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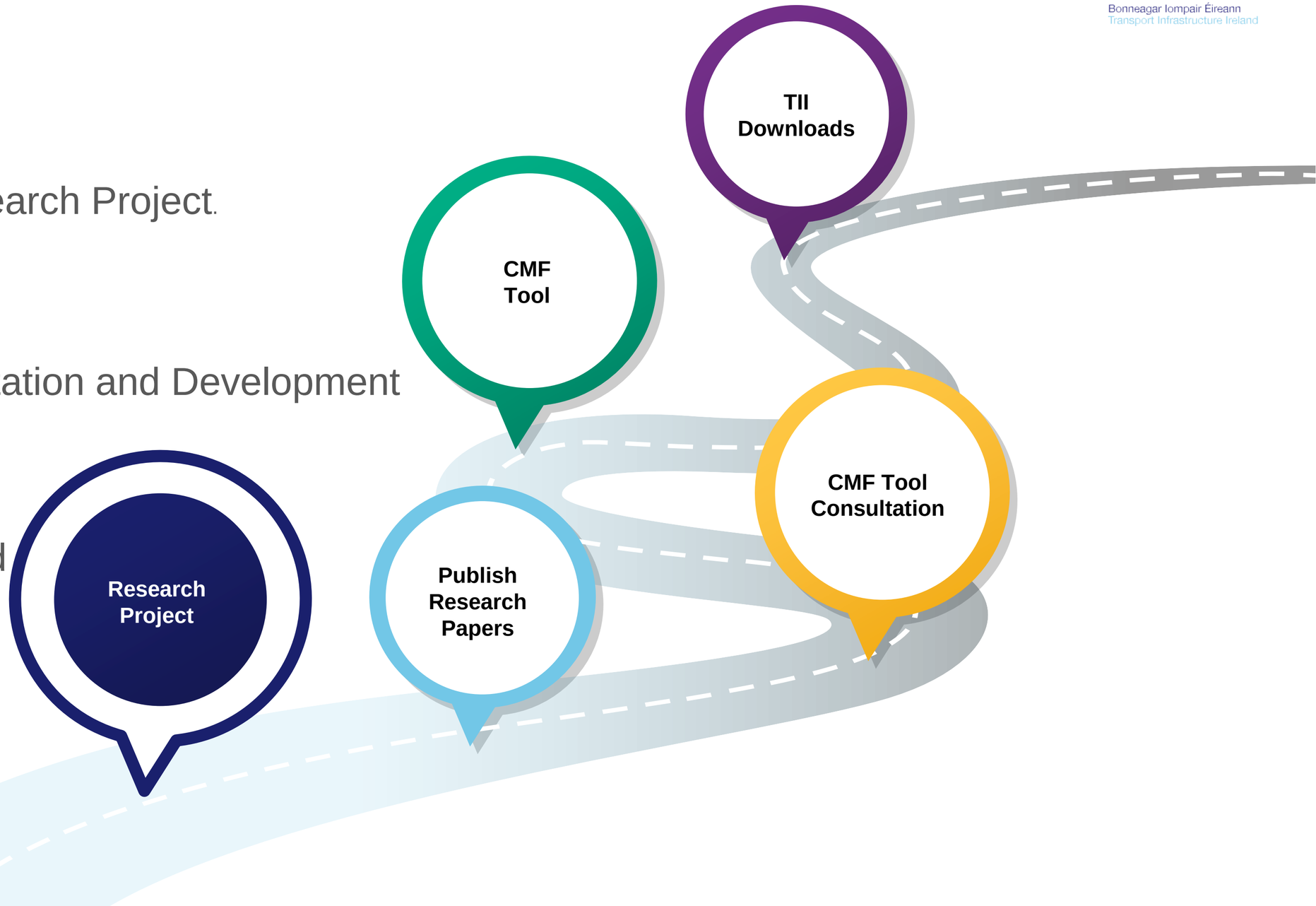
CMF TOOL

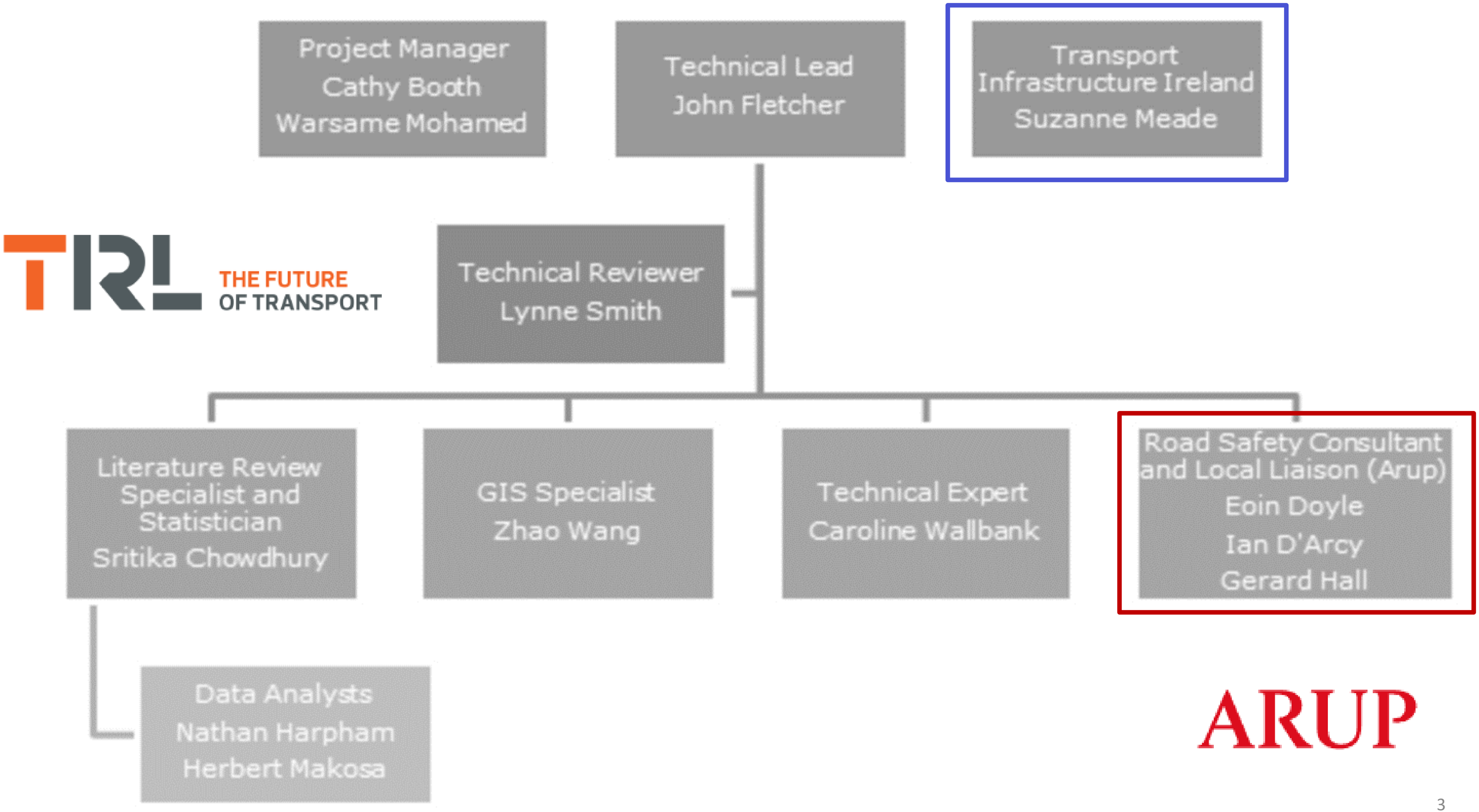
TII Road Safety Research Collision Prediction Model for the Irish National Road NetworK

Dr. Suzaanne Meade

Development

1. 2021 – 2023 Research Project.
2. Publish Research
3. CMF Tool Consultation and Development
4. CMF Tool Testing
5. New TII Download Tool – TII Publications

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THE FUTURE OF TRANSPORT
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ARUP

AIM: DETERMINE IT THERE is a statistical modelling technique that can practically be applied in the Irish context that will result in robust estimates of the CMFs for a range of (useful) countermeasures?
Model (APM) based on National road parameters and data.

OBJECTIVE 1: develop an Accident Predictive

OBJECTIVE 2: produce Crash Modification Factors (CMFs) to reflect safety performance of countermeasures in Ireland.

(Currently CMFs from international experience are available via **PRACTs** or **Clearing House only**)

APMs *- statistical approaches such as Generalised Linear Modelling (GLM). The mathematical relationship between crashes and the risk factors (Parameters) are calculated and assessed for significance. Controlled for exposure (Traffic).*

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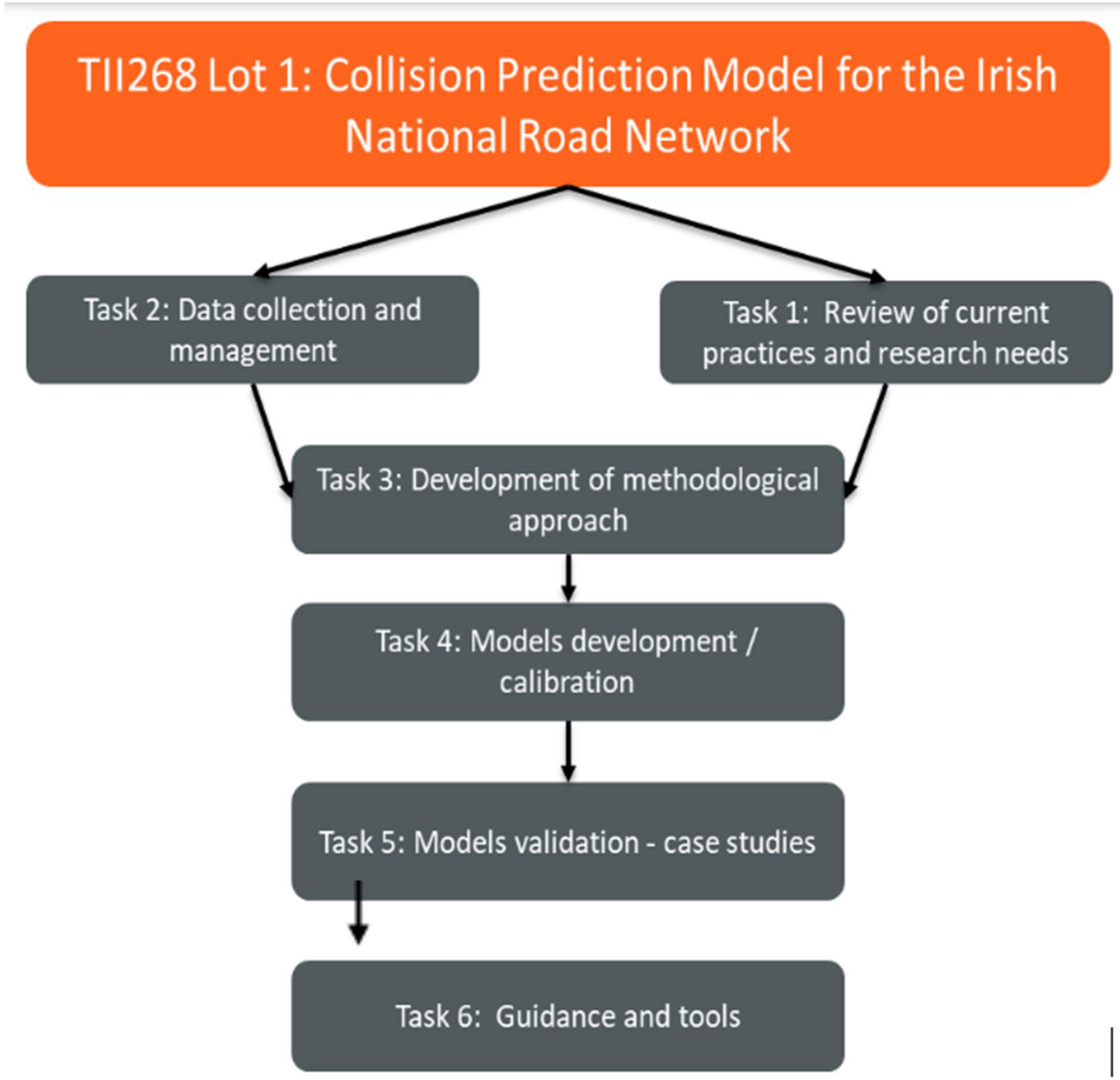


Figure 1: Project tasks

Search will identify c700	700	List on excel sheet, Review abstract on screen, Simple **yes no** recorded
Short list	50	Review abstracts more carefully
Final list	**15**	Top 15 reviewed in depth

TRL reports	**5**	Reviewed in depth
Relevant papers pre 2010	**5**	Reviewed in depth
Total reviewed in depth	**25**	

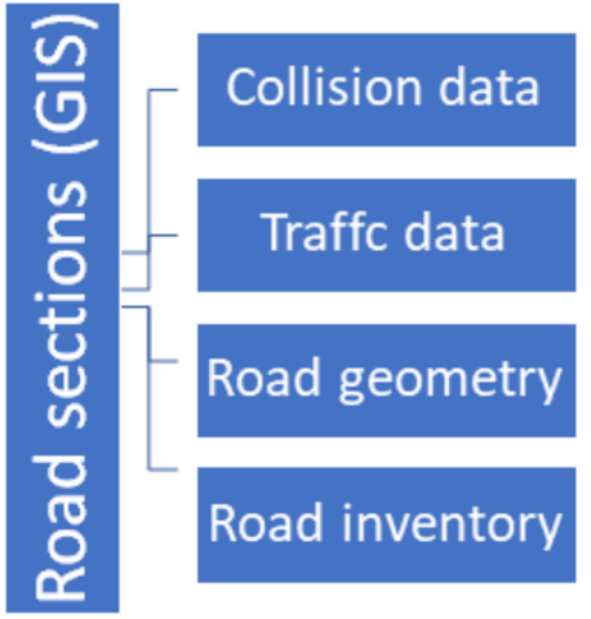
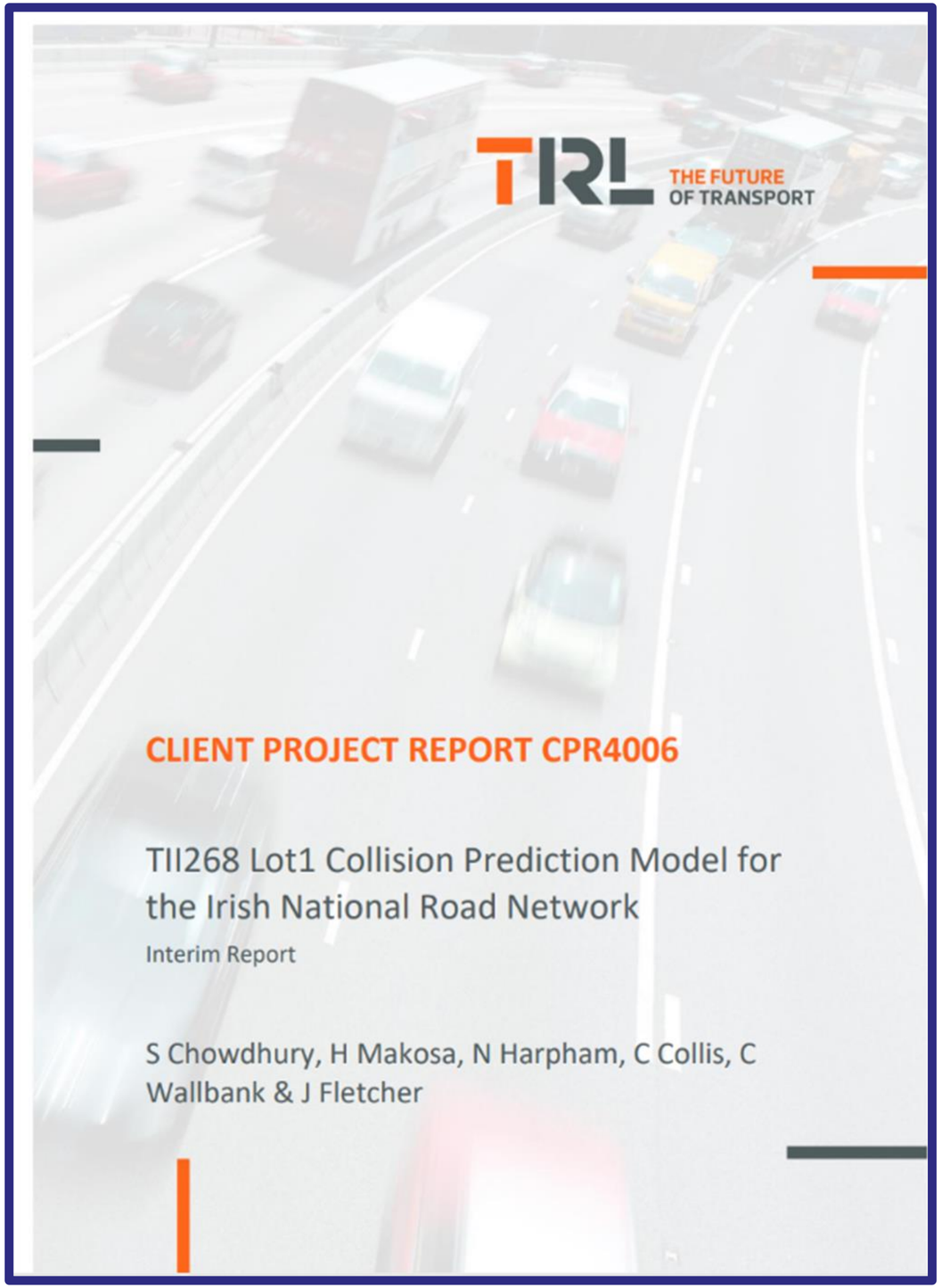


Figure 2: GIS road network and main data sources



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The Model RESULTS

REPORTS

Phase 1

Phase 2

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Models: Motorway, Dual carriageway, Single Carriageway and Legacy

(Negative Binomial _ Zero Inflation - best fit + All Collision) ***only limit was data on parameters***

Collision Reduction Parameters

1. **Reducing** the number, or improving the safety of, **minor junctions** **and access points** reduces collision risk.

2. dual carriageways, increasing the proportion of **median barriers** **decreases the risk** on a segment.

3. **Pavement Condition** It is important to ensure the skid resistance (CSC %) is maintained particularly on the single and legacy networks.

Collision Reduction Parameters

4. The geometry of the road influences collision risk: **gradient and radius** were common significant predictors of collision risk across all models.

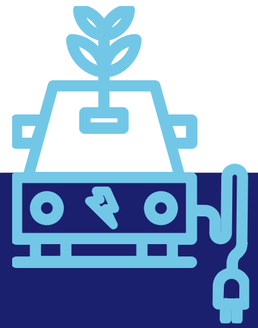
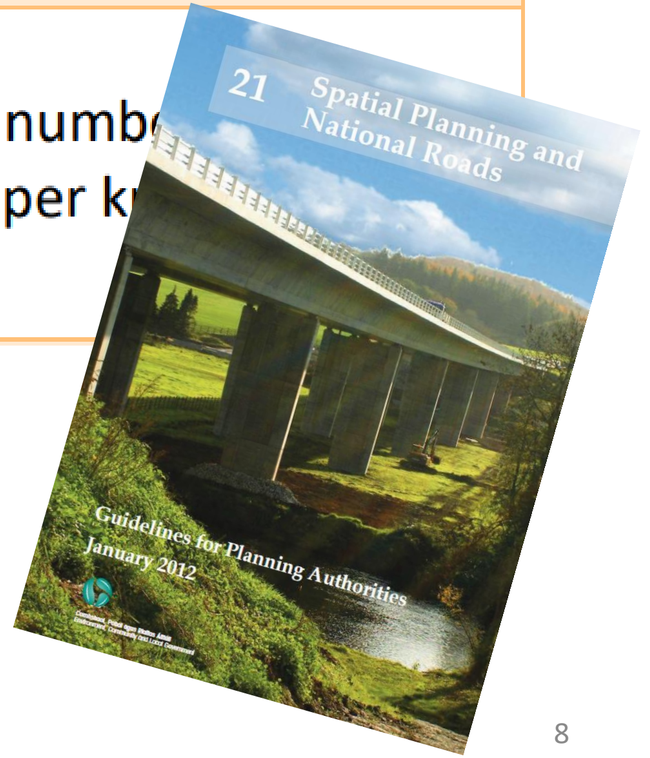


Table 24: Irish CMFs included in the calculator from the Single Carriageway model

Variable	CMF	Interpretation of CMF	Associated countermeasure in the calculator
Gradient	$e^{-0.169} = 0.845$	Decreasing the absolute maximum gradient by 1 degree decreases the number of collisions by 16%.	Decrease in absolute maximum gradient by [1/2/3/4/5] degrees
Minor junctions	$e^{-0.132} = 0.876$	Decreasing the number of minor junctions per km by 1 decreases the collision number by 12%.	Decrease numb junctions per k



New local roads/entrances – this evidence supports current TII Guidance regarding control of access onto NRN and intensification ***(i.e. Adding new minor accesses will increase collisions on NRN SCW)***

Commercial access	$e^{-0.015} = 0.985$	Decreasing the number of commercial access points by 1 per km decreases the collision number by 1%.	Decrease number of commercial accesses per km by [1/2/3]
CSC % (skid)	$e^{-0.00186} = 0.998$	Increasing the proportion of road with CSC % above the threshold by 1 decreases the collision risk by 0.2%.	Resurface a road of which [25/50/75/100]% was below the skid resistance threshold

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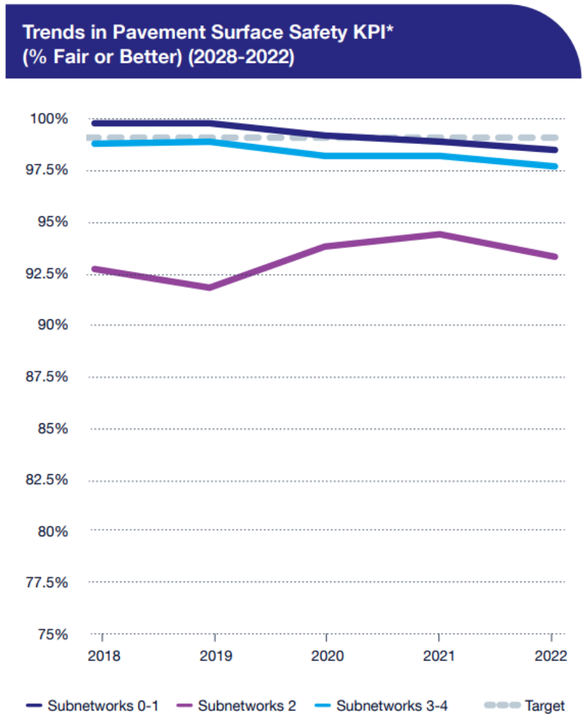
B2: Current Condition of Road Pavements

Pavement Surface Safety

TII target 95% performing fair or better for all subnetworks.

- Subnetworks 0-1 were consistently above target levels over a five-year period from 2017-2021
- Subnetworks 3-4 are below target levels but fall close to the target line
- Subnetworks 2 (urban areas) are lower, but the increased emphasis on pavement upkeep and treatment within urban areas in the past few years has resulted in a gradual increase in performance.



Pavement Condition-

Presence of well maintained pavement impacts safety performance

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TRA PAPER 2024

Prediction of Road Safety Risks

Use of Accident Prediction Models in Road Safety Management – An Irish case study

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Abstract. Evaluation of road safety measures can be a challenging element of road safety management systems in Europe. To deliver Vision Zero and implement the Road Infrastructure Safety Management Directive, national road authorities need reliable estimation tools for road safety countermeasures. Accident Prediction Models (APMs) provide an objective and cost-effective way to analyse potential safety improvements and estimate the potential impact in terms of collision reduction. However, most National Road Administrations (NRAs) do not develop or use APMs. The objective of this paper is to present research undertaken for Ireland's first APM including the modelling technique used and the data challenges faced. The primary aim of the APM development is to provide local (Irish) estimates for Crash Modification Factors (CMFs) to feed into a tool for use by Road Safety Engineers when estimating the potential collision savings of various interventions.

Keywords: Accident Prediction Models, Crash Modification Factors, road safety, safe systems, collision data.

1 Introduction

The aim of this work was to develop Ireland's first Accident Prediction Mo
to provide Irish Crash Modification Factors (CMFs) for Transport Infrastruc
(TII), local authorities and road safety practitioners to identify cost effectiv
interventions and measures to reduce road traffic collisions and achieve ta
Sligo [1]. The objectives of the project are (1) understand the e
be developed from Irish data using established metho
view), and (2) to develop a tool for practitioners

TRA 2024 Programme

TRA
TRANSPORT RESEARCH ARENA
DUBLIN 2024
10th CONFERENCE • 15-18 April

Transport Transitions: Advancing Sustainable and Inclusive Mobility

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Task led by Arup – User Tool Development

1. An online survey with users to gather opinions and views on a Collision Reduction Calculator

1. Workshops held with Local and Regional Engineers detailed discussion tool needs and end user needs.

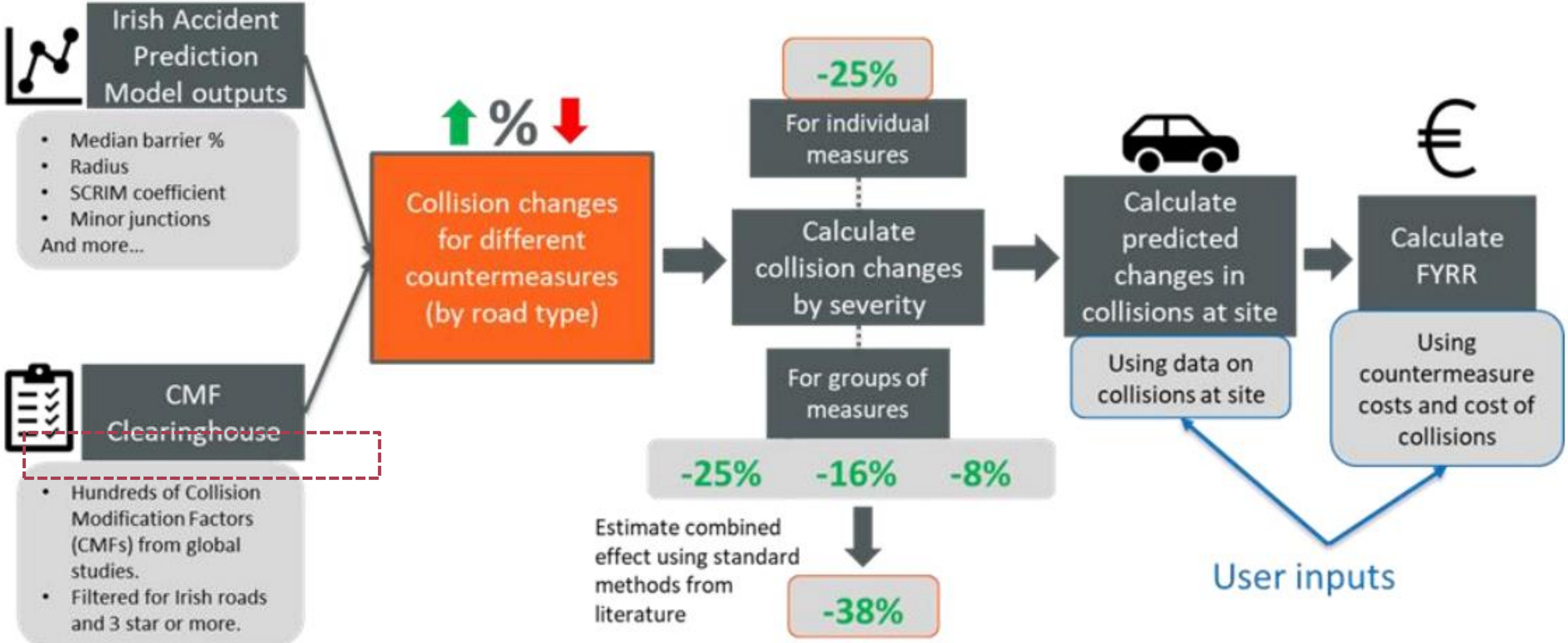
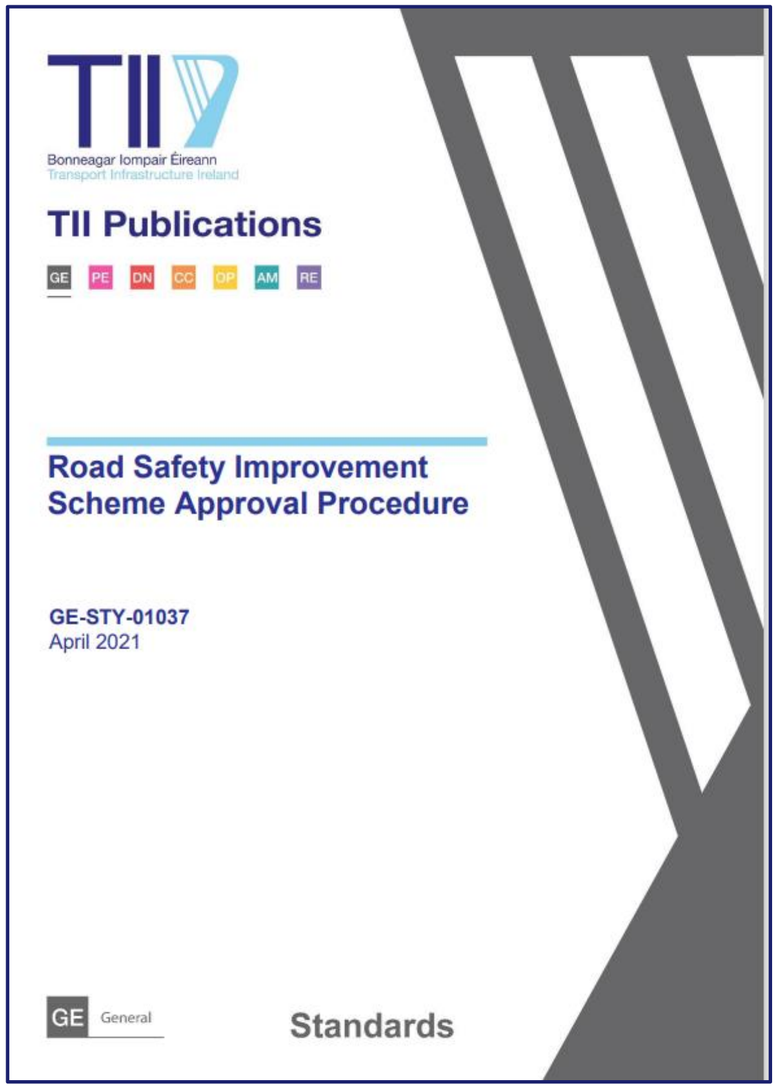
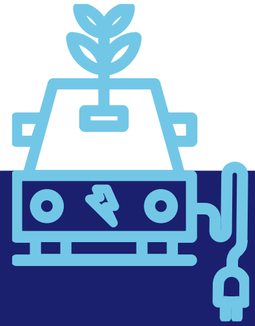


Figure 1: Summary of the process flow for the Collision Reduction Calculator

CMF Calculation for Safety Improvement schemes



- **Provides better use of CMFs**
- **Provides NEW NRN CMF's**
- **Automated calculation of safety measure collision reduction for RSIS (% change with/without/options)**
- **Calculation of FYRR (required for F&O TII Standard GE SY 01037)**



Download from TII

https://www.tiipublications.ie/downloads/

Downloads

Documents related to the TII Publications system

A number of other TII documents, closely aligned with the TII Publications system but not a formal part of it, are available for download below:

+ Appendix Associated with Guide to the Implementation of Sustainability for TII Projects GE-GEN-01101

+ Appendices Associated with Design of Vehicle Restraint Systems to DN-REQ-03034

+ Compiled Sets of SCDs

+ Proje

+ Samp

— Appendices Associated with Road Safety Improvement Scheme Approval Procedure to GE-STY-01037

- Appendix-B_Sample-Feasibility-and-Options-Report-for-Road-Safety-Improvement-Scheme.docx
- Appendix-C_Summary-Close-Out-Sheet-for-Road-Safety-Improvement-Schemes.docx
- Final_TRL_Collision-Reduction-Calculator.xlsx

Collision Reduction Calculator - Guidance

What is this tool?

This tool was built by TRL for Transport Infrastructure Ireland (TII) and is used for estimating the impact of different packages of road safety measures on collisions on the TII operated national road network.

Who is this tool for?

The tool can be used by any road safety practitioners that want to estimate the collision changes from implementing road safety measures on the national road network.

Before using the tool, make sure you have the following information:

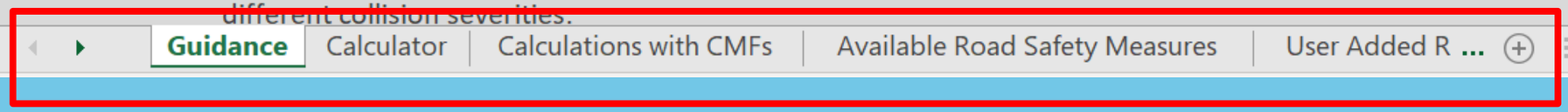
- A site
- Road type of the site
- Number of collisions at the site over the last (at least) 3 years
- Cost of road safety measures of interest
- Standard cost of collisions (value of prevention) by severity

What does the tool do?

The tool allows the user to select multiple road safety measures and assess their impact on collisions and the resulting first year rate of return (FYRR). Road safety measures are filtered according to the road type selected:

Motorway,
Dual carriageway,
Single carriageway,
Legacy road.

Legacy roads are roads that may have evolved from historic routes that are often constrained by physical or environmental conditions i.e. they may not conform to current design standards.
Once the user has chosen a road safety measure, the tool estimates the resulting change in collisions for the four different collision severities.



1. Scheme Details, 2. **Calculator,** 3. Calculations with CMFs, 4. Available Road Safety Measures, and 5. User Added CMFs

Collision Reduction Calculator

TRL THE FUTURE OF TRANSPORT

1 Scheme Details

Scheme Name : A TEST Road Safety Improvement Scheme

Road Type (from TII Network) : Single Carriageway

Date of Calculation : 29 April 2024

2 Collision Numbers at Site

Enter the most recent known collision numbers for the road safety improvement site.
Enter zeros if there are no recorded collisions.

	Fatal	Serious	Non Serious Injury	Damage only
No. of Collisions :	4	1	6	9
No. of Years of the Collision Data :	3	3	3	3
Average Annual Collisions Before the Road Safety Measure :	1.3	0.3	2.0	3.0

3 Collision Costs

Enter the recognised cost (Value of Prevention) for each collision severity

Cost per Collision Severity	
Fatal	
Serious	
Non Serious Injury	
Damage only	

4 Road Safety Measures

Select road safety measures from the dropdown lists.
Selecting a category will filter the available road safety measures.

ID	Category	Road Safety Measure(s)	Collision Change % Fatal	Serious	Non Serious Injury	Damage only
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Overall Collision Change % :						

5 Costs to Implement

Enter the total cost to implement all selected measures in euros.

OR

Enter the cost to implement each selected measure in euros.

ID	Cost
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total cost :	

6 Results

	Fatal	Serious	Non Serious Injury	Damage only
Average Annual Collisions Before :	1.3	0.3	2.0	3.0
Predicted Annual Collisions After :				
Predicted Annual Collision Change :				
Total Predicted Annual Collision Change in Collisions :				

Total Cost of Road Safety Measure(s) :

Annual Collision Saving by Severity :	Fatal	Serious	Non Serious Injury	Damage only

Total Annual Collision Saving :

1 Scheme Details

2 Collision stats at the site/section

3 Collision Costs by Severity (DoT Transport Appraisal Framework 2023– Module 8)

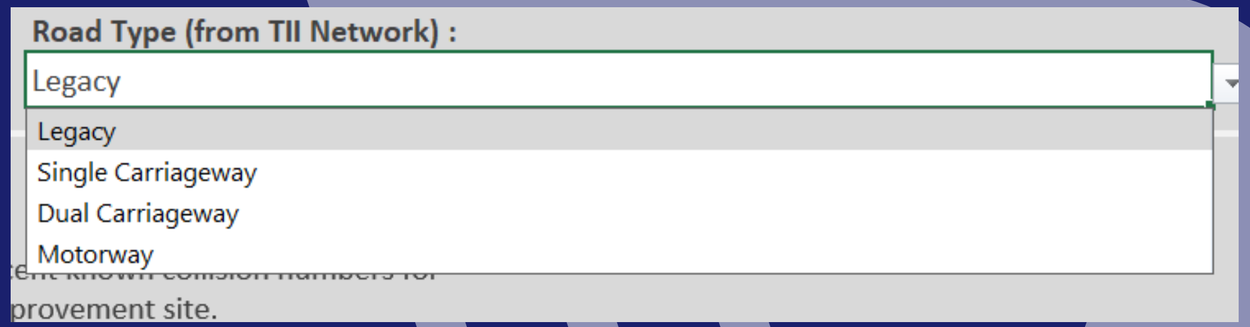
4 Select Road Safety Measures

5 Total cost to implement or for each measure

6 Results
- % change
- FYRR

Step 1 : Enter scheme details

Step 2: Enter collision data



Collision Reduction Calculator

1 Scheme Details

Scheme Name :
A TEST Road Safety Improvement Scheme

Road Type (from TII Network) :
Single Carriageway

Date of Calculation :
29 April 2024

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Enter zeros if there are no recorded collisions.

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No. of Years of the Collision Data :	3	3	3	3
Average Annual Collisions Before the Road Safety Measure :	1.3	0.3	2.0	3.0

4 Road Safety Measures

Select road safety measures from the dropdown lists.
Selecting a category will filter the available road safety measures.

ANNUAL AVERAGE COLLISIONS

4 Road Safety Measures

Select road safety measures from the dropdown lists.
Selecting a category will filter the available road safety measures.

ID	Category	Road Safety Measure(s)
1		
2		
3		
4		
5		
6		
7		
8		

- Access management
- Advanced technology and ITS
- Alignment
- Bicyclists
- Delineation
- Highway lighting
- Interchange design
- Intersection geometry
- Intersection traffic control
- Irish APM CMF
- On-street parking
- Pedestrians

Guidance | **Calculator** | Calculations with CMFs | Available Road Safety Measures | User Added R ...

"**Irish APM CMF**" (NEW) Not in Clearing House database

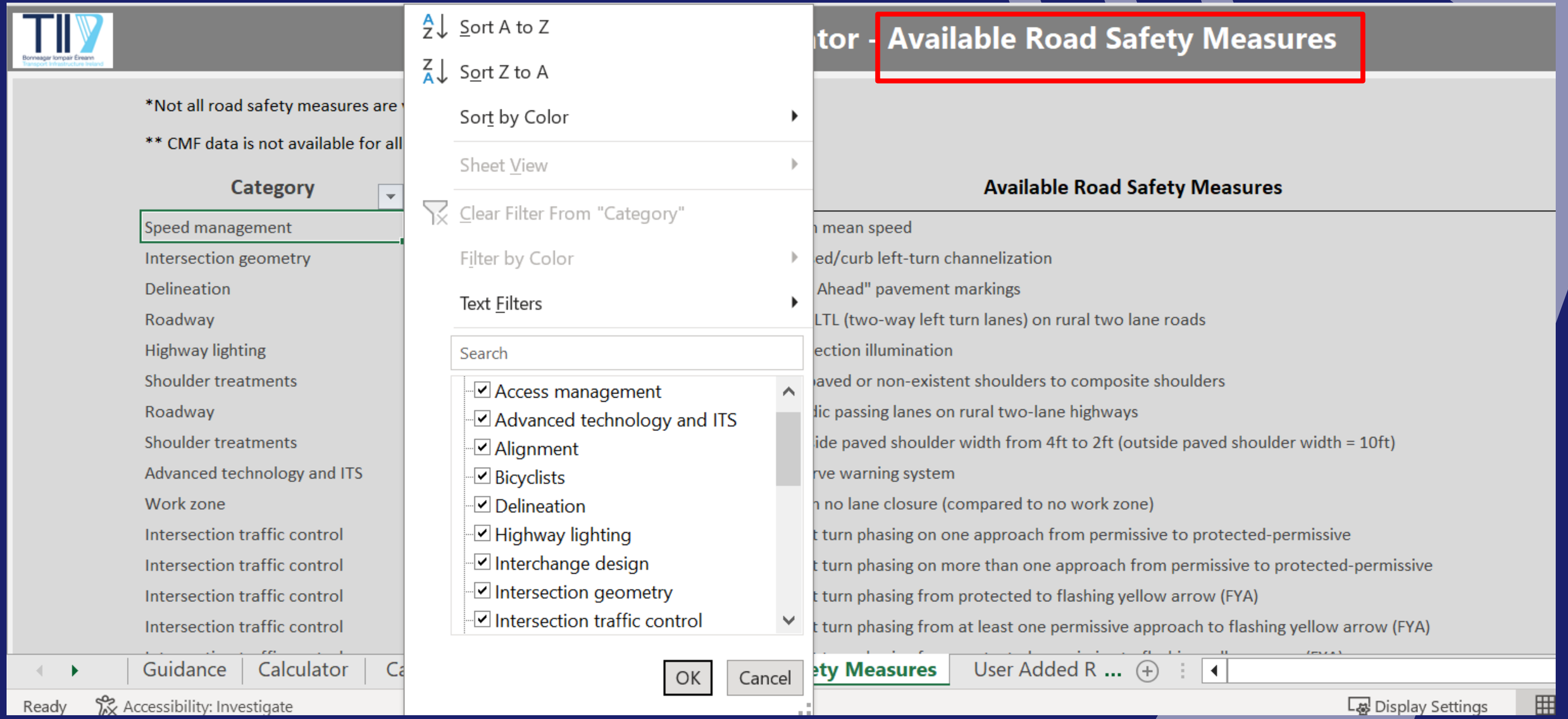
Select safety measure broad category e.g.

"**Speed Management**"

"**Pedestrians**"

"**On-Street parking**"

Etc. .....



1. Scheme Details, 2. Calculator, 3. Calculations with CMFs, 4. **Available Road Safety Measures**, and 5. User Added CMFs

ADD A CMF ?

3. What if I want to use a CMF from another database?

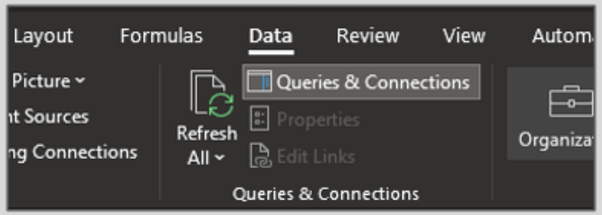
Users can add road safety measures within this tool using the 'User Added Road Safety Measures' tab. Measures added will only be available in your locally saved copy and are not shared.

Road safety measures from the APMs are clearly labelled in the tool with '[Irish APM CMF]'. Road safety measures added by the users are labelled '[User Added]' All other road safety measures are from CMF Clearinghouse and are labelled '[CH]'.

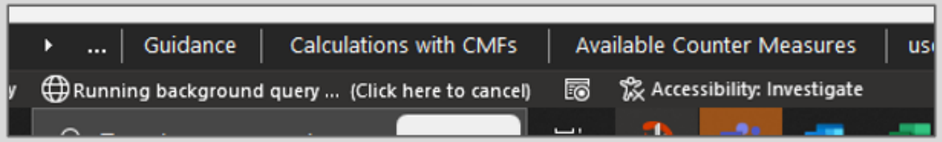
Will this tool have the most recent CMF Clearinghouse data?

This excel workbook tool has a data connection to the Clearinghouse website. To get the most up to date Clearinghouse data you can refresh this data connection. To do this:

1. Click 'Refresh All' in the ribbon above.

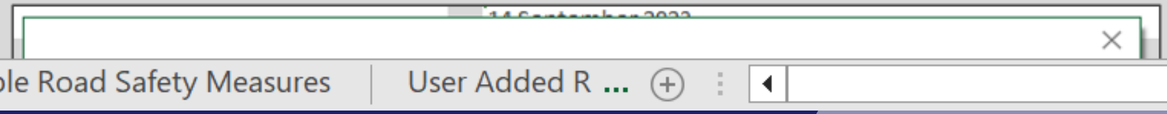


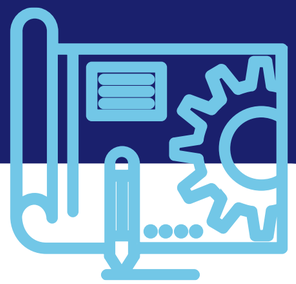
2. This will run a background query to refresh the data (you can see this at the bottom of the screen). When this query has finished running you will be able to see the most up to date road safety measures in the 'Available Road Safety Measures' and 'Calculator' tabs.



Troubleshooting while refreshing

While the refresh is happening you may see a privacy warning. You should click the ignore privacy option and then the Save button.





Example 1 Single CW

Safety Measure – Close 2No. junctions

Collision Reduction Calculator

1 Scheme Details

Scheme Name :
A TEST Road Safety Improvement Scheme

Road Type (from TII Network) :
Single Carriageway

Date of Calculation :
30 April 2024

2 Collision Numbers at Site

Enter the most recent known collision numbers for the road safety improvement site.
Enter zeros if there are no recorded collisions.

	Fatal	Serious	Non Serious Injury	Damage only
No. of Collisions :	2	1	3	9
No. of Years of the Collision Data :	3	3	3	3
Average Annual Collisions Before the Road Safety Measure :	0.7	0.3	1.0	3.0

3 Collision Costs

Enter the recognised cost (Value of Prevention) for each collision severity

Cost per Collision Severity :	
Fatal	€ 2,778,132
Serious	€ 318,373
Non Serious Injury	€ 32,346
Damage only	€ 2,785

4 Road Safety Measures

Select road safety measures from the dropdown lists.
Selecting a category will filter the available road safety measures.

ID	Category	Road Safety Measure(s)	Collision Change % Fatal	Serious	Non Serious Injury	Damage only
1	Irish APM CMF	[Irish APM CMF 30] Decrease number of minor junctions per km by 2	-23%	-23%	-23%	-23%
2						
3						

5 Costs to Implement

Enter the total cost to implement all selected measures in euros.

OR

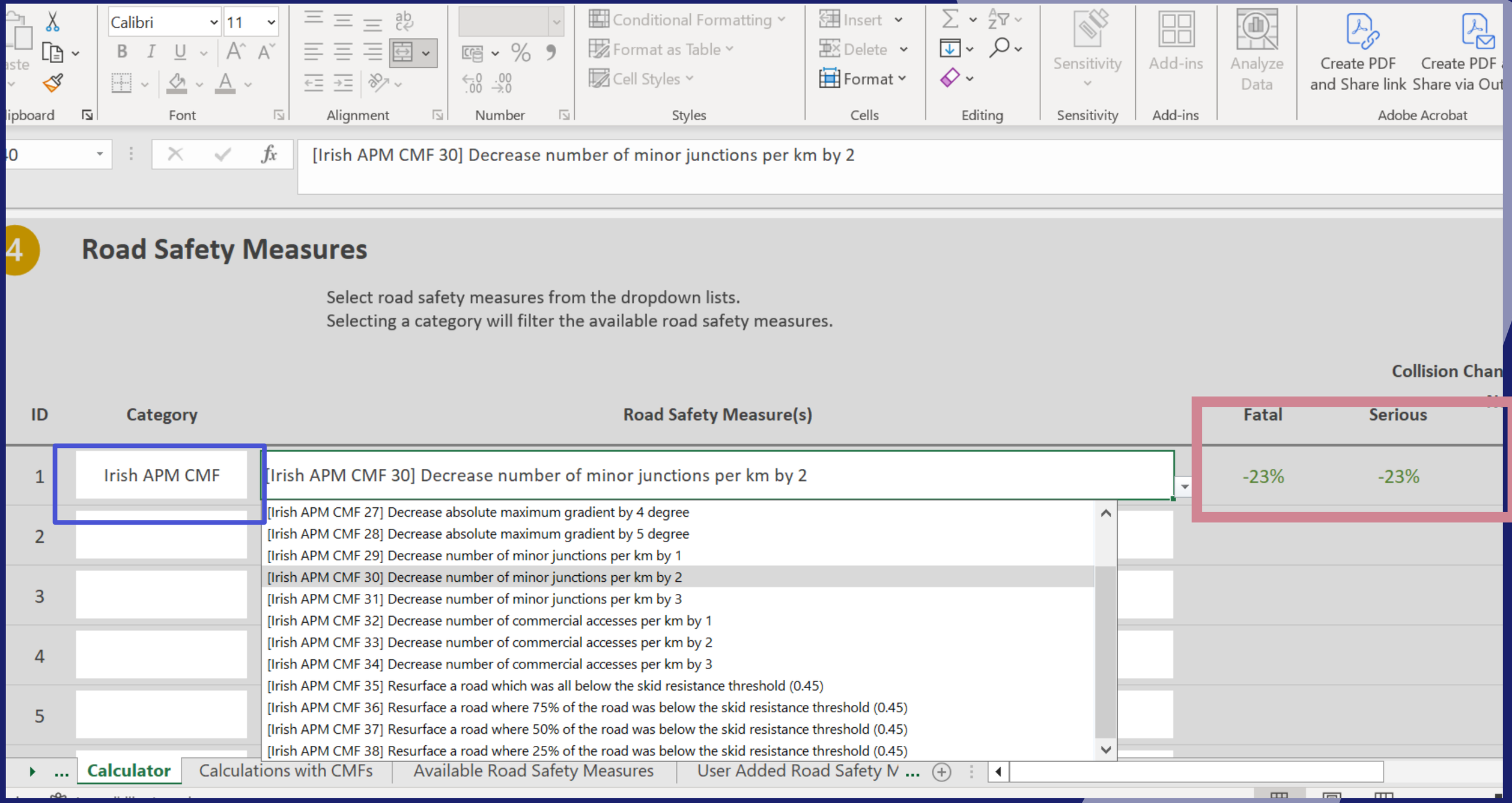
Enter the cost to implement each selected measure in euros.

ID	Cost
1	€ 333,000
2	
3	

Safety improvement - Close 2 no. rural priority junctions (low traffic) on 1km section

Collisions- 3 Yrs 2 x Fatal, 1 x Serious Injury, 3 x minor injury & 9 x Material Damage

Prelim cost - €333,000(incl.VAT)


Calibri
11
Conditional Formatting
Format as Table
Cell Styles
Insert
Delete
Format
Sensitivity
Add-ins
Analyze Data
Create PDF and Share link
Create PDF Share via Out
Font
Alignment
Number
Styles
Cells
Editing
Sensitivity
Add-ins
Adobe Acrobat
[Irish APM CMF 30] Decrease number of minor junctions per km by 2
4 Road Safety Measures
Select road safety measures from the dropdown lists.
Selecting a category will filter the available road safety measures.
Collision Chan
ID
Category
Road Safety Measure(s)
Fatal
Serious
1
Irish APM CMF
[Irish APM CMF 30] Decrease number of minor junctions per km by 2
-23%
-23%
2
3
4
5
[Irish APM CMF 27] Decrease absolute maximum gradient by 4 degree
[Irish APM CMF 28] Decrease absolute maximum gradient by 5 degree
[Irish APM CMF 29] Decrease number of minor junctions per km by 1
[Irish APM CMF 30] Decrease number of minor junctions per km by 2
[Irish APM CMF 31] Decrease number of minor junctions per km by 3
[Irish APM CMF 32] Decrease number of commercial accesses per km by 1
[Irish APM CMF 33] Decrease number of commercial accesses per km by 2
[Irish APM CMF 34] Decrease number of commercial accesses per km by 3
[Irish APM CMF 35] Resurface a road which was all below the skid resistance threshold (0.45)
[Irish APM CMF 36] Resurface a road where 75% of the road was below the skid resistance threshold (0.45)
[Irish APM CMF 37] Resurface a road where 50% of the road was below the skid resistance threshold (0.45)
[Irish APM CMF 38] Resurface a road where 25% of the road was below the skid resistance threshold (0.45)
Calculator
Calculations with CMFs
Available Road Safety Measures
User Added Road Safety M

RESULTS

Overall Collision Change % :	-23%	-23%	-23%	-23%

Total cost : € 333,000

	Fatal	Serious	Non Serious Injury	Damage only
Average Annual Collisions Before :	0.7	0.3	1.0	3.0
Predicted Annual Collisions After :	0.5	0.3	0.8	2.3
Predicted Annual Collision Change :	-0.2	-0.1	-0.2	-0.7

Total Predicted Annual Collision Change in Collisions : **-1.2**

Total Cost of Road Safety Measure(s) : € 333,000

Annual Collision Saving by Severity :	Fatal	Serious	Non Serious Injury	Damage only
	€ 430,840	€ 24,687	€ 7,524	€ 1,944

Total Annual Collision Saving : € 464,995

FYRR : 140%

Reduction 1.2 Collisions per year (compared to Before)

FYRR (First Year Rate of Return) **140%**

Example 2 Rural Town

Safety Measure – Relocate parking and add pedestrian crossings

4 Road Safety Measures

Select road safety measures from the dropdown lists.
Selecting a category will filter the available road safety measures.

ID	Category	Road Safety Measure(s)	Collision Change % Fatal	Serious	Non Serious Injury	Damage only
1	On-street parking	[CH 121] Prohibit on-street parking		-20%	-20%	-27%
2	Intersection traffic control	[CH 39] Install a traffic signal	-34%	-34%	-34%	-34%
3						

5 Costs to Implement

Enter the total cost to implement all selected measures in euros.

OR

Enter the cost to implement each selected measure in euros.

ID	Cost
1	€ 50,000
2	€ 350,000
3	

6 Results

	Fatal	Serious	Non Serious Injury	Damage only
Average Annual Collisions Before :	0.4	0.2	0.6	1.8
Predicted Annual Collisions After :	0.3	0.1	0.4	1.0
Predicted Annual Collision Change :	-0.1	-0.1	-0.2	-0.8

Total Predicted Annual Collision Change in Collisions : **-1.3**

Total Cost of Road Safety Measure(s) : € 400,000

Annual Collision Saving by Severity :	Fatal	Serious	Non Serious Injury	Damage only
	€ 381,258	€ 26,079	€ 7,949	€ 2,264

Total Annual Collision Saving : € 417,551

FYRR : 104%

- **Safety improvement –** remove or relocate existing perpendicular on-street parking & new controlled crossings
- **Collisions**- 5 Yrs 2 x Fatal, 1 x Serious Injury, 3 x minor injury & 9 x Material Damage
- **Prelim cost** - €400,000(incl. VAT)
- Annual collision reduction after implementation – 1.3 Collisions
- **FYRR – 104%**

Thank you

Questions?

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