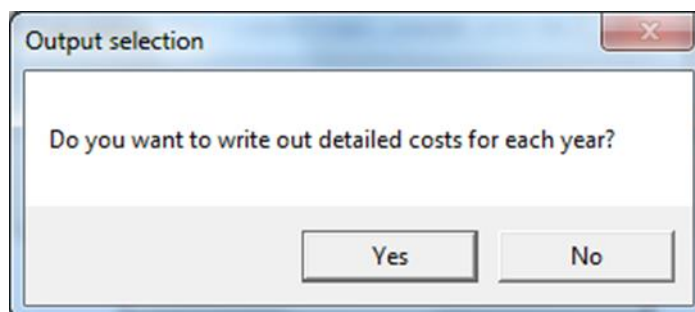


### 5.3 Progress Bar

A progress bar will appear for the main stages of COBALT. An example is given below. The length of time each stage takes will vary depending on the size of the scheme. The Output Results stage can also take longer on a network drive than a hard drive.

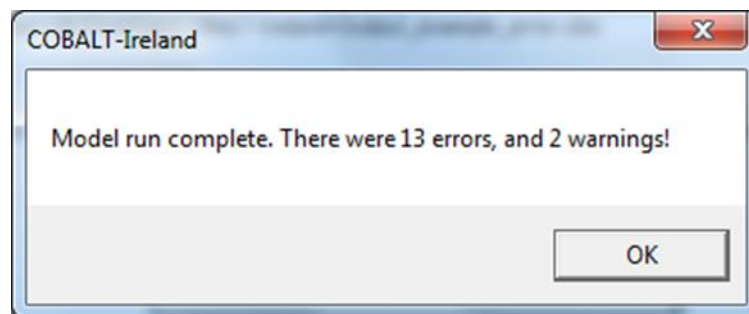


At the end of the run, the user will be offered the option to 'write out detailed costs for each year' (as shown below). If 'Yes' is selected, each of the tables in Sections 1 and 2 of the output file will provide results for each year in the appraisal period. Section 2 will also include additional detail on collisions and costs by severity and cost type. If 'No' is selected, the tables will include only total results and results for each 'key year'.



### 5.4 Finishing the Run

Once the program has run, a message box will appear. This will identify whether the program detected any errors or warnings. An example is given below.



The standard cross in the top right of the window is used to close COBALT. As the outputs are saved to a separate file, there is no need to save the COBALT Excel file when exiting. The only benefit of doing this is to save the locations of the input, parameter and output files, in case a re-run of the program for that road scheme is needed.

The output file will need to be viewed separately in a text editor (e.g. Notepad).

## 5.5 About Box

The 'About' button opens a window containing a brief description of COBALT and the version number.



## 6. Parameter File

The parameter file is a text file consisting of a series of data tables of standard parameters required to calculate collision impacts in line with PAG Unit 6.11 - National Parameter Values Sheet. The tables include the information required to undertake an economic appraisal (including discount rates and appraisal period).

The majority of the tables provide the inputs required to calculate collision and casualty numbers and costs by year, using costs per collision type, rates of collisions and casualties of different severities by road type and allowance for changes in collision and casualty rates through time using change factors (known as beta factors).

An example parameter file<sup>3</sup> is provided in PAG Unit 6.5 - TUBA & COBALT Standard Input Files, so users can see what is in each data table.

### 6.1 Percentages

Where data is entered as a percentage, for example growth rates, a value of 20 is interpreted as 20%. A value of 0.2 would be interpreted as 0.2%, not 20%.

### 6.2 Growth Rates

Growth rates are required to be applied to a number of economic data inputs. The common format is start year, end year, rate (as % p.a.) as per the example in Table 6.4.1

Table 6.4.1 COBALT Errors and Warnings

Start Year	End Year	Rate (%) Per Annum
2016	2019	3.6
2020	2024	2.2

The interpretation of this is as follows: the 2017 value is 3.6% higher than the 2015 value; the 2018 value is 3.6% higher than the 2017 value and so on, up to the 2019 value being 3.6% higher than the 2018 value. Then the 2020 value is 2.2% higher than 2019 and so on. Where several periods with different growth rates are defined, they must not overlap.

Any growth defined after the appraisal horizon year (opening year plus the number of years in the appraisal period) will be ignored and a warning message issued.

### 6.3 Link Classifications

COBALT parameters and calculations are differentiated into a number of different link types. Link types vary according to the road standard, road width, number of lanes and presence of central reserve barrier.

At present there are 10 different road link types classified in COBALT-Ireland, as identified in Table 6.4.2.

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<sup>3</sup> Note - Please check for the latest version of this file on the TII Publications website rather than using the version included in PAG Unit 6.5.

**Table 6.4.2 COBALT Combined Link Types**

<b>COBALT Link Type</b>	<b>Description</b>
1	Motorway
2	2 Lane Single Carriageway over 60 km/h
3	2 Lane Single Carriageway up to 60 km/h
4	Dual Carriageway over 60 km/h
5	Dual Carriageway up to 60 km/h
6	2+1 without Central Reserve Barrier over 60 km/h
7	2+1 without Central Reserve Barrier up to 60 km/h
8	2+1 with Central Reserve Barrier over 60 km/h
9	2+1 with Central Reserve Barrier up to 60 km/h
10	1 Way up to 60 km/h

## **6.4 Parameters**

### **6.4.1 Version**

This is the version number of the parameter file. This may not be the same as the version number for COBALT, as updated parameter files may not always be released at the same time as updated versions of COBALT and vice versa.

### **6.4.2 Cost Base Year**

This is the present value year for scheme appraisal, which is provided in PAG Unit 6.11 - Table 6.11.1. All costs in the parameter file should be entered in values and prices for this year. Discounting within COBALT is to be undertaken to this year.

### **6.4.3 Appraisal Period**

This is the appraisal period covering the number of years over which the assessment is undertaken. The default appraisal period (30 years) can be adjusted to reflect the expected life of the proposed scheme. For schemes with an expected life less than the default (i.e. 5 years, 10 years etc.) the appraisal period should be adjusted down accordingly.

For schemes with an expected life in excess of 30 years, the residual value of the scheme should be calculated by extending the appraisal period. For major road schemes this generally equates to a 60 year appraisal period, however the residual value period should be set out and justified in the Appraisal Plan.

### **6.4.4 Discount Rate**

This identifies the discount rate that applies to each year of the appraisal. Guidance on the discount rate that should be used is given in PAG Unit 6.11 - Table 6.11.3. The first rate applies from the current year for the number of years stated. Further rates apply once the previous rate is no longer applicable for the number of years stated.

#### **6.4.5 Cost per Casualty (by Severity)**

The cost per casualty, in €, by casualty type: for fatal, serious and slight injuries. Values used are given in PAG Unit 6.11 - Table 6.11.19 and are the sum of Lost Output, Human and Medical & Ambulance Costs.

#### **6.4.6 Cost per Collision (by Severity, by Component Part)**

This table, from PAG Unit 6.11 - Table 6.11.19, contains the non-casualty costs of collisions. It is split in two: firstly the insurance and damage to property costs (split by urban, rural and motorway), and secondly the Gardaí costs (split by urban, rural and motorway). Both parts of the table have four rows: for fatal, serious, slight and damage only collisions.

#### **6.4.7 Compound Annual Rates of Growth of Collision Values**

These are applied cumulatively to reflect real growth in collision cost values through time from the base year and are based on the rate of change of Gross National Product (GNP) per person, in real terms. These should start from the cost base year and finish with a rate for a period of the form '2025+' to cover later years.

#### **6.4.8 Number of Damage Only Collisions per PIC**

COBALT-Ireland does not calculate the number of damage only collisions per personal injury collision (by collision type) as per the UK version. As at present no data is available in the Republic of Ireland to inform this calculation.

#### **6.4.9 Link and Junction Combined Collision Proportions**

These are the default link and junction combined collision proportions by collision severity. Different values are provided for each link type. These collision proportions change over time, and so the base year for which the values apply is given at the top of the table. Values used are given in PAG Unit 6.11 - Table 6.11.23 but adjusted for under-reporting as outlined in 3.1.

#### **6.4.10 Link and Junction Combined Collision Rates and Change Factors**

This table contains the combined link and junction collision rates. Values vary by road type and speed limit and apply for the base year given at the top of the parameter file. Values used are provided in PAG Unit 6.11 - Table 6.11.22 but adjusted for under-reporting as outlined in 3.1.

Collision rates are assumed to change over time and the Beta ( $\beta$ ) factors given in this table are used to calculate the change in collision rates through the years. For the years directly after the base year the  $\beta$  factor represents the year-on-year growth rate for the collision rate relative to the previous year; for later years the  $\beta$  factor is adjusted before giving the year-on-year growth rate applied.

#### **6.4.11 Link and Junction Combined Collision $\beta$ - Factor Changes over Time**

These values indicate how the  $\beta$  factors are adjusted to give the year-on-year collision rate growth factors applied for different years. The adjustment is expressed as a factor of the difference between the  $\beta$  factor and 1. So, for example, if the  $\beta$  factor for a given collision rate was 0.96 from PAG Unit 6.11 - Table 6.11.25 and the  $\beta$  factor changes for year X and year Y are 0.5 and 0.25 respectively, then:

- the year-on-year growth in collision rates between year X-1 and year X is  $1 - (0.5 * (1 - 0.96)) = 0.98$ ; and
- the year-on-year growth in collision rates between year Y-1 and year Y is  $1 - (0.25 * (1 - 0.96)) = 0.99$ .

A change factor of 0 means the year-on-year growth is 1 (i.e. no change).

#### **6.4.12 Link and Junction Combined Casualty Rates (Fatal, Serious & Minor)**

These tables specify the number of fatal, serious and slight casualties per Personal Injury Collision (PIC), split by road type. Values used are given in PAG Unit 6.11 - Table 6.11.24.

#### **6.4.13 Link and Junction Combined Casualty Change Factors (Fatal, Serious & Minor)**

These tables contain the  $\beta$  change factors for the casualty rates for each casualty type based on road type. Values used are provided in PAG Unit 6.11 - Table 6.11.25. The  $\beta$  factors are adjusted, using the Link and Junction Combined Casualty Beta Factor Changes over Time, to calculate year-on-year growth rates for each year.

#### **6.4.14 Link and Junction Combined Casualty $\beta$ - Factor Changes over Time**

This table gives the adjustments made to the casualty rate beta factors to calculate year-on-year reduction in casualty rates over time. Adjustments are expressed as a proportion of the difference between the  $\beta$  factor and 1. A value of 1 means the year-on-year growth factor is the same as the  $\beta$  factor; a value of 0 means that the growth factor is 1 (i.e. no change). Values used are given in PAG Unit 6.11 -Table 6.11.25.



## **7. Scheme Specific Input File**

### **7.1 Scheme Data**

This section contains a description of the data required for the scheme-specific input file. The initial tables provide general information on the scheme such as the scheme name and any forecast years, while subsequent tables provide information related to the road network to be assessed, traffic flow data and any local collision rates and/or severity splits (if applicable)

COBALT compares the traffic flow outputs from two model forecasts – a ‘Without- Scheme’ forecast which excludes the scheme, and a ‘With-Scheme’ forecast which is identical to the ‘Without-Scheme’ forecast except that it includes the scheme. Much data in this file will be required twice for each modelled year and once for the base.

Where a link changes details other than flow between the ‘Without-Scheme’ and ‘With-Scheme’ forecasts, separate entries will need to be made in the combined table as appropriate, with zero flow on the version of the link which is not used in each forecast.

It should be noted that when entering data in a table in the input file, each column of data should be separated by a ‘space’ or ‘tab’ as shown in the example file in PAG Unit 6.5 - TUBA & COBALT Standard Input Files.

### **7.2 General**

#### **7.2.1 Scheme Name**

Enter a scheme name for identification purposes.

#### **7.2.2 Years Subsection**

In this section users need to enter the current year (i.e. the year in which the appraisal is being undertaken) and the base year (the flow base year, generally equivalent to the base year of the traffic model being used to supply the flows, if there is one). Then users can enter up to five key years in the life of the appraisal, for each of which the ‘Without- Scheme’ and ‘With-Scheme’ forecasts will be compared.

The current year is required since the discounting rates are applied for periods of years starting relative to the current year. Flow information will be required for the base year and each of the modelled future years. The key years need to be identified accounting for any changes in network during the appraisal period with one year as the year before the change and a second year as the first year of the revised network (described further below under Link and Junction Combined Flow Subsection).

#### **7.2.3 Scheme Opening Year**

Input the relevant scheme opening year. Results will be provided from the scheme opening year over the appraisal period.

## 7.3 Link and Junction Combined Input Section

### 7.3.1 Link and Junction Combined Classification Subsection

In this section users need to specify every link involved in or affected by the scheme, as covered by the study network. The user must enter a link name, a COBALT link type number, the length of the link (in km) and the speed limit of the link (in kph). An example of the format required is:

Link	Road	Length	Speed Limit
Name	Type	(km)	(km/h)
1	2	1.90	100
2	2	3.20	100
3	2	0.80	80

If the link type is likely to change details between the two schemes, for example if a link is changed from a single to dual carriageway, the link needs to be entered twice in the input file:

- Once in its 'Without-Scheme' state (e.g. single carriageway), which will have zero flow in the With-Scheme forecast in the link flow subsection (described below)
- Once in its 'With-Scheme' state (e.g. dual carriageway), which will have zero flow in the Without-Scheme forecast

The two versions of the link will need to be referred to by different link names; e.g. one could be given the suffix '\_DS'.

### 7.3.2 Link and Junction Combined Flow Subsection

In this section enter the vehicle flows, in units of Annual Average Daily Traffic (AADT), for each link using the same link names as specified in the link classification section. This information needs to be entered for the base year, and any years identified in the years subsection. As mentioned previously, the users can enter up to five key years in the life of the appraisal, for each of which the 'Without-Scheme' and 'With-Scheme' forecasts will be compared. If only three forecast years are being utilised, then the columns under Years 4 and 5 should be left vacant. An example of the format required is:

Link	Base Year	Without-Scheme Flows					With-Scheme Flows					
		Name	Flows	Year 1	Year 2	Year 3	Year 4	Year 5	Year 1	Year 2	Year 3	Year 4
1	1085		1105	1110	1137			1099	1120	1115		
2	5352		5422	6309	6619			5525	6406	6771		
3	7322		7796	8512	8764			7747	8537	8768		

For links which do not have any flow for a particular forecast (e.g. because they appear in the 'With-Scheme' scenario but not in the 'Without-Scheme' scenario), a zero value should be entered.

### 7.3.3 Link and Junction Combined Local Collision Rate Subsection

In this section, users can enter local collision rates for all, some, or none of the links identified in the previous sections.

Data to calculate local collision rates can be obtained from the Road Safety Authority (RSA) Personal Injury Accident database or from the local authority and should relate to a period when conditions on the road have been broadly unchanged (for example, no abnormal changes in traffic flow, no changes in junction design or road geometry, etc.). This is discussed in further detail in PAG Unit 6.1: Guidance on Conducting CBA.

For existing links where local collision data is not available, and for new links, the program will use the default collision rates from the parameter file.

For links where observed collision data exist, it can be entered in this table in one of two ways. Either:

- The observed numbers of collisions on a given link for consecutive years should be entered as a comma-delimited series in the second column 'Observed Collisions'. The first year of this series should be given in a third column 'First Observed Collision Year'. Data for a maximum of 5 consecutive years can be used (e.g. 1 2, 5, 2, 1, 3 2010); or
- A pre-calculated rate (PIC per million vehicle km) may be entered in the second column with an 'R' suffix and the year to which it refers in the third column (e.g. 1 0.236R 2010).

If no observed collision data is being used, the table should remain in the input file, but with no links listed.

## 8. COBALT Output File

The output file starts with the date and time of the model run. It also gives the version number of COBALT and contact details for the TII Strategic & Transport Planning Section and file contents.

### 8.1 Section 1 – Summary Statistics

#### 8.1.1 Section 1.1 – Economic Summary

This section gives the total costs of collisions on the study network over the appraisal period (discounted to and in the price base year as defined in the parameter file) for the ‘Without-Scheme’ and ‘With-Scheme’ forecasts, and the total economic benefit of the scheme (this will be negative if there is a dis-benefit). The total benefit is the total ‘With-Scheme’ cost subtracted from the total ‘Without-Scheme’ cost.

If the detailed output option is selected whilst COBALT is running, ‘Without-Scheme’ and ‘With-Scheme’ collision costs are also provided for each year of the appraisal period.

#### 8.1.2 Section 1.2 – Collision Summary

This presents the total number of collisions over the appraisal period for the ‘Without-Scheme’ and ‘With-Scheme’ forecasts, with the difference between the two.

If the detailed output option is selected, ‘Without-Scheme’ and ‘With-Scheme’ collision numbers are also provided for each year in the appraisal period.

#### 8.1.3 Section 1.3 – Casualty Summary

This table shows the number of fatal, serious and slight casualties over the appraisal period for the ‘Without-Scheme’ and ‘With-Scheme’ forecasts, along with the difference between the forecasts for each severity level. Note that the total number of casualties is likely to be higher than the total number of collisions (shown in the previous table), as on average, there is more than one casualty per collision.

If the detailed output option is selected, ‘Without-Scheme’ and ‘With-Scheme’ forecast casualty numbers are also provided for each year in the appraisal period.

### 8.2 Section 2 – Combined Link and Junction Collision Statistics

This section shows the number and cost of collisions for each link in the network, for the ‘Without-Scheme’ and ‘With-Scheme’ forecasts.

The table shows each combined section as appropriate, with the number of collisions in each ‘key year’ (as defined in the years subsection of the input file), and the total number of collisions over the whole appraisal period for the ‘Without-Scheme’ and ‘With-Scheme’ forecasts. There is also a total cost associated with that combined link/junction, which is the total discounted cost of all the collisions in the total column. Finally, there is a section showing the benefits of the scheme, which is the number of collisions / total cost in the ‘With-Scheme’ forecast subtracted from the number of collisions / total cost in the ‘Without-Scheme’ forecast. Dis-benefits will be shown as negative benefits.

At the bottom of each table, there is a total row, summarising collisions and costs for all the combined sections in that table for each defined year and across the appraisal period.

If the detailed output option is specified, each of the key components of the collision calculation is presented in a separate table, which displays values for each combined link/junction (rows) and each year from the scheme opening year for the appraisal period (columns).

The additional tables provide collision proportions and costs by severity of collision and costs by component for each section and year.

### 8.3 Section 3 – Combined Link and Junction Collision Rates

This section shows the parameters used to calculate collision rates. These are expressed as a single rate in each key year of the number of personal injury collisions per million vehicle kilometres in Combined Link and Junction Collision Rates.

Collision rates will be the same for both the 'Without-Scheme' and 'With-Scheme' forecasts as when the characteristics of a combined link/junction vary between the 'Without-Scheme' and 'With-Scheme' forecasts, they must be entered as two separate inputs, and therefore, the table does not need to be shown for both.

### 8.4 Section 4 – Input Data - Scheme File

The output file contains a complete copy of the scheme input file so that it can be checked that COBALT is correctly reading the input file as the user intended. Additional comments to identify warnings and errors are included on necessary lines.

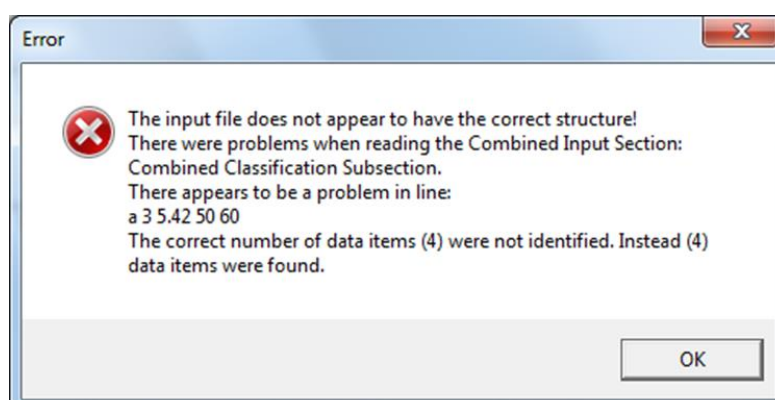
- '!' signifies an error
- '#' signifies a warning to make searching the output file easier

### 8.5 Section 5 – Input Data - Parameter File

The output file contains a complete copy of the parameter file that was used

### 8.6 Errors and Warnings

Some internal errors will cause the program to stop running, and an appropriate message will be given. Sometimes this will inform the user about an error with a particular line of the input file, an example is shown in the screenshot below where there were too many inputs. In this case, COBALT required a link name (a), a link type (3), flow (5.42) and speed limit (50). However, there is an additional entry (60). Specifying the line content helps the user find the error in the input file.



Other errors with input values that cause results to fall outside expected ranges can result in either a warning or an error. The program will finish running and write out an output file in these cases, but caution should be taken with the results. Warnings indicate possible anomalies in the input data and should be investigated. Errors will cause the COBALT calculation to exclude some links/junctions from the calculations.

The screenshot below shows an example of the message given when there are errors or warnings. In addition, details are given against the line of the input file affected in the copy included in Section 4 of the output file.

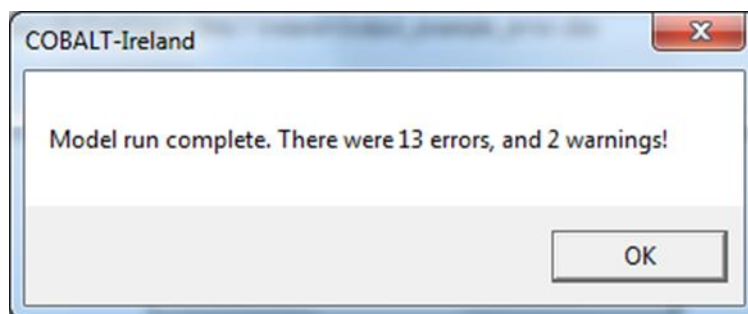



Table 6.4.3 lists the main reasons for error and warning messages appearing.

**Table 6.4.3 COBALT Errors and Warnings**

Error	Outcome
Road type is not numeric, or is outside the range 1 to 10	Error
Road type is a decimal. In this instance, the program rounds it down to a whole number	Warning
Link length is zero or negative	Error
Speed limit is not numeric	Error
Speed limit is not a multiple of 10	Warning
Motorway speed limit is less than 60kph	Error
Speed limit is outside the range for that road link type	Warning
Flows are not numeric or are negative	Error





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