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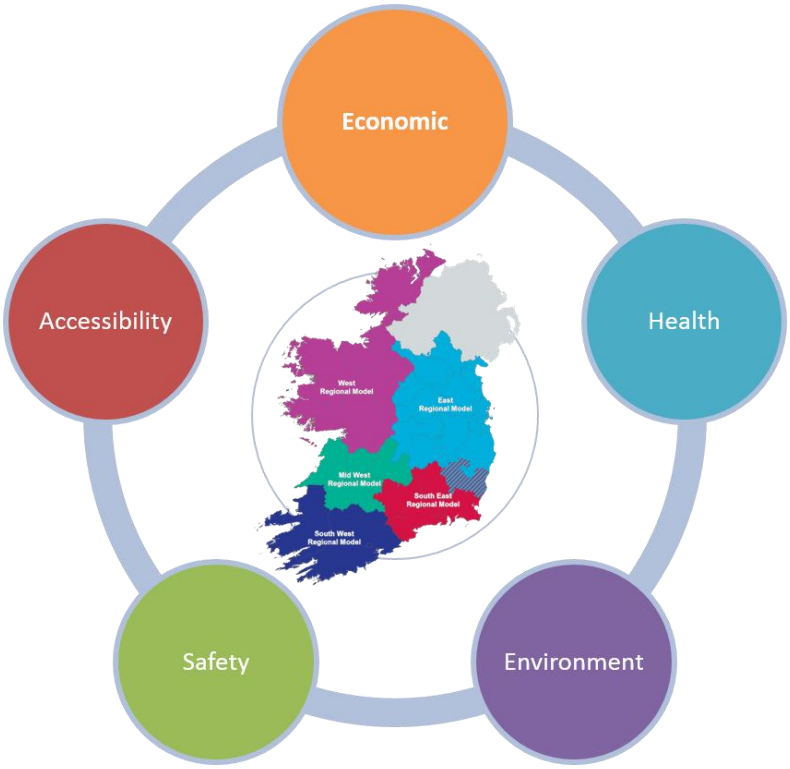
Údarás Náisiúnta Iompair
National Transport Authority



Safety Module

Development report

March 2021 (v3.1.1)

National Transport Authority,
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1 Introduction

1.1 Introduction to the Task

Jacobs/SYSTRA were commissioned by the National Transport Authority to develop a set of Appraisal Modules linking to the outputs of its Regional Modelling System. Appraisal modules were developed for each of the following aspects of standard transport scheme assessment and appraisal:

- **Safety Appraisal**
- Economic Appraisal
- Environmental Appraisal
- Health Appraisal; and
- Accessibility and Social Inclusion Appraisal.

This report describes the technical implementation of Safety Appraisal Module.

1.2 Safety Appraisal Module Overview

The purpose of this technical note is to document the development and describe the operation of the Safety Appraisal Module. This note also describes the testing and sense checking of the appraisal module and outlines some items that were considered when the module was incorporated into the other regional transport models.

The Safety Appraisal Module has been developed using model parameters and outputs from the Eastern Regional Model (ERM), formerly known as the Greater Dublin Area (GDA) model, as the module was incorporated firstly into the ERM model and then into all other regional transport models.

The Safety Appraisal Module has been developed in accordance with the methodology outlined in the Safety Overview note, December 2016, and is accompanied by a User Guide, *"Safety Appraisal Module User Guide, December 2016."*

The structure of this note is as follows:

- Section 2: Overview of Safety Appraisal Module Development, including input assumptions, current limitations and potential future enhancements;
- Section 3: Testing and Sense Checking, including a description of tests and checks undertaken; and
- Section 4: Incorporating the Safety Appraisal Module into the other regional transport models, including an outline of items that were considered.

2 Overview of Safety Appraisal Module Development

2.1 Introduction

The Safety Appraisal Module process has been developed in Cube Voyager software (Version 6.0.2) and uses a bespoke version of the COBALT Ireland spreadsheet.

The bespoke version of the COBALT Ireland spreadsheet has been developed by Transport Infrastructure Ireland (TII) for use with the regional transport models. This bespoke version automatically reads in a path file locations file, which are created automatically by the Cube Voyager process, so that the Cube Voyager process can automatically open and run the COBALT spreadsheet.

A simple overview of the Safety Appraisal Module process is shown in Figure 1 below.

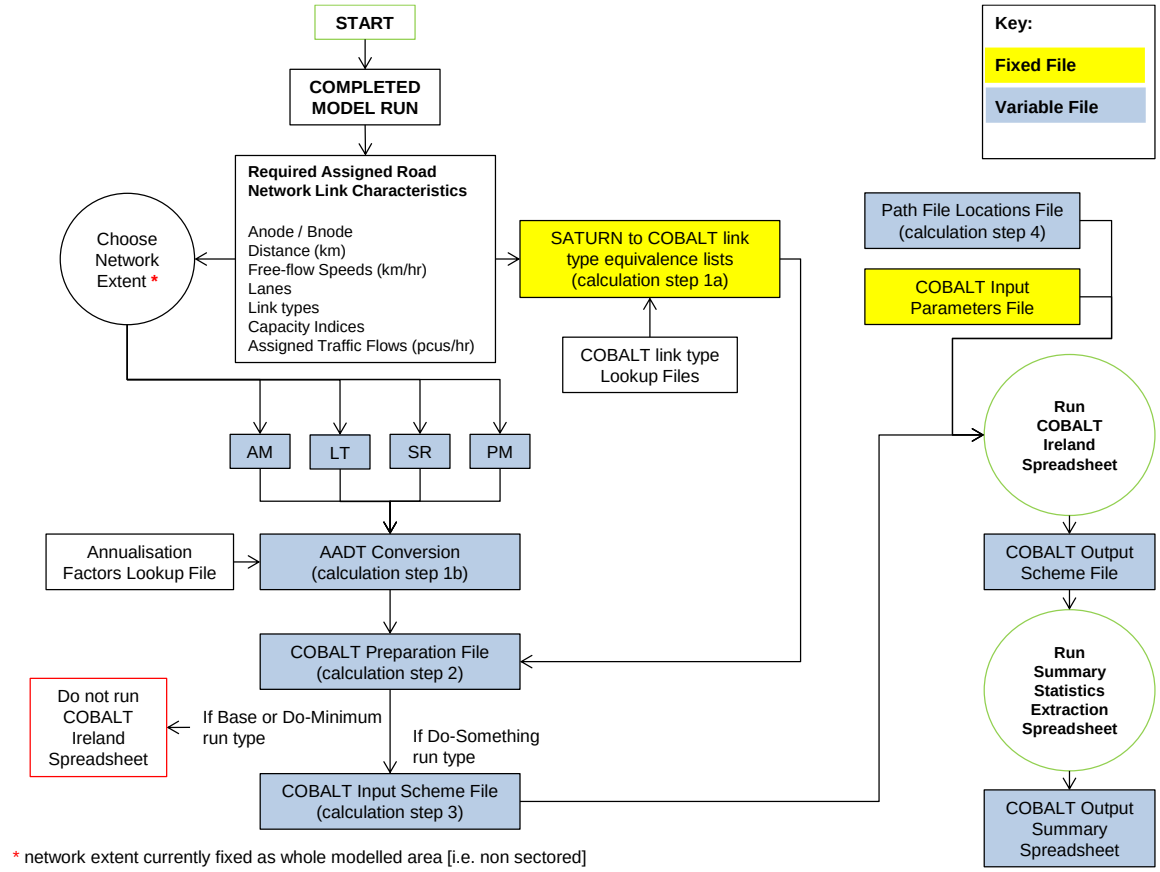

Figure 1: Safety Appraisal Module Process Flow Chart

2.2 Cube Voyager Catalogue

Preparing COBALT Ireland Spreadsheet File Inputs

The Safety Appraisal Module process uses all four time period's specific assigned road network outputs from the Base, Do-Minimum and Do-Something modelled scenarios. It is those network outputs, in conjunction with COBALT link types, that ultimately provide the combined link and junction traffic flow information for input to the COBALT Input Scheme Files. As COBALT has issues with runs with over 10,000 links, the scheme input CBI file gets split into multiple files with 9,900 links each. These are then sequentially run through COBALT.

There are three main inputs to the COBALT Ireland spreadsheet and these are:

- COBALT Input Scheme File:
  {Do-Something Run ID}{Growth}{YY}_COBALT_SCHEME_FILE_NON_SECTORED(File Number).cbi
  Where {Do-Something Run ID} =Run ID name, {Growth}= Forecast Year Growth, {YY} = Modelled Year, (File Number) = current file number.
- **Path File Locations File:**
  Cobalt_run_files.txt
- COBALT Input Parameters File:
  COBALT-Ireland_NRPAG_Parameters.cbp

The Cube Voyager Interface process automatically creates the COBALT Input Scheme Files and the Path File Locations Files, whereas the COBALT Input Parameters File is not created by the process. This file is fixed and its inputs do not change.

Four overarching calculation steps are undertaken to create the COBALT Input Scheme Files and the Path File Locations Files. These are shown in the process flow chart in Figure 1 above and are described in more detail below.

Calculation Steps

Step 1A – SATURN to COBALT link type equivalence

This initial step assigns a COBALT link type to the SATURN road network links. Each SATURN road link has been assigned a COBALT link type based on road link capacity indices or a combination of road speeds and number of lanes. The latter has been used for road links where no capacity index has been defined, this is an area which broadly covers links in the central Dublin area within the M50 motorway.

The input files are;

- **COBALT Equivalence Step 1.dbf**
- **COBALT Equivalence Step 2.dbf**

and are read using a VLOOKUP function in conjunction with the assigned road networks

- Road_AM_{Do-Something Run ID}{Growth}{YY}.NET
  where AM = Time Period, {Do-Something Run ID} = Run ID Name, {Growth} = Demand Scenario and {YY} = Model Year

Both COBALT Equivalence files are based on the attributes from the calibrated ERM 2012 Base year network and were updated using the ERM 2016 Base year. When the network changes in a forecast

scenario, there may be new combinations of link speeds and number of lanes, or capacity indices, which is handled via the CBI_Links.exe file as explained further down.

Table 1: SATURN to COBALT link type equivalence, Voyager Programs Location

Voyager Program	Module Execution Number	Model Type	Location
NETWORK	6	Base	Sub-Group 5
NETWORK	19	Do-Minimum	Sub-Group 7
NETWORK	4	Do-Something	Sub-Group 10

Step 1B – AADT Conversion

The second part of this initial step converts the modelled peak hour traffic flows from Passenger Car Unit (PCU) to Vehicles and then converts the peak hour traffic flows (in vehicles) into Annual Average Daily Traffic (AADT) flows.

The PCU to Vehicle factors are shown in Table 3 below and are consistent with those specified in Section 3.6.5 of the *"GDA Road Model Development Report, July 2015."* The PCU factors are hard coded into the relevant Voyager script files and noting that the modelled PCU traffic flows are divided by the PCU factor to give modelled vehicle traffic flows.

The Annualisation Factors for ERM are shown in Table 4. These have been calculated based on a simple methodology from the period to hour factors obtained from the NDFM. Each annusliation factor is calculated by converting the modelled hour to a modelled period, by the following calculation: (1/"Period To hour factor"). This then gets multipled by 252 working days to calculate a the final annusliation factors. The factors should be reviewed on a project basis based on local data.

The Annualisation Factors are contained within the input file;

- **{Regional Model}_Annualisation factors.dbf**
  and are read using a VLOOKUP function in conjunction with the assigned road networks
- Road_AM_{Do-Something Run ID}{Growth}{YY}.NET
  where AM = Time Period, {Do-Something Run ID} = Run ID Name, {Growth} = Demand Scenario and {YY} = Model Year
  The annualised traffic flows (in vehicles) are then divided by 365 to give AADT traffic flows.

Table 2: AADT Conversion, Voyager Programs Location

Voyager Program	Module Execution Number	Model Type	Location
NETWORK	6	Base	Sub-Group 5
NETWORK	19	Do-Minimum	Sub-Group 7
NETWORK	4	Do-Something	Sub-Group 10

Table 3: PCU to Vehicle Factors by User Class

User Class	PCU to Vehicle Factor
Taxi, Car and LGV's	1.0
OGV1	1.9

OGV2 Permit Holder and OGV Other	2.9
Bus	3.0

Table 4: Default Annualisation Factors by Mode, East Regional Model (ERM)

Period	Car	Public Transport
Weekday Morning Peak Hour to Annual Weekday Morning Peak Period (AM)	716	548
Weekday Evening Peak Hour to Annual Weekday Evening Peak Period (PM)	728	630
Weekday Average Lunch Time Hour (Inter-peak 1) to Annual (LT)	735	720
Weekday School Run Hour (Inter-peak 2) to Annual (SR)	696	681

Step 2 – COBALT Preparation File

Step 2 creates the COBALT preparation file. This is an intermediate file that is used as the basis for creating the COBALT Input Scheme File. The file contains all necessary link information that is used by the COBALT Ireland spreadsheet including link ID, COBALT link type, distance, speed and AADT traffic flows for the Base, Do-Minimum and Do-Something scenarios.

A fundamental part of this calculation is looping through the Do-Something scenario records and combining their link Anodes and Bnodes. This ensures all network links are accounted for [i.e. including those contained within the Base and Do-Minimum scenarios] and, hence, the correct link information is used.

For example, if a link in the Do-Something scenario is not in the Do-Minimum scenario, then the link for the Do-Minimum scenario will still appear in the COBALT Preparation File but with zero AADT, which is correct. If, however, the calculation looped through the Do-Minimum scenario records and combined their link Anodes and Bnodes, then links that are specific to the Do-Something scenario will not appear in the COBALT Preparation File, which is incorrect.

Table 5: COBALT Preparation File, Voyager Program Location

Voyager Program	Module Execution Number	Model Type	Location
NETWORK	7	Base	Sub-Group 5
MATRIX	8, 10, 12, 20, 22, 24	Do-Minimum	Sub-Group 7
MATRIX	7, 11, 15	Do-Something	Sub-Group 10

Step 3 – COBALT Input Scheme File

This step creates the COBALT Input Scheme File. The calculation, in effect, dumps the information contained within the COBALT Preparation File into the COBALT Input Scheme File and formats the information according to the COBALT spreadsheet requirements. During this process, only modelled

links that include a COBALT link type are used; zone centroid connectors are excluded from the process. This is done via an external .exe file, due to the character limit in a string in CUBE as not all the information needed can fit on a string. Therefore the .exe file takes the base, do something, and do minimum files and combines them, producing the final COBALT Input scheme file. This executable file is called CBI_Links.exe. It is located in the \Program directory of the main directory. It takes as an input any number of preparation files created beforehand (depending how many years the run has used) as well as various factors such as the zone number, years and other variables, to produce a final cbi file. It was written in C#, and the raw code for the executable can be found in can be found on the NTA server, under the Executables Code folder. As mentioned in section 1a above, this .exe deals with links changing characteristcs between the Base / DM / DS scenarios, and splits out the links into separate ones if characteristsics have changed.

Other information is also appended to the General Scheme Section of the COBALT Input Scheme File, including the scheme name, modelled years, scheme opening year and current year [i.e. the year in which the appraisal is being undertaken. This is currently set to 2016].

As a final step, the COBALT Input scheme file gets automatically split into separate input files, each containing 9900 links. This is to ensure that COBALT runs, as COBALT does not run with over 10000 links. This is done via an external .exe file, and keeps all the other information (Such as the years) the same. This file is called CBI_Split.exe. It is also located in the \Program directory of the main directory. It takes the CBI produced by the above executable, and produces split cbi files, and a file containing the number of cbi files that were created. It was also written in C#, and the raw code for the executable can also be found in can be found on the SharePoint site, under the Executables Code folder

In keeping with the run requirements of the COBALT Ireland spreadsheet, the Safety Appraisal Module allows a maximum of five forecast years for each of which the Do-Minimum and Do-Something can be compared.

Table 6: COBALT Input Scheme File, Voyager Program Location

Voyager Program	Module Execution Number	Model Type	Location
MATRIX	9, 13, 16	Do-Something only	Sub-Group 10

Step 4 – Path File Locations File

This fourth and final step creates the path file locations file which is named **Cobalt_run_files.txt**. This file consists of the locations of the required input files (see beginning of Section 2.2) to run the COBALT Ireland spreadsheet and the location of the output file. The calculation is hard coded into the relevant Voyager script file and it uses a selection of catalogue keys to define the path file locations. This file is created in a loop, as COBALT needs to run individually for every COBALT Input scheme file, this file gets reproduced with the correct COBALT Input scheme file for every loop.

Table 7: Path File Locations File, Voyager Program Location

Voyager Program	Module Execution Number	Model Type	Location
MATRIX	16	Do-Something only	Front End User Interface

Running the COBALT Ireland Spreadsheet

A bespoke version of the COBALT Ireland spreadsheet (COBALT-Ireland_2015_06_v0.8.xls) has been developed by Transport Infrastructure Ireland (TII) for use with the regional transport models. This

bespoke version automatically reads in **Cobalt_run_files.txt** which contains the input and output files locations. There is no need for the user to manually input the locations of the files. COBALT will run for every COBALT Input scheme file created and will produce an appropriate output file for each run. The number of runs is determined by the .exe file mentioned above that splits the initial COBALT Input scheme file. This .exe also produces a text file with the number of files that have been created; this is read by the program to determine the number of runs.

The Voyager process also automatically runs the COBALT Ireland spreadsheet for a Do-Something Scenario only and once all necessary input files have been created, including the Base, Do-Minimum and Do-Something COBALT Preparation Files. The COBALT spreadsheet then produces a detailed output scheme file consisting of accident summary statistics. The output scheme file is called:

- {Do-Something Run ID}{Growth}{YY}_COBALT_OUTPUT_FILE_NON_SECTORED(File Number).cbo

  where {Do-Something Run ID} = Run ID Name, {Growth} = Forecast Year Growth, {YY} = Modelled Year, (File Number) = current file number.

Exact details of what is contained in the output file can be found in the COBALT User Guide which is readily available on the Department for Transport (DfT) website[1].

Table 8: Running the COBALT Ireland Spreadsheet, Voyager Program Location

Voyager Program	Module Execution Number	Model Type	Location
PILOT	17	Do-Something only	Front End User Interface

Running the Summary Statistics Extraction Spreadsheet

Once the COBALT Ireland Spreadsheet has run successfully and has produced the detailed output scheme file [i.e. COBALT Output Scheme File], the Voyager process then automatically runs the Summary Statistics Extraction Spreadsheet. The macro contained in this spreadsheet facilitates the extraction of high level safety appraisal summary statistics from the COBALT Output Scheme File. This summary is then populated into a separate spreadsheet which is saved in the relevant output directory folder. The COBALT Output Summary Spreadsheet is called:

- {Do-Something Run ID}{Growth}{YY}_Safety_Summary_Statistics_NON_SECTORED.xlsx

  where {Do-Something Run ID} = Run ID Name, {Growth} = Forecast Year Growth, {YY} = Modelled Year

Table 9: Running the Summary Statistics Extraction Spreadsheet, Voyager Program Location

Voyager Program	Module Execution Number	Model Type	Location
PILOT	0	Do-Something only	Front End User Interface

Note the spreadsheet above has not updated from v2 of the tool, and the spreadsheet itself has not been used in the v3 development.

[1] https://www.gov.uk/government/publications/cobalt-software-and-user-manuals

A summary of all the input and output files that are required for the Safety Appraisal Module is shown in Table 10 below.

Table 10: Safety Appraisal Module Input and Output Files

Input File	Description	Location
Road_AM_BY05A512.NET * * example Time Period, Base Run ID, Base Demand Scenario, Base Model Year	**Assigned Road Network** that is time period and scenario specific, and in Voyager format. It contains the required link characteristics used to create the COBALT Input Scheme File. This is a variable file and its inputs will change according to differing transport model runs. It is not created by the Safety Appraisal Module process.	**{Catalog_Dir}\{Regional model}\Runs\{YY}\{Do-Something Run ID}\4_Output_}\{Regional model}_{Growth}_{Do-Something Run ID}_Input_V{Version number}\Road\AM** * Model Year, Run ID, Demand Scenario, Time Period, Version number
{Regional model}_Annualisation factors.dbf	**Annualisation Factors** by mode as described above This is a fixed file and its inputs do not change. It is not created by the Safety Appraisal Module process. The factors should be reviewed on a project basis based on local data.	**{Catalog_Dir}\COBALT**
COBALT Equivalence Step 1.dbf	**SATURN to COBALT link type equivalence list** consisting of the number of lanes, lane speed and corresponding COBALT link types. This file is used to attribute a COBALT link type to links where no capacity index is defined. This is a fixed file and its inputs do not change. It is not created by the Safety Appraisal Module process.	**{Catalog_Dir}\COBALT**
COBALT Equivalence Step 2.dbf	**SATURN to COBALT link type equivalence list** consisting of link capacity indices and corresponding COBALT link types. This is a fixed file and its inputs do not change. It is not created by the Safety Appraisal Module process.	**{{Catalog_Dir}\COBALT**
COBALT-Ireland_NRPAG_Parameters.cbp	**COBALT Input Parameters File** consisting of a series of data tables of standard parameters required to calculate accident impacts in line with Project Appraisal Guidance (PAG). This is a fixed file and its inputs do not change. It is not created by the Safety Appraisal Module process. The user should confirm with the NTA if a different cbp file should be used.	**{Catalog_Dir}\COBALT**
Cobalt_run_files.txt	**Path File Locations File** consisting of files locations for input to the COBALT Ireland spreadsheet. This is a variable file and its inputs will change according to differing transport model runs. It is created automatically by the Safety Appraisal Module process for a Do-Something model type only.	**{Catalog_Dir}\COBALT**

Input File	Description	Location
LR701SD235_COBALT_SCHEME_FILE_NON_SECTORED2.cbi * * example Do Something Run ID, Forecast Growth, Forecast Year, File Number	**COBALT Input Scheme Files** consisting of modelled and scheme specific information for the safety appraisal (NB non-sectored and hence covering the full modelled area). This is a variable file and its inputs will change according to differing transport model runs. It is created automatically by the Safety Appraisal Module process for a Do-Something model type only. The number of these files created will change according to different transport models runs.	{Catalog_Dir}\{Regional model}\Runs\{YY}\{Do-Something Run ID}\4_Output_}\{Regional model}_{Growth}_{Do-Something Run ID}_Input_V{Version number}\Appraisal_Tools\Safety * Model Year, Run ID, Demand Scenario, Time Period, Version number
COBALT-Ireland_2015_06_v0.8.xls	**COBALT Ireland Spreadsheet** that governs the Safety Appraisal calculations and is run for a Do-Something model type only.	{Catalog_Dir}\COBALT
Summary_Statistics_30_Year_Appraisal_v2.xlsm	**Summary Statistics Extraction Spreadsheet** that facilitates extraction of high level safety appraisal summary statistics from the COBALT Output Scheme File. It is run for a Do-Something model type only.	{Catalog_Dir}\COBALT
LR701SD235_COBALT_OUTPUT_FILE_NON_SECTORED2.cbo * * example Do Something Run ID, Forecast Growth, Forecast Year, File Number	**COBALT Output Scheme Files** consisting of safety appraisal summary statistics (NB non-sectored and hence covering the full modelled area). This is a variable file and its outputs will change according to differing transport model runs. It is created automatically by the Safety Appraisal Module process for a Do-Something model type only. The number of these files created will change according to different transport models runs.	{Catalog_Dir}\{Regional model}\Runs\{YY}\{Do-Something Run ID}\4_Output_}\{Regional model}_{Growth}_{Do-Something Run ID}_Input_V{Version number}\Appraisal_Tools\Safety * Model Year, Run ID, Demand Scenario, Time Period, Version number
LR701SD235_Safety_Summary_Statistics_NON_SECTORED.xlsm * * example Do Something Run ID, Forecast Growth and Forecast Year	**COBALT Output Summary Spreadsheet** consisting of high level safety appraisal summary statistics extracted from the COBALT Output Scheme File. This is a variable file and its outputs will change according to differing transport model runs. It is created automatically by the Safety Appraisal Module process for a Do-Something model type only.	{Catalog_Dir}\{Regional model}\Runs\{YY}\{Do-Something Run ID}\4_Output_}\{Regional model}_{Growth}_{Do-Something Run ID}_Input_V{Version number}\Appraisal_Tools\Safety * Model Year, Run ID, Demand Scenario, Time Period, Version number

2.3 Current Limitations and Future Enhancements

This subsection outlines current limitations of the Safety Appraisal Module as well as highlighting potential future enhancements.

Current Limitations

The current limitations are listed and described below:

- The Safety Appraisal Module can only be run using Excel 64-bit version and on a 64-bit operating system;

- The network extent is currently fixed as whole modelled area [i.e. non-sectored] for the safety appraisal calculations;
- The safety appraisal analysis is provided in the COBALT Output Scheme for a 30 year appraisal period only; and
- The Safety Summary Statistics spreadsheet assumes that under Sections 1.1 to 1.3 of the COBALT Output Scheme File a space between an equals sign and numerical values, as well as a space between the 'year' column and numerical values will always exist.

Future Enhancements

Potential future enhancements are listed and described below:

- Create the Step 1 SATURN to COBALT link type equivalence list (see Table 10 above) that could potentially cover all likely combinations of link speeds and number of lanes. A review of this link type equivalence list would still need to be undertaken when a new scheme is coded into the model. It is therefore more practical to update the list manually and incorporate into the Safety Appraisal Module when a new scheme is being coded;
- Create the Step 2 SATURN to COBALT link type equivalence list (see Table 10 above) that includes a list of new link capacity indices. However, it would not be practical to create a list of new capacity indices because any new index would be dependent on the scheme that is being coded into the model. It is therefore more practical to update the list manually and incorporate into the Safety Appraisal Module when a new scheme is being coded;
- The modelled network extents used in the Safety Appraisal Module could be sectored so that the safety benefits (or otherwise) are presented at a sector level [e.g. by county]. The functionality is in place but it needs to be fully developed and tested prior to use;
- Include update to economic parameters that are set in the COBALT Input Parameters File to be in line with the forthcoming update of Common Appraisal Framework (CAF);
- Update the Summary Statistics Extraction Spreadsheet to account for a 60 year appraisal period; and
- Update the Safety Appraisal Module so that it extracts safety benefits (or otherwise) from the COBALT Output Scheme File and then maps areas of safety benefits to the modelled network. The mapping of safety benefits could potentially use the ENEVAL grid square process.

3 Testing and Sense Checking

3.1 Introduction

This section outlines the results of the testing and sense checking that has been undertaken to determine the robustness of the Safety Appraisal Module process and its results. A full testing spreadsheet for both phase 1 and phase 2 of developments have been created and documented with tests, however the major tests will be set out here.

3.2 ERM Test

Tests have been successfully undertaken on NTA machines and consultant's computers. A sample ERM runs was used as a Do-Something single intervention test has been used as the basis for testing and sense checking. It is not the intention of the testing and sense checking to provide a full safety appraisal of the sample scheme. Instead, the safety appraisal has been undertaken to determine whether the results and trends are in line with expectations and thereby confirming the Safety Appraisal Module is performing as expected.

An update on other items that are required as part of the Testing and Signing Off process is also included and this is shown in Table 11 below.

Table 11: Steps in Testing and Signing Off the Safety Appraisal Module Process

Item	Completed	Comment
Peer review of standard economic file	No	The COBALT Input Parameters File has been provided by TII. It is assumed that the parameters have been peer reviewed and are appropriate for use with the regional models.
Detailed (independent) checking that the scheme file is as expected	Yes	A detailed line-by-line check has been made that confirms the COBALT Scheme Input File in both single and multiple forecast year modes is populated with the correct scenario specific information and in the correct format.
Check that link / network specification functionality in the scheme file output process performs as expected	Yes	The COBALT Input Scheme File has been created manually and then crosschecked against the COBALT Input Scheme File that is created automatically by the Safety Appraisal Module process. Both input files have then been run through the COBALT Ireland spreadsheet which has resulted in the same COBALT outputs being produced.
Run COBALT for a sample scheme and sense check headline appraisal results	Yes	Headline results for the Sample scheme are in line with expectations and are summarised in Section 3.3, Results Summary.

3.3 Results Summary

Table 13 below presents a summary of the accident appraisal results for the sample Scheme. These same results have been produced using the Safety Appraisal Module and using the more conventional approach of manually creating the COBALT Scheme Input File and running the COBALT Ireland spreadsheet.

Table 12: Summary of Safety Appraisal, Metro North Scheme, 30 year appraisal

Item	Do-Minimum (DM)	Do-Something (DS)	Difference (DS vs DM)
Economic Summary (€1,000s)	3,407,670	3,401,508	-6,162
Accident Summary	67,568	67,440	-128
Casualty Summary			
Fatal	856	854	-2
Serious	3,672	3665	-7
Slight	92,588	92,414	-174

3.4 Updated parameters

As part of the v3 update of the tool, the annualisation factors and .cbp file parameters were updated. The calculations for the annualisation factors was explained above, while the new .cbp file is the latest available file from the TII website (Accessed 10/03/2021). Below is a summary table comparing the results of the same ERM reference scenario, but using different facotrs. The table has three columns, one was a run with all the old v2 factors. One was a run with the old cbp file but with the new annualisation factors and the final run used the new annualisation factors and the new cbp file.

Table 13: Summary of Safety Appraisal using different annualisation factors and cbp file.

		Updated annualisation factors	Updated annualisation factors + new cbp
[Section 1] Summary Statistics			
[Section 1.1] Economic Summary			
Total Without-Scheme Collision Costs =		2809666	3407670
Year		W/o-scheme	W/o-scheme
2020		186736.3	203322.3

2021		175028.2	192406.9
2022		164060.3	182083.8
2023		153785.4	172321.3
2024		144159.4	163088.6
2025		135141	154356.1
2026		126693	146098
2027		120332.9	140098.4
2028		114293.1	134346.1
2029		108557.7	128831.2
2030		103111.1	123544
2031		97938.3	118474.5
2032		93026	113614.5
2033		88361.1	108954.4
2034		83930.6	104486.7
2035		79723.2	100203.3
2036		75727.3	96095.9
2037		72859.1	93345.2
2038		70099.6	90673.1
2039		67444.5	88077.5
2040		64889.8	85556.3
2041		62432.2	83107.5
2042		60067.4	80728.5
2043		57792.2	78417.5
2044		55603.3	76172.8
2045		53497.2	73992.4
2046		51471	71874.3
2047		49521.4	69817.1
2048		47645.8	67818.4
2049		45841.2	65877.2
Costs and benefits discounted to 2011 in multiples of a thousand euros.			
[Section 1.2] Collision Summary			
Total Without-Scheme Collisions =		67568.20	67568.20
Year		W/o-scheme	W/o-scheme
2020		2683	2683
2021		2626.6	2626.6
2022		2571.4	2571.4
2023		2517.5	2517.5
2024		2464.6	2464.6
2025		2412.8	2412.8

2026		2362.1	2362.1
2027		2337.3	2337.3
2028		2312.7	2312.7
2029		2288.5	2288.5
2030		2264.5	2264.5
2031		2240.6	2240.6
2032		2217.1	2217.1
2033		2193.9	2193.9
2034		2170.8	2170.8
2035		2148	2148
2036		2125.4	2125.4
2037		2125.4	2125.4
2038		2125.4	2125.4
2039		2125.4	2125.4
2040		2125.4	2125.4
2041		2125.4	2125.4
2042		2125.4	2125.4
2043		2125.4	2125.4
2044		2125.4	2125.4
2045		2125.4	2125.4
2046		2125.4	2125.4
2047		2125.4	2125.4
2048		2125.4	2125.4
2049		2125.4	2125.4
[Section 1.3] Casualty Summary			
Year		Without-Scheme	Without-Scheme
Year		Fatal	Fatal
2020		37.6	37.6
2021		36.3	36.3
2022		35.2	35.2
2023		34	34
2024		32.9	32.9
2025		31.7	31.7
2026		30.8	30.8
2027		30.2	30.2
2028		29.7	29.7
2029		29.2	29.2
2030		28.7	28.7
2031		28.2	28.2
2032		27.7	27.7
2033		27.3	27.3

2034		26.7	26.7
2035		26.4	26.4
2036		26	26
2037		26	26
2038		26	26
2039		26	26
2040		26	26
2041		26	26
2042		26	26
2043		26	26
2044		26	26
2045		26	26
2046		26	26
2047		26	26
2048		26	26
2049		26	26

Appendix A Regional Models Annualisation Factors

Model	Car Annualisation Factors				Public Transport Annualisation Factors			
	AM	LT	SR	PM	AM	LT	SR	PM
Eastern Regional Model	716	735	696	728	548	720	681	630
South West Regional Model	558	554	527	473	487	564	535	577
West Regional Model	441	553	551	453	436	441	444	492
South East Regional Model	512	515	555	525	409	496	472	514
Mid-West Regional Model	616	728	683	668	681	720	764	681