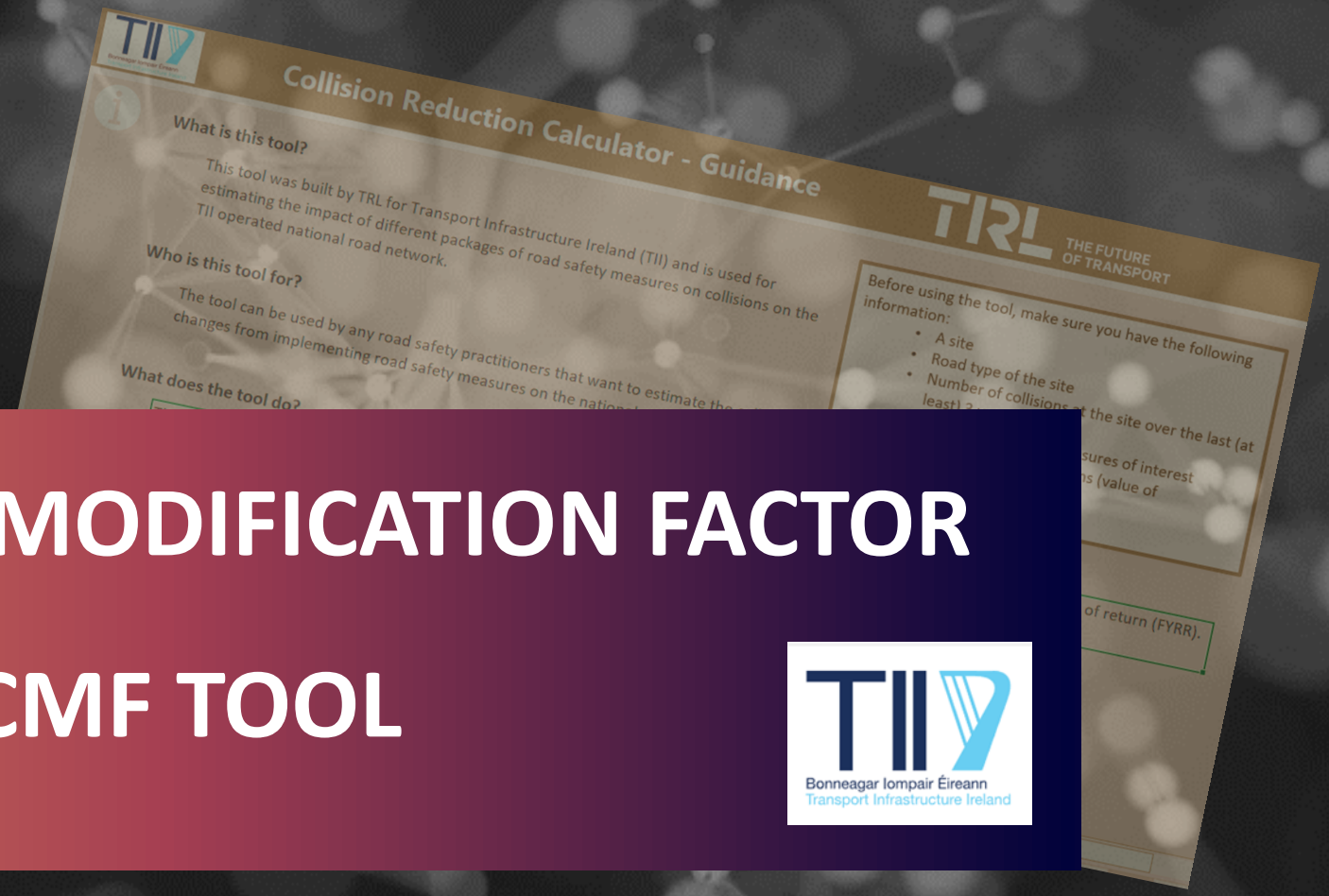


TII COLLISION MODIFICATION FACTOR

CMF TOOL

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Presented By: Dr.Suzanne Meade

TII Standards Road Show *11.20 – 11.30*

May 1st and 2nd 2024

OUTLINE

The Research Project

Results Phase 1 and Phase 2

CMF Tool

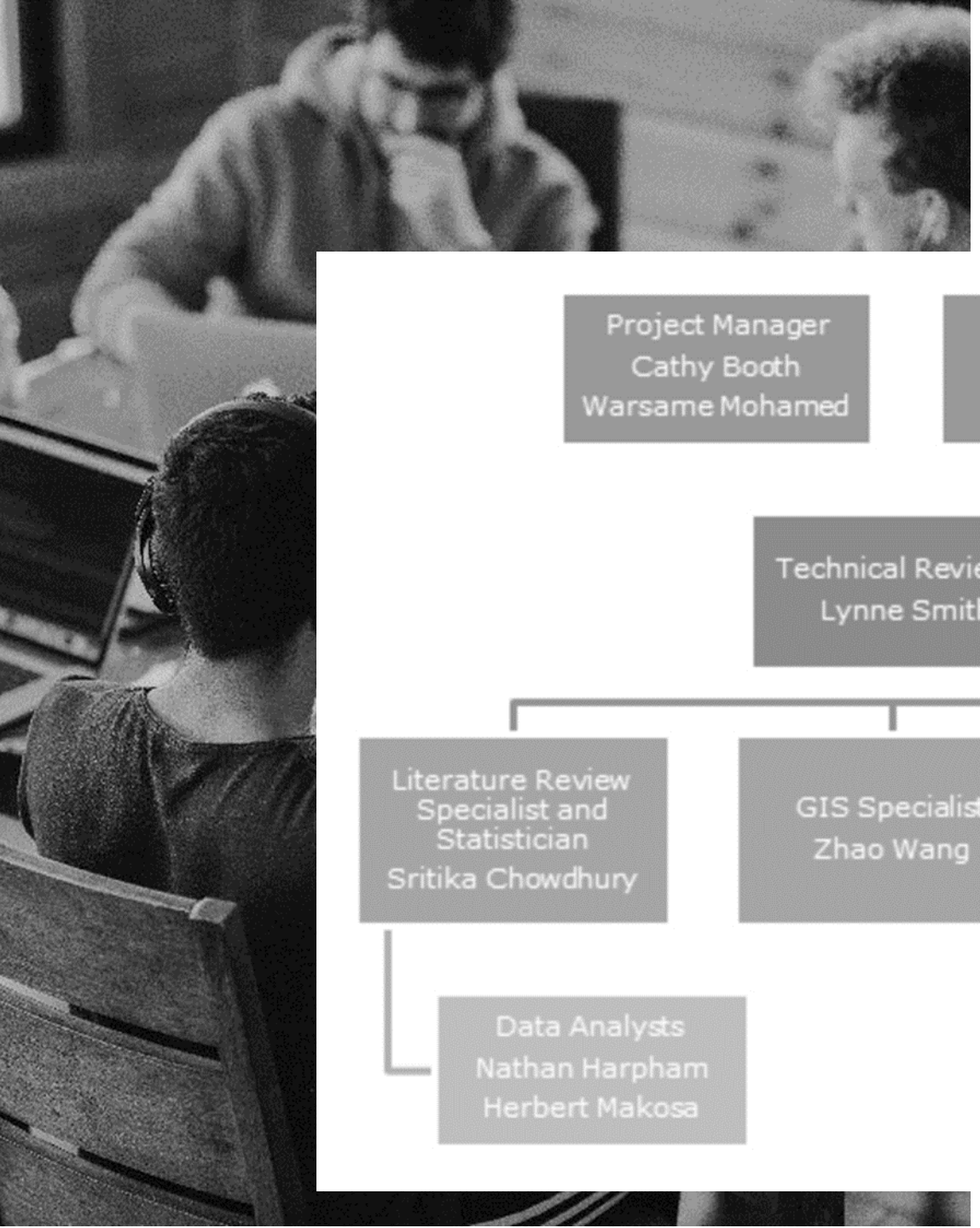
Worked Examples

TII268 LOT1

TITLE: COLLISION PREDICTION MODEL FOR THE IRISH NATIONAL ROAD NETWORK

TII ROAD SAFETY RESEARCH

Project 2021 - 2023



INTRODUCTION

PROJECT TEAM

Project Manager
Cathy Booth
Warsame Mohamed

Technical Lead
John Fletcher

Transport Infrastructure Ireland
Suzanne Meade

Technical Reviewer
Lynne Smith

Literature Review Specialist and Statistician
Sritika Chowdhury

GIS Specialist
Zhao Wang

Technical Expert
Caroline Wallbank

Road Safety Consultant and Local Liaison (Arup)
Eoin Doyle
Ian D'Arcy
Gerard Hall

Data Analysts
Nathan Harpham
Herbert Makosa

TRL THE FUTURE OF TRANSPORT

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?

OBJECTIVE: DEVELOP AN ACCIDENT PREDICTIVE MODEL (APM) BASED ON NATIONAL ROAD PARAMETERS AND DATA.

OBJECTIVE: 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).

KNOWLEDGE GAP

PROJECT FLOW CHART

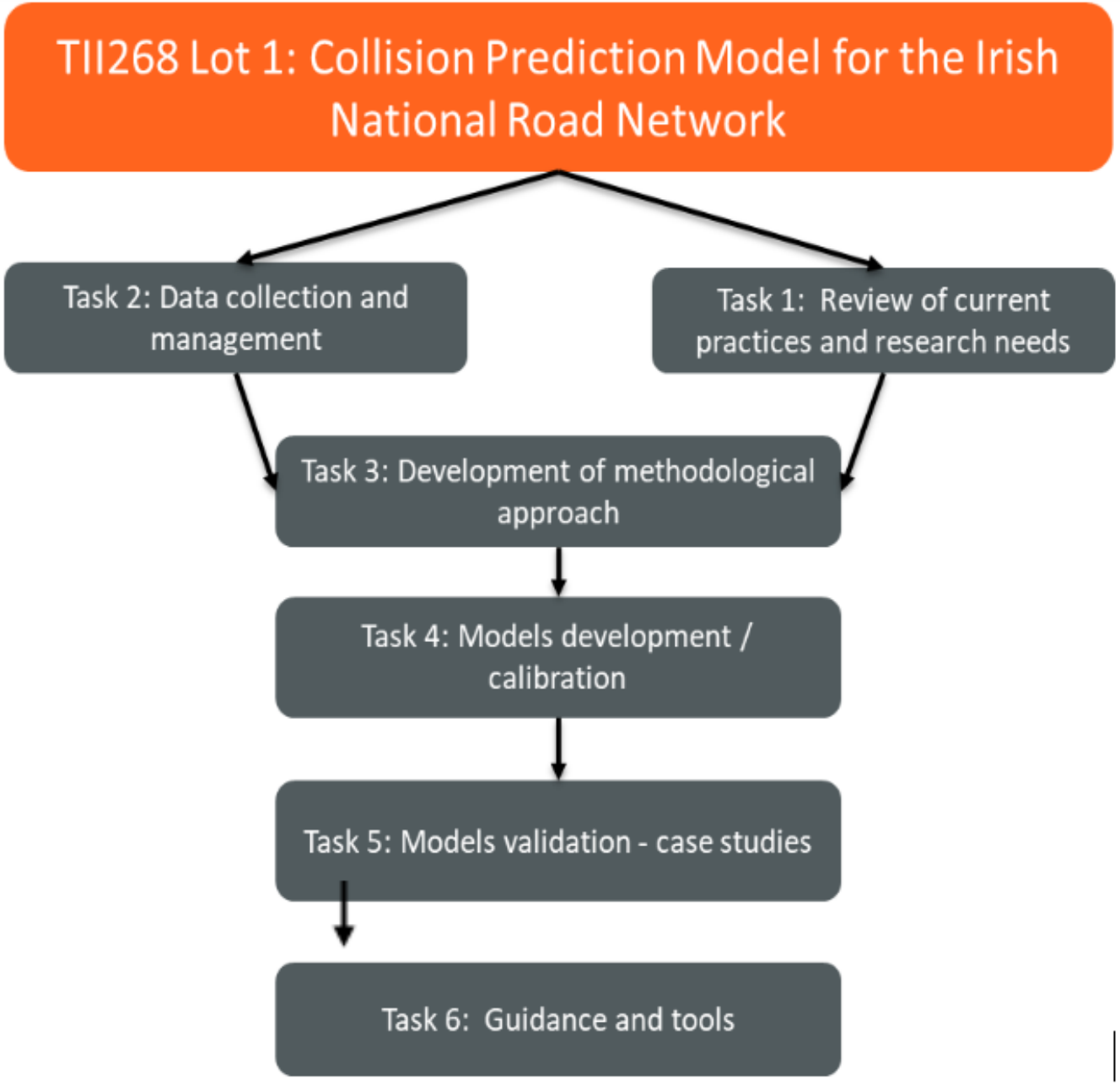


Figure 1: Project tasks

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**	

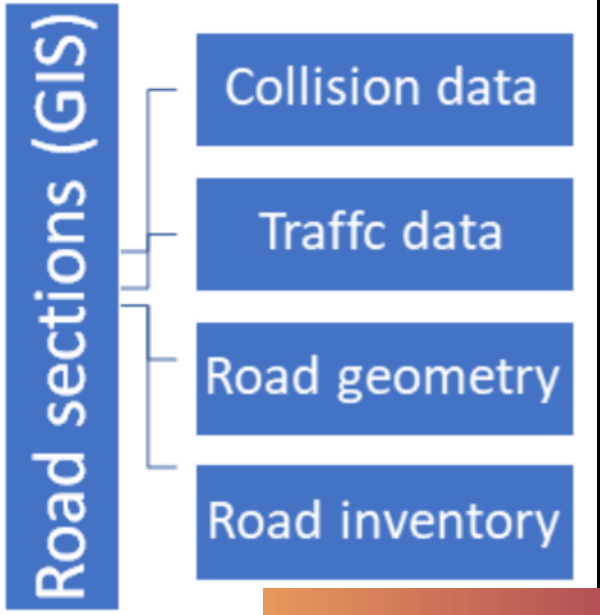


Figure 2: GIS road netw

PROJECT RISKS

REPORTS

PHASE 1

PHASE 2

THE MODEL RESULTS

MODELS: MOTORWAY, DUAL CARRIAGEWAY, SINGLE CARRIAGEWAY AND LEGACY

(NEGATIVE BINOMIAL _ ZERO INFLATION - BEST FIT + ALL COLLISION) ONLY LIMIT WAS DATA ON PARAMETERS

1. REDUCING THE NUMBER, OR IMPROVING THE SAFETY OF, **MINOR JUNCTIONS AND ACCESS POINTS** REDUCES COLLISION RISK.

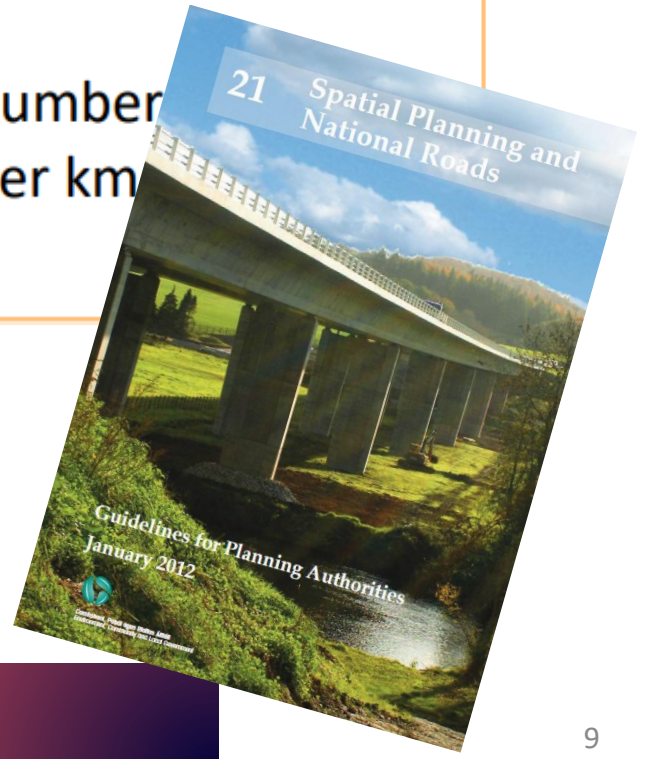
2. DUAL CARRIAGEWAYS, INCREASING THE PROPORTION OF **MEDIAN BARRIERS DECREASES THE RISK** ON A SEGMENT.

3. **PAVEMENT CONDITION** IT IS IMPORTANT TO MAINTAIN SKID RESISTANCE (CSC %) ON SINGLE AND LEGACY ROADS AND TO ENSURE THAT LOCATIONS WHICH REACH THE INVESTIGATORY LEVEL ARE INVESTIGATED.

4. THE GEOMETRY OF THE ROAD INFLUENCES COLLISION RISK: **GRADIENT AND RADIUS** WERE COMMON SIGNIFICANT PREDICTORS OF COLLISION RISK ACROSS ALL MODELS. AS EXPECTED.

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 number junctions per km



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)***

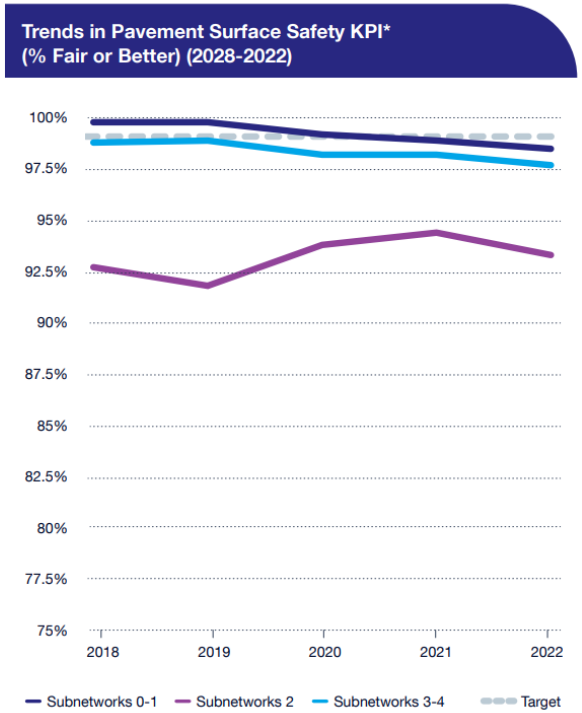
Commercial access	$e^{-0.015} = 0.985$	Decreasing the number of commercial access points by 1 per km decreases the collision number by 1%.	Decrease number of commercial accesses per km by [1/2/3]
CSC % (skid)	$e^{-0.00186} = 0.998$	Increasing the proportion of road with CSC % above the investigatory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

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.

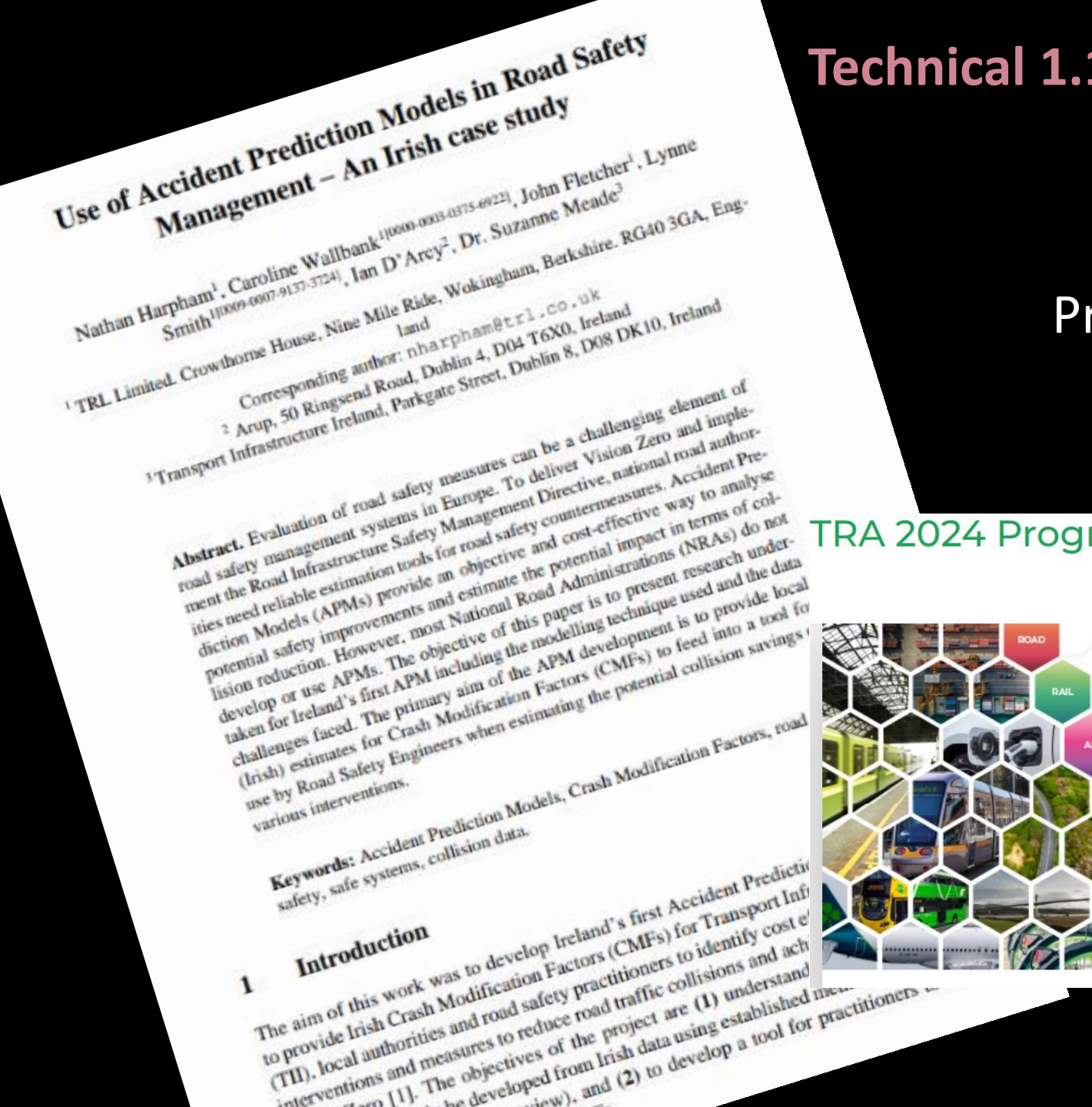


Pavement Condition- Well maintained pavement Skid resistance impacts safety performance

Technical 1.1.11 Prediction of Road Safety Risks

8:45 AM Thursday 18th April

Presenter: Mr Nathan Harpham (TRL)



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

Nathan Harpham[1], Caroline Wallbank[1][0000-0003-0375-6922], John Fletcher[1], Lynne Smith[1][0009-0007-9137-3724], Ian D'Arcy[2], Dr. Suzanne Meade[3]

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[2] Arup, 50 Ringsend Road, Dublin 4, D04 T6X0, Ireland

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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 Predicti… to provide Irish Crash Modification Factors (CMFs) for Transport Infr… (TII), local authorities and road safety practitioners to identify cost e… interventions and measures to reduce road traffic collisions and ach… [1]. The objectives of the project are (1) understand… be developed from Irish data using established me… 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

TRA PAPER

OUTLINE

The Research Project

Results Phase 1 and Phase 2

CMF Tool

Worked Examples

Task led by Arup

1. An online survey with Road Safety Engineers to gather opinions and views on a Transport Infrastructure Ireland (TII) Collision Reduction Calculator
2. Workshops held with Local and Regional Engineers to facilitate a more detailed discussion on what was needed from a tool and how end users would use it

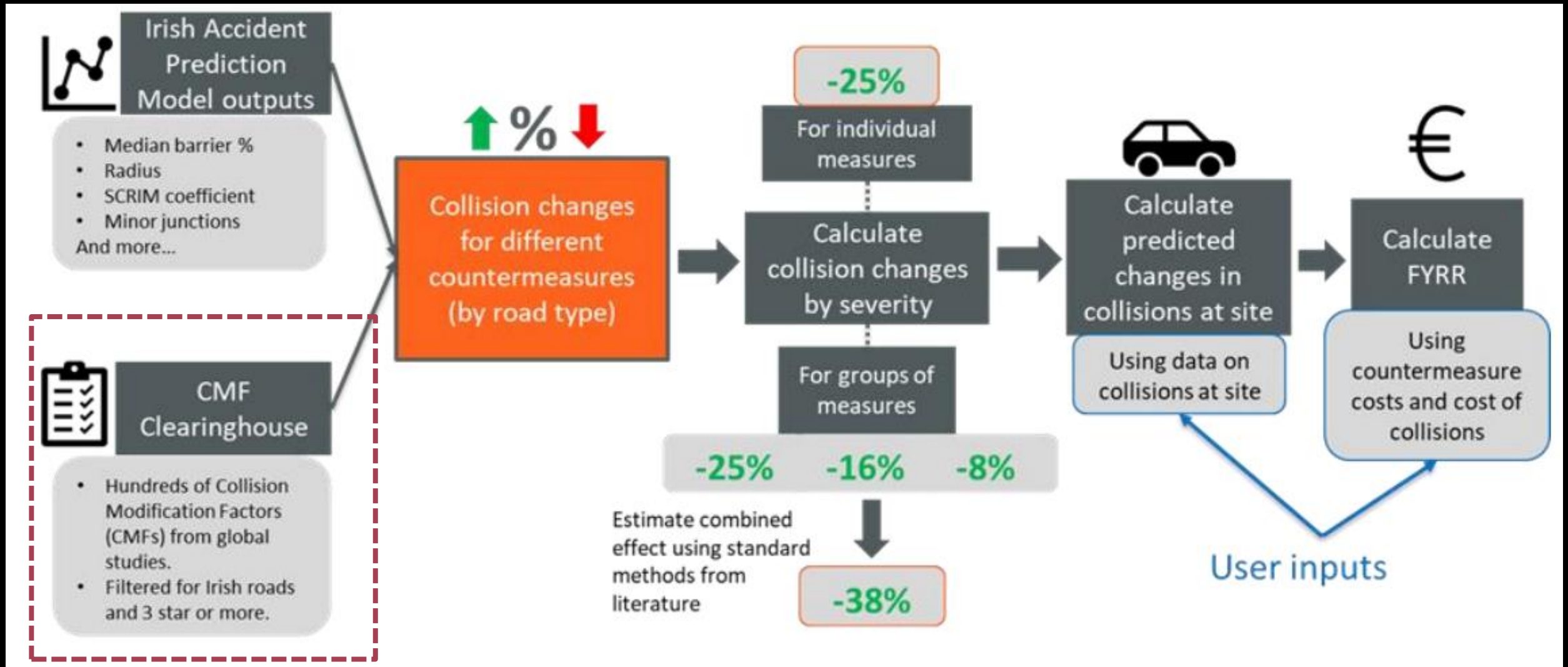
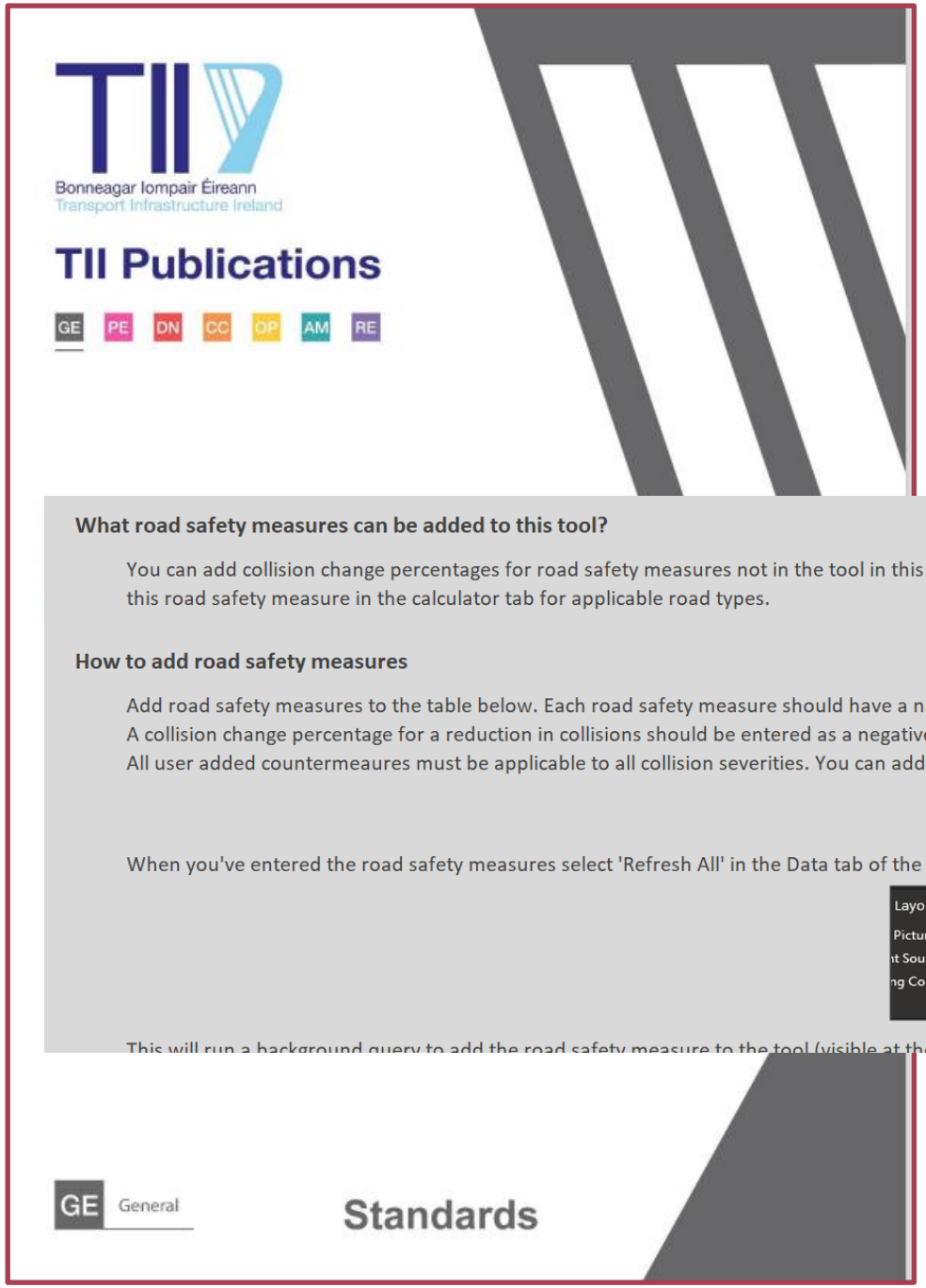


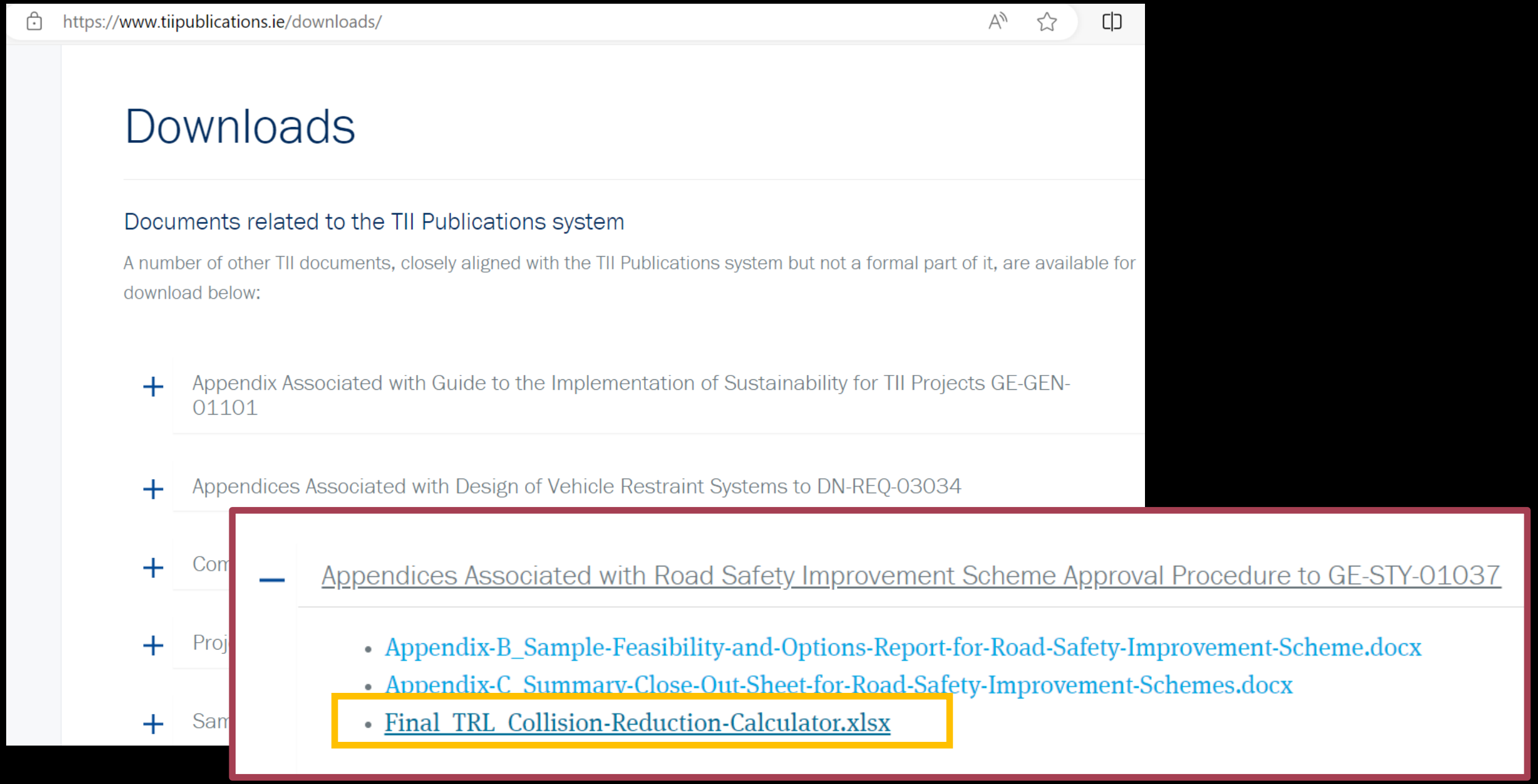
Figure 1: Summary of the process flow for the Collision Reduction Calculator

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



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.

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

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

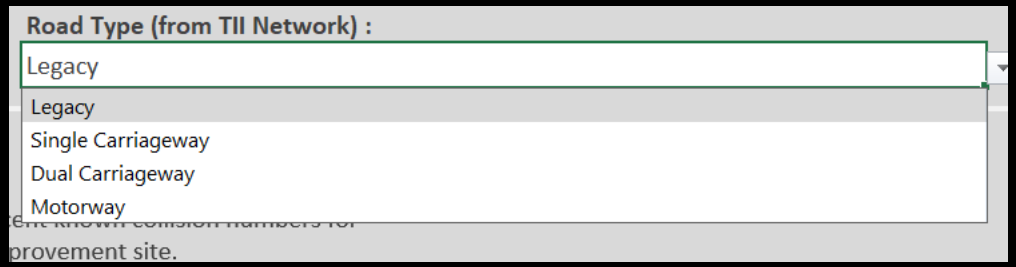
3 Collision Costs by Severity (DoT Transport Appraisal Framework 2023– Module 8)

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

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

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

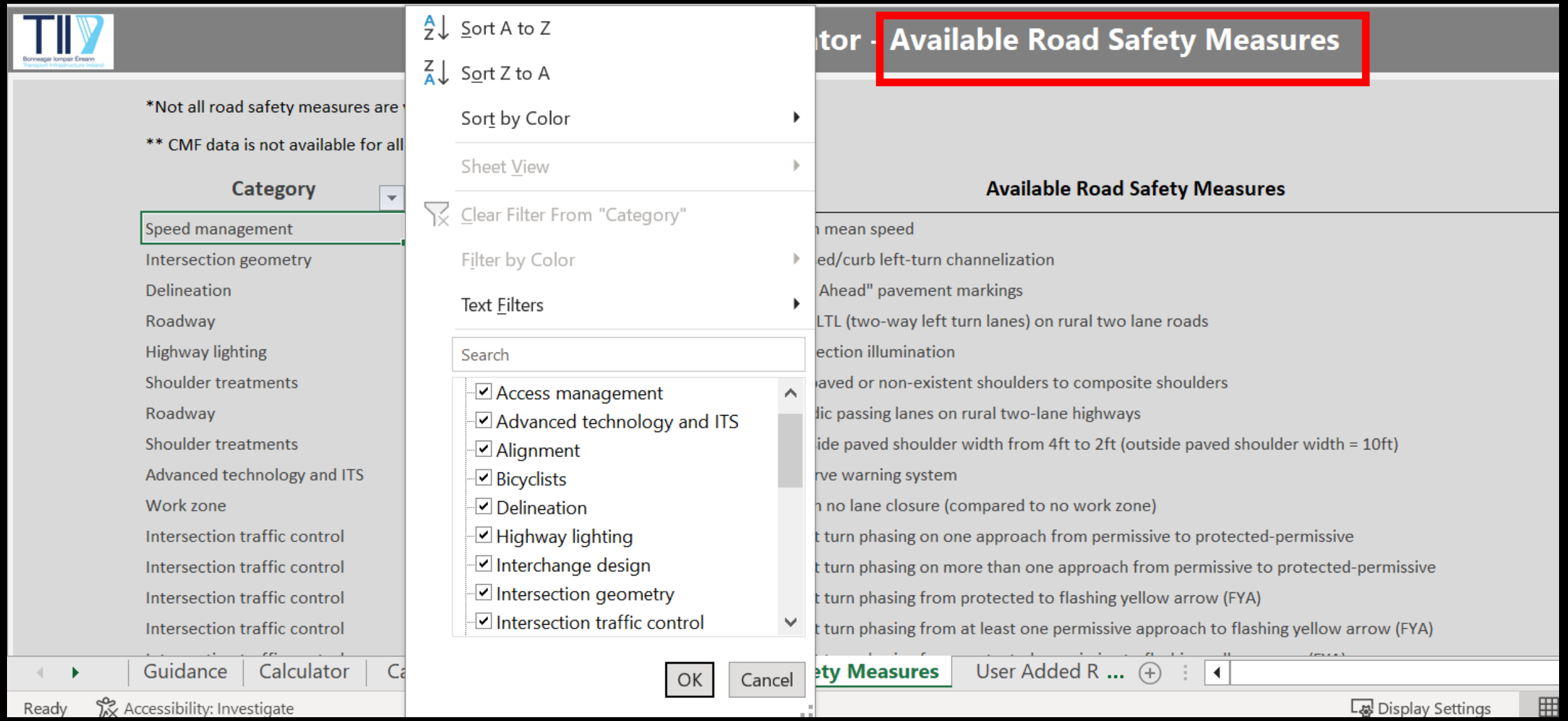
Select safety measure broad category e.g.

"**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?**

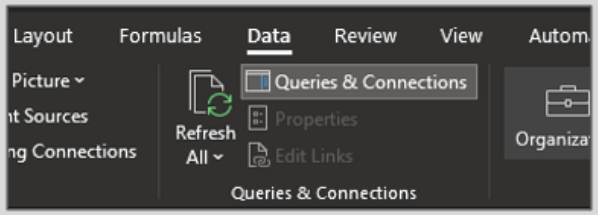
   Users can add road safety measures within this tool using the 'User Added Road Safety Measures' tab. Measures added will only be available in your locally saved copy and are not shared.

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]'.

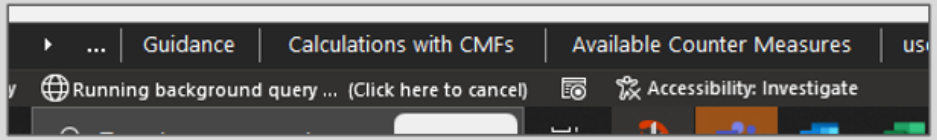
Will this tool have the most recent CMF Clearinghouse data?

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.

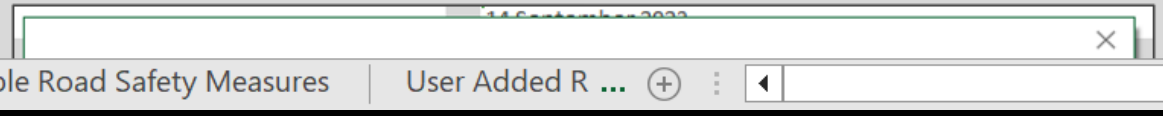


2. This will run a background query to refresh the data (you can see this at the bottom of the screen). When this query has finished running you will be able to see the most up to date road safety measures in the 'Available Road Safety Measures' and 'Calculator' tabs.



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.



OUTLINE

The Research Project

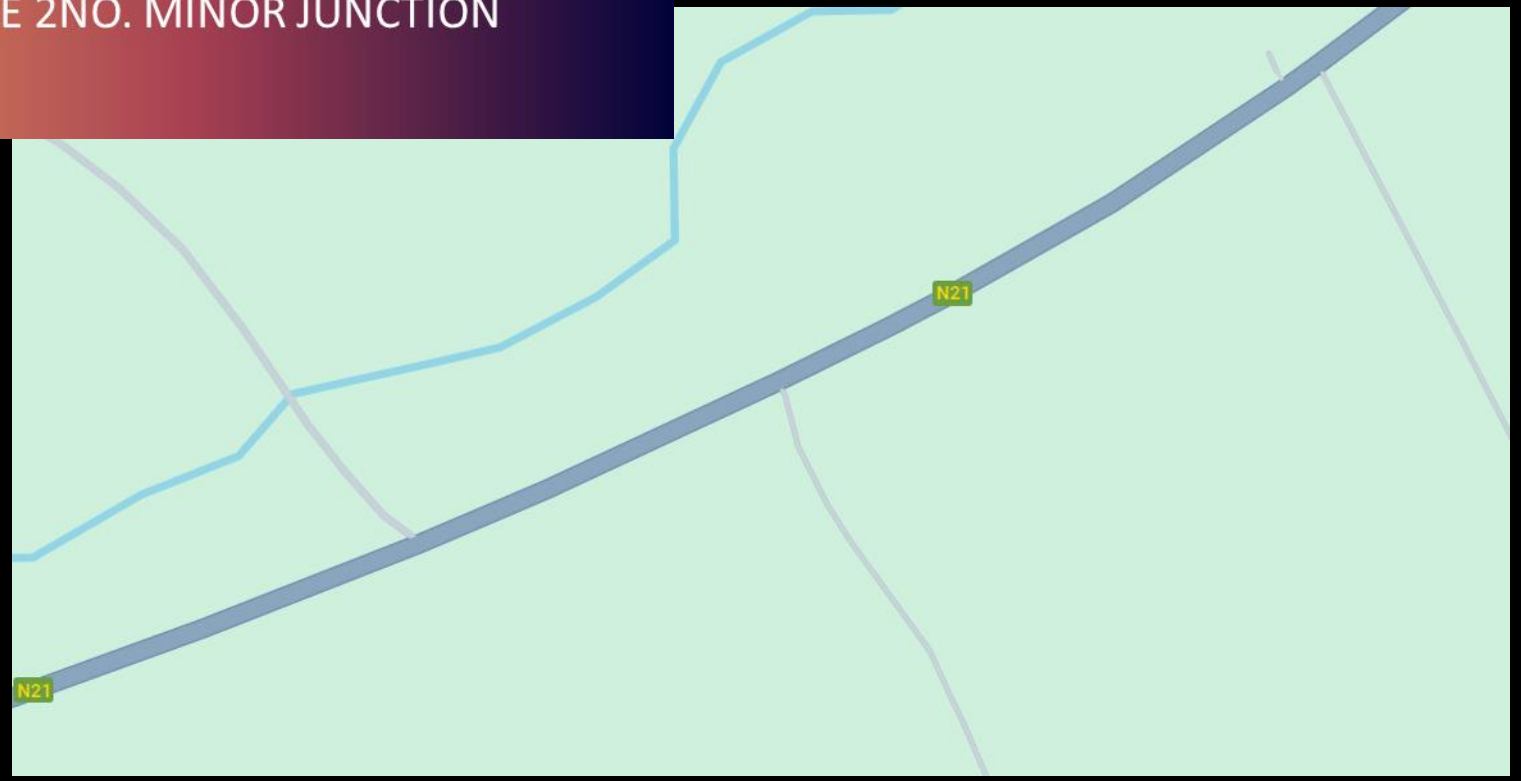
Results Phase 1 and Phase 2

CMF Tool

Worked Examples

EXAMPLE 1 SINGLE CW –

CLOSE 2NO. MINOR JUNCTION



Collision Reduction Calculator

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 : 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

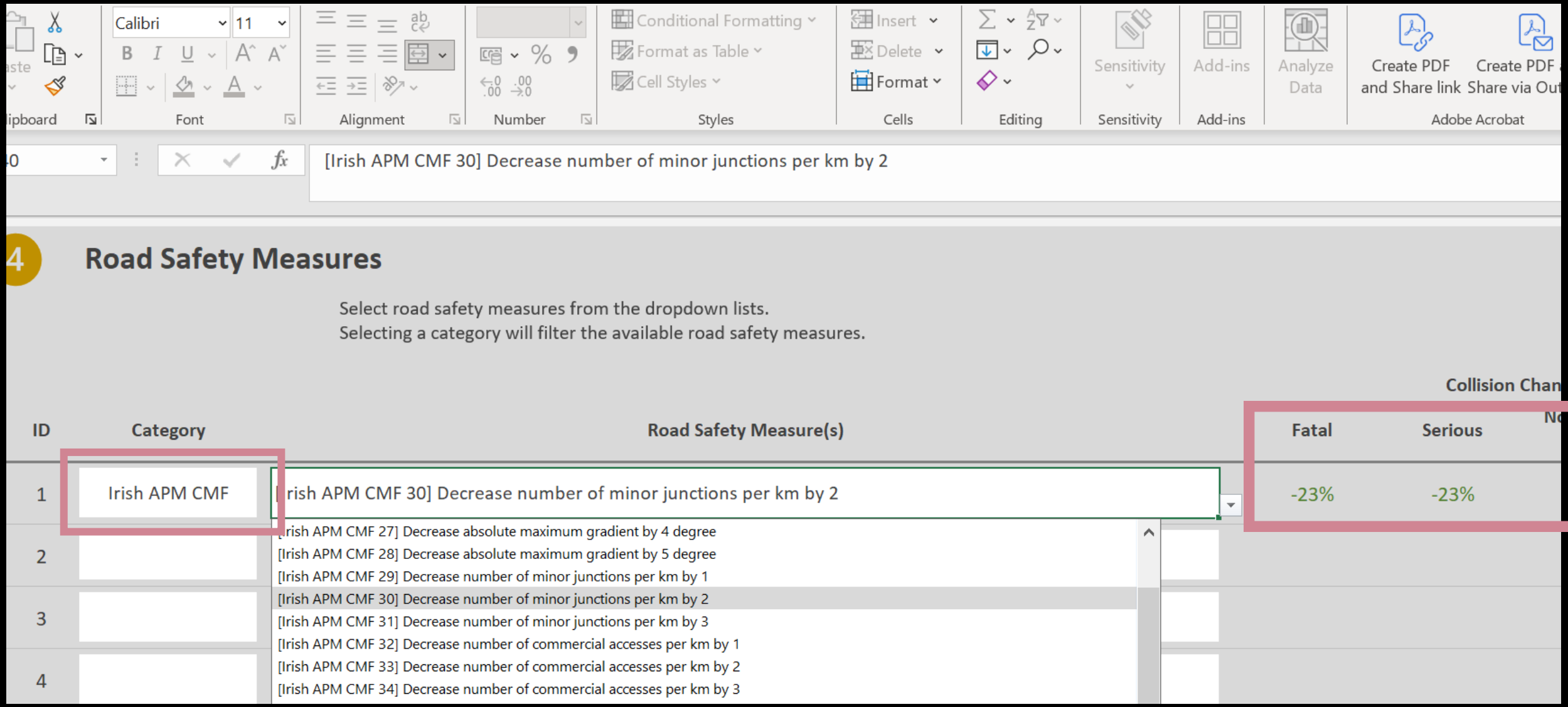
Enter the cost to implement each selected measure in euros.

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
Clipboard
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
[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

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%

RESULTS

Reduction 1.2 Collisions per year

(compared to Before)

FYRR (First Year Rate of Return)

140%

EXAMPLE 2 RURAL TOWN –

RELOCATED ON-STREET PARKING AND

PROVIDE NEW 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 and provide 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%

SUMMARY

New way to predict collision outcomes

(***limitations*** – parameters limited to existing available data sets in TII)

New TII CMF tool

Developed for all Road Safety Practitioners in Ireland – see TII Downloads

TRA 2024 Conference – Full Paper

TII contribution to Road Safety – APM applicable in small countries

TRL Publications

See https://www.trl.co.uk/publications/collision-prediction-model-for-the-irish-national-road-network---phase-2

THANK YOU

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TII Road Safety Section