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Provision of Guidelines for Roadside Safety (PROGReSS) – Roadside safety Organizational Robustness Assessment Tool - User Guide – Version 2.0

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CEDR Call: Safety

Provision of Guidelines for Roadside Safety (PROGReSS) – Roadside safety Organizational Robustness Assessment Tool

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1 Introduction

The PROGRess (Provision of Guidelines for Roadside Safety) project is a study on the relevance, application and use of roadside safety design, operations and maintenance standards and guidelines applicable to European roads with speed limits higher than 70km/h (40mph).

The primary objectives for PROGRess are:

- To review existing roadside safety design, maintenance and operational requirements for clear (obstacle free) zones and also for road restraint systems (as defined by for e.g. EN 1317).
- To determine to what extent national road authorities in Europe and their contractors are capable of implementing and maintaining compliance with the standards and guidelines throughout the life cycle of roads.
- To develop recommendations for safe roadside design and management ensuring broad acceptance among member National Road Authorities (NRAs) of CEDR.
- Development of a tool to aid road authorities to assess their organisational robustness with regard to roadside safety.

WP2 made use of the output from WP1 and its primary aim was to establish current working practices with respect to the design and management of (safe) roadsides in the six countries funding this research (Belgium-Flanders, Ireland, Netherlands, Slovenia, Sweden, United Kingdom). WP2 based this primarily on personal interviews with NRAs in the six funding countries, plus NRAs in Germany and Portugal, among other countries. In order to broaden the input of road authorities from different countries, internet questionnaire surveys were conducted. Apart from the interviews and surveys, WP2 also informed respondents of the project and specifically drew their attention to the project website. The contact details of respondents, who opted to be contacted following the survey, will provide input to WP4.

1.1 Purpose of this deliverable

This document provides details on the methodology used in the development of the Roadside Safety Organizational Robustness Assessment Tool and also acts as a guide to using the tool.

Full knowledge of the content of this document is not required to perform the necessary steps within the Excel tool. The tool itself provides sufficient helpful advice on how to complete each stage of the process.

1.2 About Roadside safety Organizational Robustness Assessment Tool

The Roadside safety Organizational Robustness Assessment Tool can be employed by road authorities, or their agencies, to undertake a robustness assessment of the processes and policies with regard to roadside safety.

The tool allows assessors to assign a priority rating to a number of conditions that has shown to have a detrimental effect on roadside safety. Each condition is assigned a relevance factor, i.e. the significance this condition has on the impact.

Once all the conditions have been assessed the assessor can then stipulate what countermeasures are currently employed within the organisation. The final element of the tool is the generation of a list of tailor made recommendations for new procedures and policies that could be employed to improve the organisation's robustness with regard to roadside safety.

2 Basic Theory and Research

This chapter describes the basic theory and research incorporated in the tool. It outlines how the conditions and countermeasures that affect roadside safety were identified and how the risk based model for development of prioritised recommendations was determined.

2.1 Background

One of the primary aims of this work package was to draft a user specification for future roadside safety guidelines by making use of the findings of the survey and to develop an assessment tool. To achieve this aim, the survey responses were analysed in detail to identify and understand the various issues, problems and shortcomings experienced by road authorities.

The first step of the analysis was a detailed review of the survey responses received. As the responses were reviewed, each problem and shortcoming identified was added to a list of potential conditions that impact on roadside safety. Every item added to this list was effectively a factor that may contribute to the ultimate undesired outcome of injury resulting from a Run-off-Road (RoR) crash. As the list grew in size, it was understood that the identified contributory factors may be introduced at different stages of the lifecycle of a roadside, such as the design, implementation and maintenance phases.

As the review phase matured, it was realized that the team was effectively carrying out a type of fault tree analysis through the way the contributory factors were organized. Therefore it was decided to call this model “Roadside Safety Organisational Robustness Fault Tree”. This Fault Tree (FTA) formed the basis of the assessment tool

An FTA begins with the definition of an undesirable outcome of the system. Then all of the possible ways that can lead to the undesirable outcome and the underlying contributory factors are identified. These factors are then visually organized in a fault tree diagram so that the logical connections between the contributory factors that can lead to the undesirable outcome can be sequentially displayed and analysed.

At the beginning, the Roadside Safety Organisational Robustness Fault Tree was only based on the findings of the survey. This stage only represented a partial FTA, other data and findings were used that could contribute to the analysed undesired outcome. Therefore it was decided to include all of these other identified contributory factors to represent a more complete FTA.

There are many factors that may contribute to the ultimate undesired outcome of injury resulting from a Run-off-Road (RoR) crash and these contributory factors may be introduced at different stages of the lifecycle of a roadside, such as the design, implementation and maintenance phases. For example, a roadside design which is compliant with existing guidelines may end up contributing to negative consequences in the event of a RoR crash if it is not implemented properly; a compliant VRS installation may end up contributing to negative consequences in a RoR crash if it is not maintained properly; or a roadside design

guide may fail to prevent harm in the event of a RoR crash if the local problems are not understood properly due to lack of network monitoring.

National Road Authorities (NRAs) have to be aware of and take into account these potential failure mechanisms so that the necessary countermeasures can be introduced in the shape of more comprehensive standards, guidelines and processes. The more the potential failure mechanisms are countered, the more the organisational robustness will be. The Roadside Safety Organisational Robustness Fault Tree is an attempt at classifying all of these potential roadside safety risk contributors, which relate to the organisational processes which are within the realm of influence of NRAs. Therefore, it constitutes a framework for future guidelines as the NRAs can use the fault tree to assess their own organisational robustness and identify the necessary countermeasures for the identified areas of shortcomings (this will be supported by the WP3 tool).

The fault tree begins with the assumption of the undesired final outcome of “injury resulting from a RoR crash” and then outlines the potential factors that may contribute to the undesired outcome and the associated stages of the roadside timeline, namely the network monitoring, design (standard writing and policy, use of the standard, departures from standard, design level Road Safety Audit (RSA)), implementation/installation, operational life and Road Safety Inspection (RSI).

Whilst the tool has been developed based on known research and feedback from stakeholders it should be noted that this is not detailed design tool for use at individual site locations.

Furthermore, the list of failure conditions, and potential countermeasures, is not an exhaustive list. Whilst every effort has been made to identify the most common failure conditions and countermeasures, based on the research performed, there are likely to be other conditions and further countermeasures than those detailed in the tool.

2.2 Development of prioritisation model

The main output of the tool is a list of recommendations to improve an organisation’s robustness with regard to roadside safety. This list is generated by a combination of the inputs to the FTA and the current employed countermeasures. The list is sorted in the direction of descending priority along with possible countermeasures.

Overall priority level for a contributory factor is based on a combination of its relevance level and the number of countermeasures applied to mitigate it, as detailed in Table 1

Table 1: Contributory Factor Prioritization Matrix

		Number of Countermeasures Applied		
		>1	1	0
Contributory Factor Relevance Level	1 – Not considered to be an issue			
	2 – Considered to be an issue			
	3 – Considered to be a <u>significant</u> issue			

Priority level is categorised in a red, amber, green scale:

- Red (high priority),
- Amber (medium priority)
- Green (low priority)

Contributory Factor Relevance Level is categorised in a 1, 2 & 3 scale:

- 1 - Not considered to be an issue
- 2 - Considered to be an issue
- 3 Considered to be a Significant issue

Number of countermeasures applied are also categorised in a three level scale:

- >1 (more than one countermeasure applied),
- 1 (only one countermeasure applied)
- 0 (no countermeasure applied),

When developing the prioritised list the failure conditions with the highest risk (red) with lowest number of countermeasures (0) will be listed first with those with the lowest risk (green) and the highest number of countermeasures positioned at the bottom of the recommendation list.

3 Guide to the software tool

3.1 *About this manual*

This user guide is intended for anyone who is likely to be involved with reviewing and assessing a road or highway organization's processes with regard to roadside safety. The aim is to provide content that allows new users to quickly understand the essential aspects of the tool.

To achieve these aims, this user guide describes, in separate chapters, how to get started quickly with the tool, all interface features and the outputs. A number of examples and screenshots have been included to aid in the understanding the structure and use of the tool

The following label has been used throughout to highlight relevant points about the topics being covered:

NOTE:

3.2 *Product versions*

The product version number is displayed on the introduction screen and within the title of the accompanying user guide. To ensure you have the latest version of the tool please navigate to www.cedrprogress.eu where the tool can be downloaded along with version history.

3.3 *Installing the software*

The Roadside Safety Organizational Robustness Assessment Tool is a macro-enabled spreadsheet that has been developed to work on systems with Windows 7 and later, but will require Microsoft Excel run.

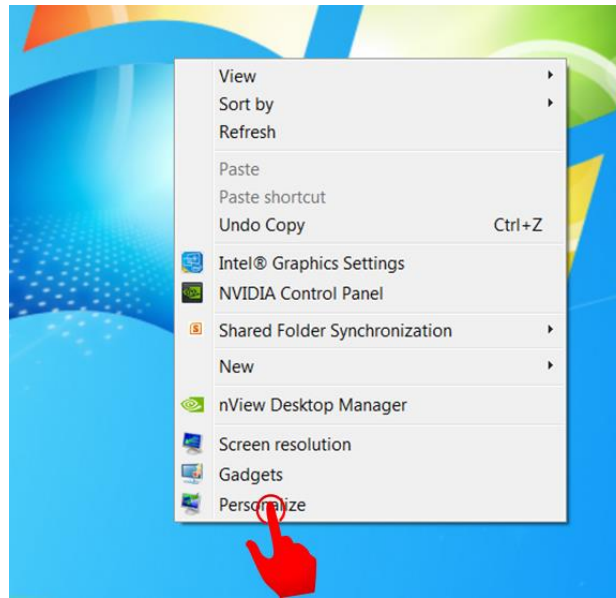
There is no installation process. The spreadsheet can be downloaded free of charge from the project website www.cedrprogress.eu and later on the CEDR website (www.cedr.eu). Once the download is complete selecting the spreadsheet will automatically access Microsoft Excel and open the sheet ready to start. Please see Windows display scaling setup below for optimum performance.

3.4 *Windows Display Scaling Setup*

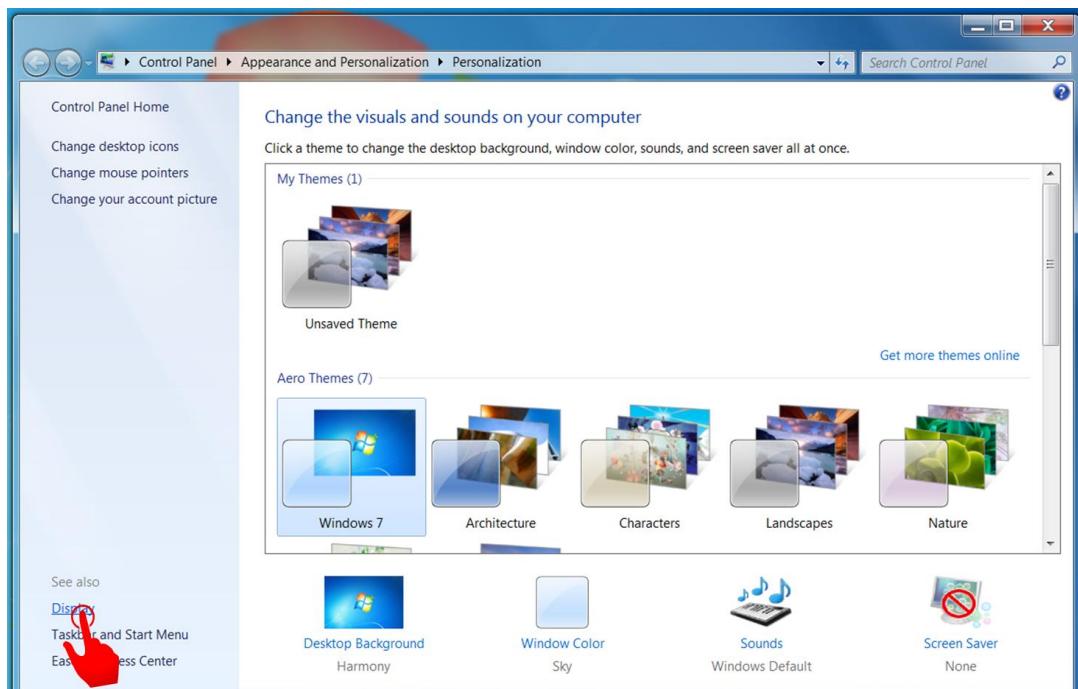
The Roadside Safety Organizational Robustness Assessment Tool is designed to work with a Medium (125%) Windows display scaling setting. In other display scaling settings, some of the features of the tool may not be displayed correctly. Therefore it is recommended to adjust the display scaling setting to 125% for optimum performance:

3.4.1 Display Scaling Setup for Windows 7

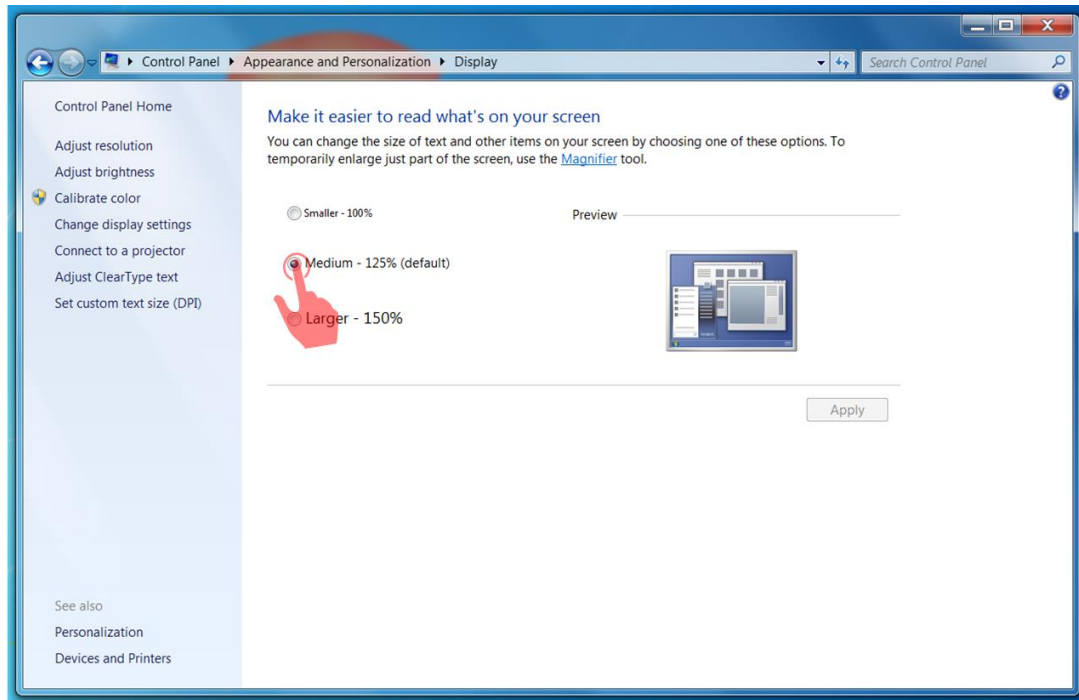
Step 1 – Right click on an empty part of the Windows desktop and left click on “Personalize” option in the drop-down menu.



Step 2- Left click on “Display” option at the bottom left corner of the pop-up screen.

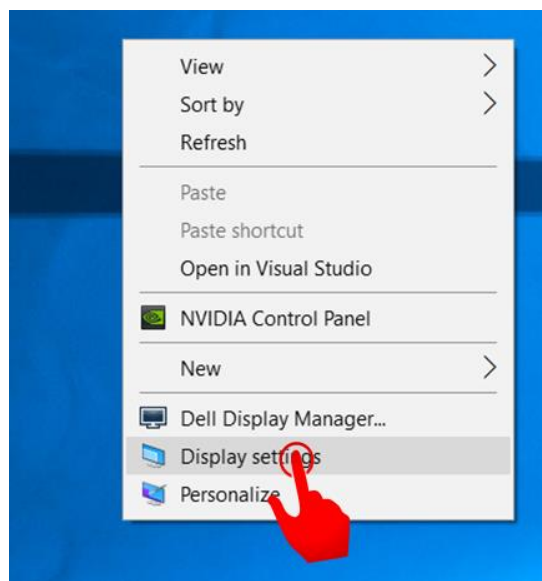


Step 3 – Select “Medium – 125%” scaling setting and then click “Apply”

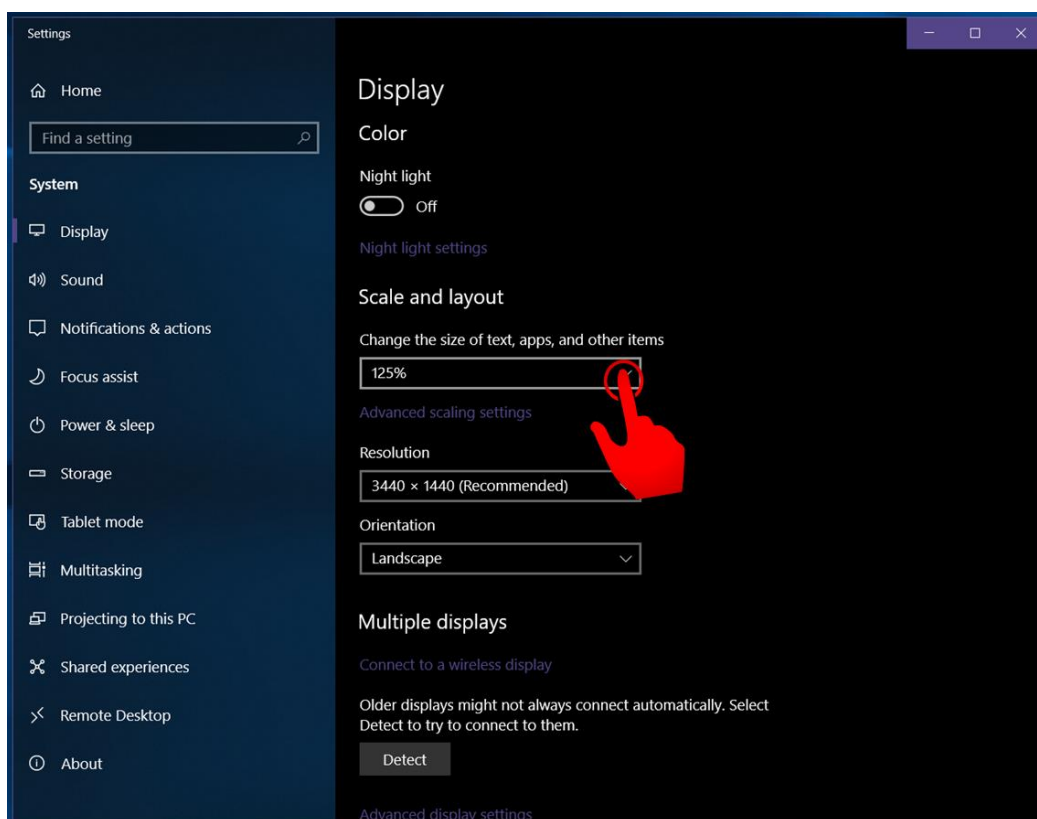


3.4.2 Display Scaling Setup for Windows 10

Step 1 – Right click on the desktop and left click on “Display settings” option in the drop-down menu.

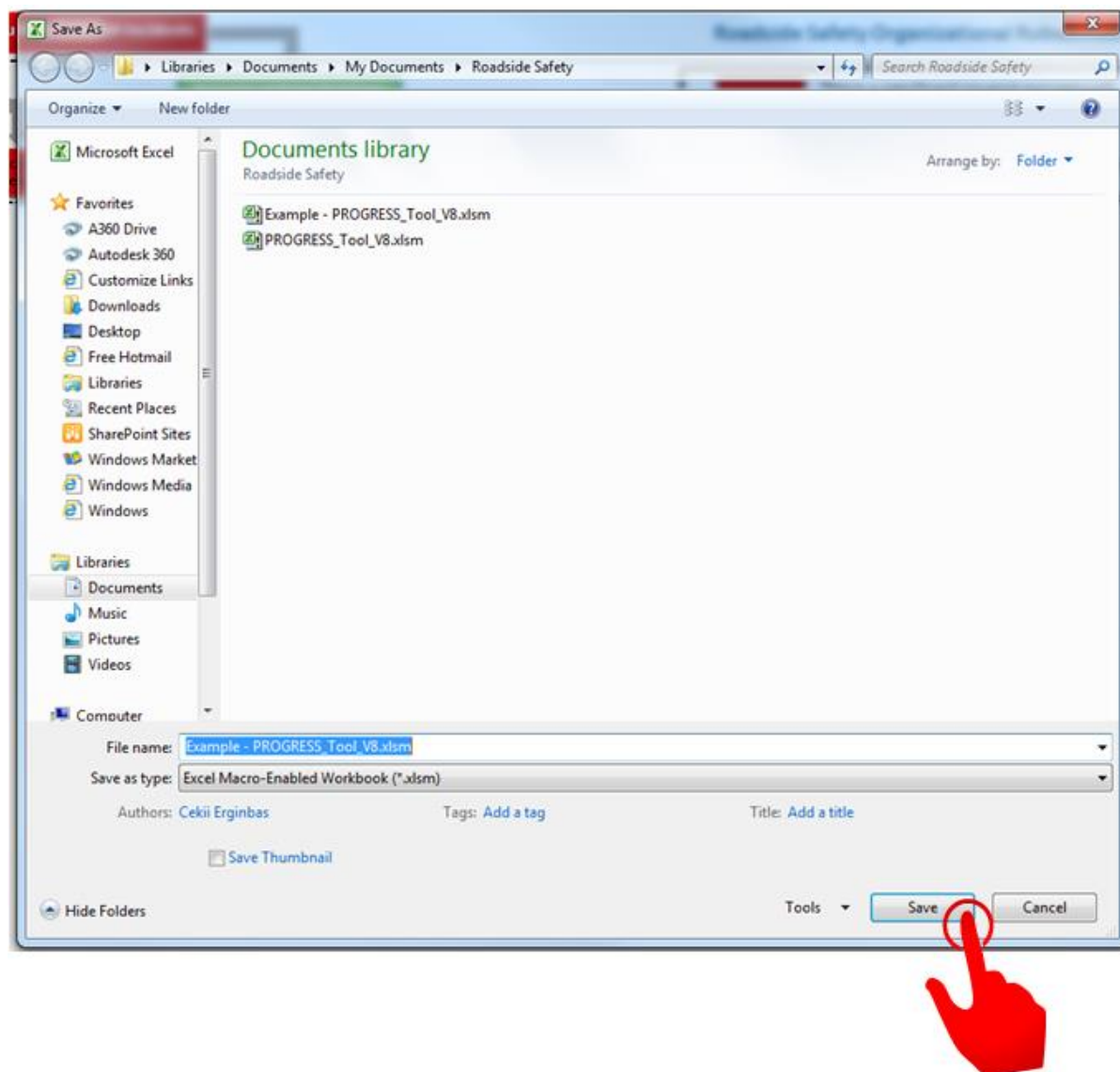


Step 3 – Click on the scaling option and select “125%” scaling setting in the drop down menu



3.5 Saving a file

A file can be saved at any point during the assessment process. The file can be saved by navigating to *File>Save as* and then using Windows Explorer to browse to the desired save location. Enter a *File name* and use the *save* button to complete the process.



NOTE: On opening a saved file the general information, see Section 4.1.3, will not be saved and new data and dates will need to be entered.

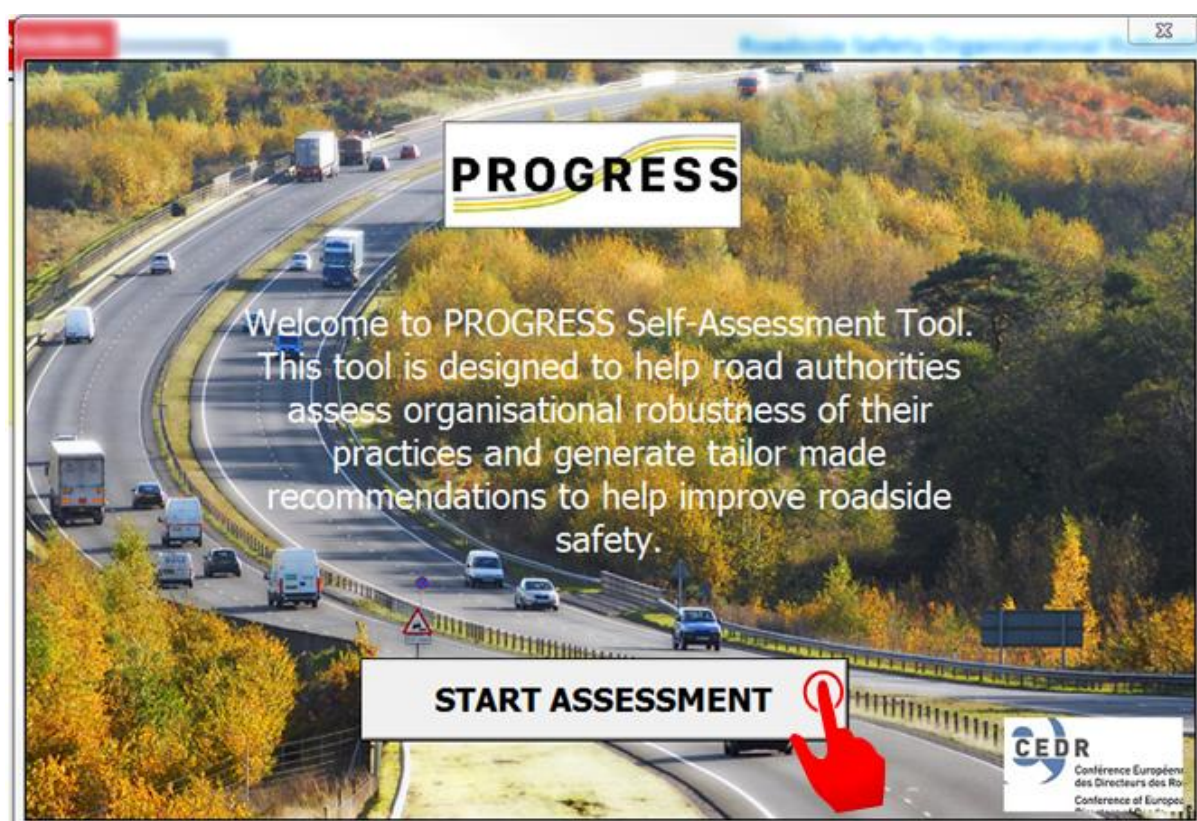
4 How to use the PROGRESS tool

4.1 Starting the tool

The Roadside Safety Organizational Robustness Assessment Tool is a macro-enabled spreadsheet that has been developed to guide users through the assessment process in a systematic and logical manner.

4.1.1 Introduction screen

When the tool first starts an introduction screen will be shown. This provides introductory text on the purpose of the tool. Select 'START ASSESSMENT' to navigate to the next stage.



4.1.2 Workflow screen

The next screen displayed is the workflow screen. This provides a high level overview of the Steps that need to be followed to progress through the assessment.

Detailed descriptions of each Step are provided in the following sections. To progress to Step 1 select 'Next'.



4.1.3 Step 1: Provide General Information

At the start of each assessment (or reassessment) a number of general details need to be entered. This includes:

- 1 **The date of the assessment**
- 2 **The name of the person or persons performing the assessment**
- 3 **The organization who is undertaking the assessment.** This can be different from the organisation that has legal responsibility for the road network, in this instance it is recommended that the road authority is also entered at this point.
- 4 **The assessment type.** This tool can be run to assess the robustness of the approach to roadside safety at an organisational level or it can be run to assess the robustness of approach for a specific type of incident or for a specific area. Please select between the two options of "General Assessment" and "Specific Assessment".
 - a. For an organisational level full assessment, please select "General Assessment" option box and then click "Next".

STEP 1 - PROVIDE GENERAL INFORMATION

General Information
Please fill in the following information

Date of Assessment

Name of Assessor

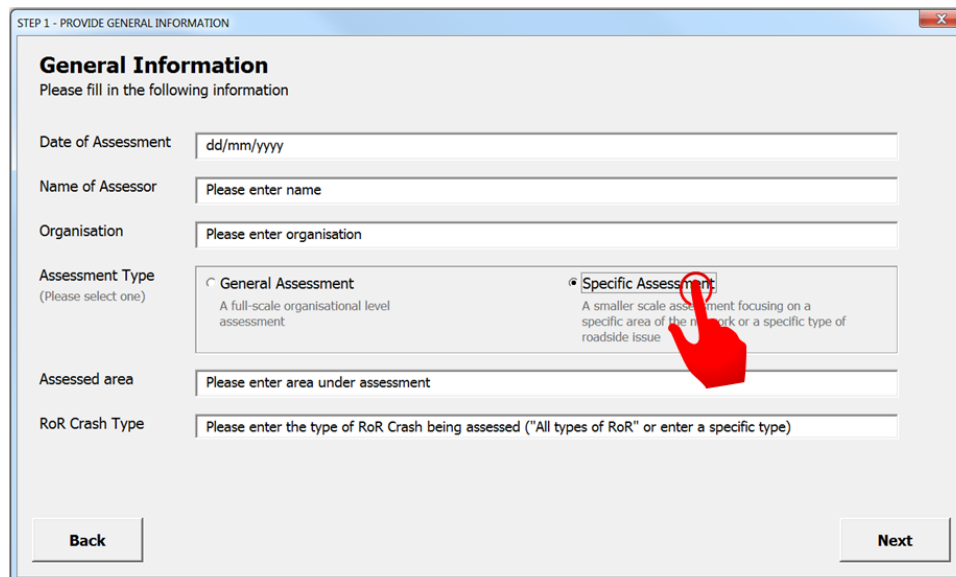
Organisation

Assessment Type
(Please select one)

☒ **General Assessment**
A full-scale organisational level assessment

☐ **Specific Assessment**
A smaller scale assessment focusing on a specific area of the network or a specific type of roadside issue

- b. For a smaller scale assessment focusing on a specific area of the network or a specific type of roadside safety issue, please select “Specific Assessment” option box. This will enable two new information boxes:
- 5 **The area to be assessed.** This assessment process can be performed on different areas within a large road authority, or different road types (strategic / local) for example. Complete the specific area / details that is being assessed
- 6 **RoR Crash Type.** The organizational robustness assessment tool can be used on different scales of reviewing roadside safety. One can review ROR crashes as a whole, for a certain road type, for a certain transport mode or for a certain accident type. The user can utilize this box to record the type of assessment that was carried out.



STEP 1 - PROVIDE GENERAL INFORMATION

General Information
Please fill in the following information

Date of Assessment: dd/mm/yyyy

Name of Assessor: Please enter name

Organisation: Please enter organisation

Assessment Type (Please select one):

☐ General Assessment
A full-scale organisational level assessment

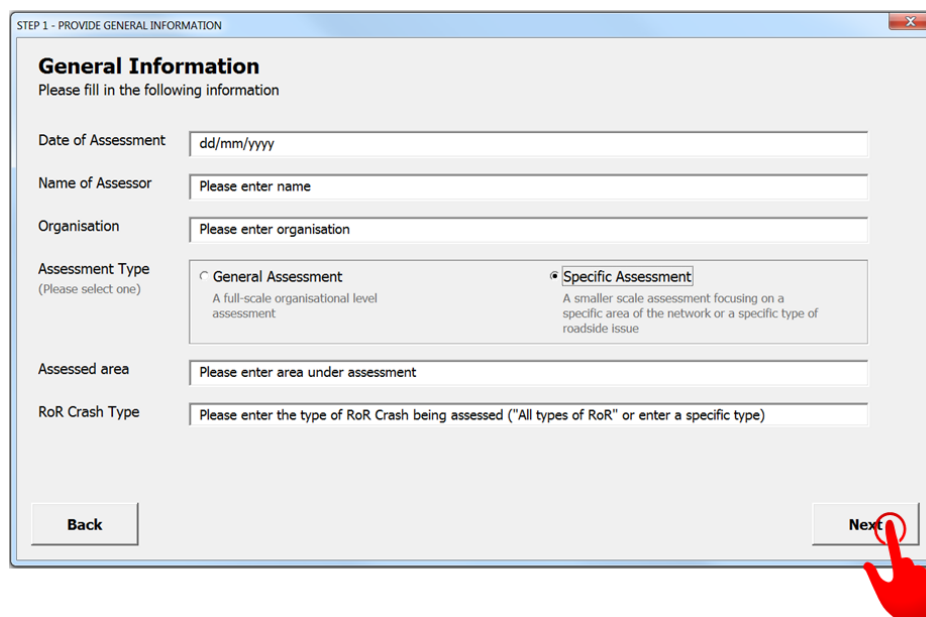
☒ Specific Assessment
A smaller scale assessment focusing on a specific area of the network or a specific type of roadside issue

Assessed area: Please enter area under assessment

RoR Crash Type: Please enter the type of RoR Crash being assessed ("All types of RoR" or enter a specific type)

Back Next

To progress to Step 2 select '*Next*' or if required select '*Back*' to navigate back to the workflow screen.



STEP 1 - PROVIDE GENERAL INFORMATION

General Information
Please fill in the following information

Date of Assessment: dd/mm/yyyy

Name of Assessor: Please enter name

Organisation: Please enter organisation

Assessment Type (Please select one):

☐ General Assessment
A full-scale organisational level assessment

☒ Specific Assessment
A smaller scale assessment focusing on a specific area of the network or a specific type of roadside issue

Assessed area: Please enter area under assessment

RoR Crash Type: Please enter the type of RoR Crash being assessed ("All types of RoR" or enter a specific type)

Back Next

NOTE: Whilst it is not essential to enter this data, and the assessment tool can be progressed and used without entering details, it is recommended that this is always completed for auditing purposes. Furthermore the information is provided in the final output (Step 4: Generate Recommendations) and this will display the default data if no other information has been provided.

4.1.4 Step 2: Identify and Prioritise Issues

4.1.4.1 Step 2 Overview

This Step of the process provides the assessor with the ability to select those contributory factors that may relate to or may be affected by road authority processes that contribute directly, or indirectly, to road user injury as a result of a Run-Off-Road incident.

The overall aim of this Step is to assess the organisational robustness of current safety practices.

The process is a fault tree stage based approach, split in four distinct Stages that need to be completed in full before progressing to the next Step. The Stages of the fault tree are:

- 1 Network Performance Monitoring
- 2 Design
- 3 Implementation and installation
- 4 Operational Life

4.1.4.2 Step 2 Instructions

At the start of Step 2 an initial help screen is provided detailing the purpose and short form instructions. This can be closed by selecting the close icon at the top right corner of the screen.

STEP 2 - IDENTIFY & PRIORITISE PROBLEMS




Purpose:

This step presents Roadside Safety Organisational Robustness Fault Tree Diagram. Factors which may contribute directly or indirectly to injury as a result of Run-Off-Road incident are presented throughout the diagram. Contributory factors included are mainly those which relate to and may be affected by road authority processes. The aim is to assess organisational robustness of roadside safety practices, while using the fault tree as a template.

Instructions:

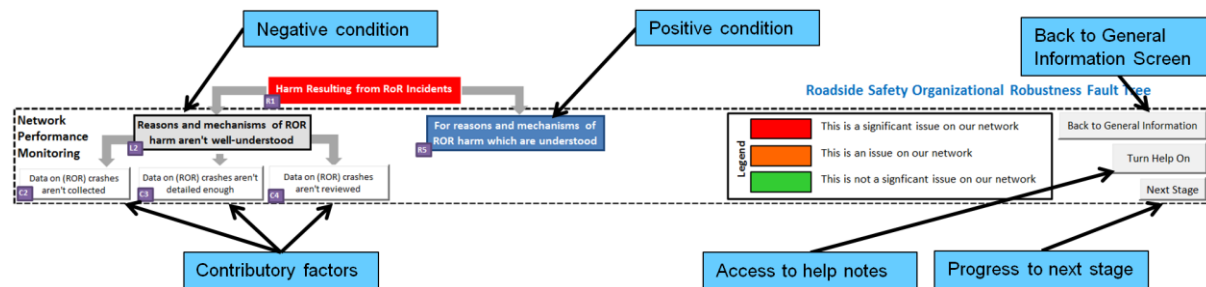
- Review each factor (white box) and assess the level of relevance for your network
- Click on each white box until desired colour code is assigned (see legend below)
- Once all boxes have a color assigned, click 'Next Stage' button to progress
- If a box is left colorless, a warning message will be displayed
- Once all stages are complete, click 'Continue to Countermeasures' button to progress

Note: 'Turn Help Off/On' button to toggles help dialog boxes on or off

Legend		This is a significant issue on our network
		This is an issue on our network
		This is not a significant issue on our network

For each Stage there are two main heading; one describing a positive and the other describing a negative condition, as shown in the image below. For each stage, the negative condition heading is located to the left of the positive condition. The negative condition heading branches out into a number of sub-headings, which detail the likely contributory factors affecting this stage. The positive condition has no sub-factors. This is shown for Stage 1 in the figure below which denotes:

- Both the negative and positive conditions
- Contributory factors
- Back to general information (allows access to Step 1, general information, and alteration if items have been miscoded)
- Access to help notes (turns on and off help notes)
- Next stage button, allows progress to next stage in the fault tree

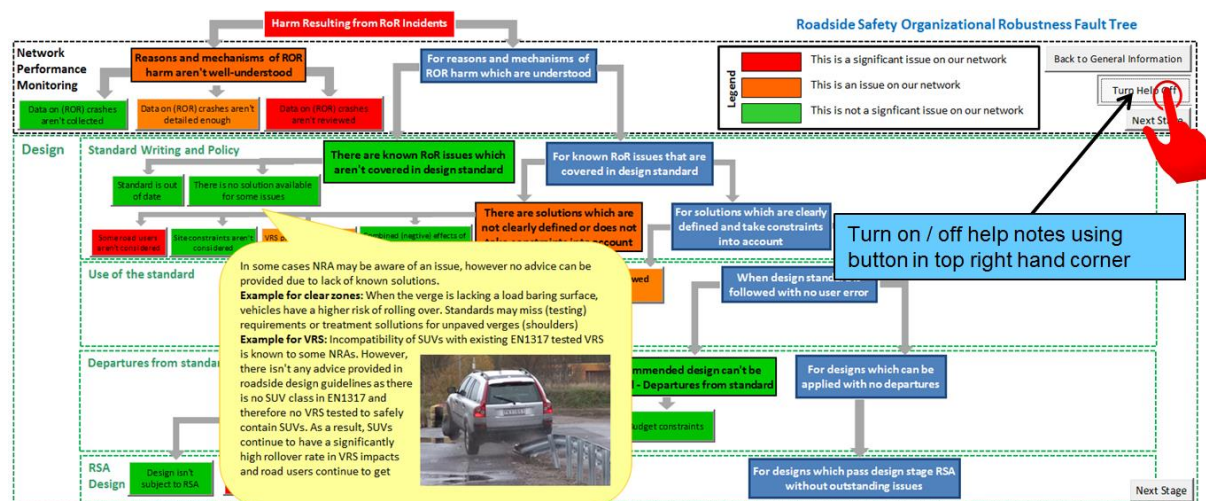


Some negative conditions branch out to underlying sub-contributory factors, such as the “Reasons and mechanisms of RoR harm aren’t understood” box shown in figure above. These boxes have a grey colour at the launch of the tool.

4.1.4.3 Step 2 Help boxes

There is help function for Step 2. For each negative condition and all contributory factor boxes explanatory notes can be accessed, these provide details for each item and aid assessors in the process of determining RAG relevance. The notes can be viewed by hovering the cursor over each box.

The help boxes can be turned on and off via the button in top right hand corner of the screen.



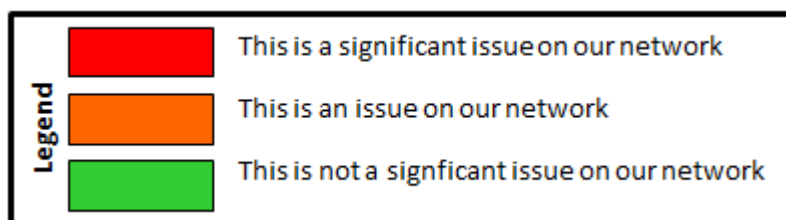
4.1.4.4 Step 2 Process

The following process will need to be applied for each stage of Step 2.

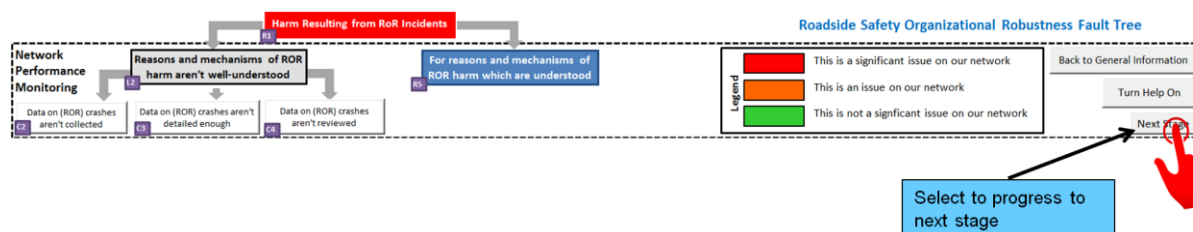
- 1 All the contributory factors will need to be assessed and the level of relevance for the network assigned.

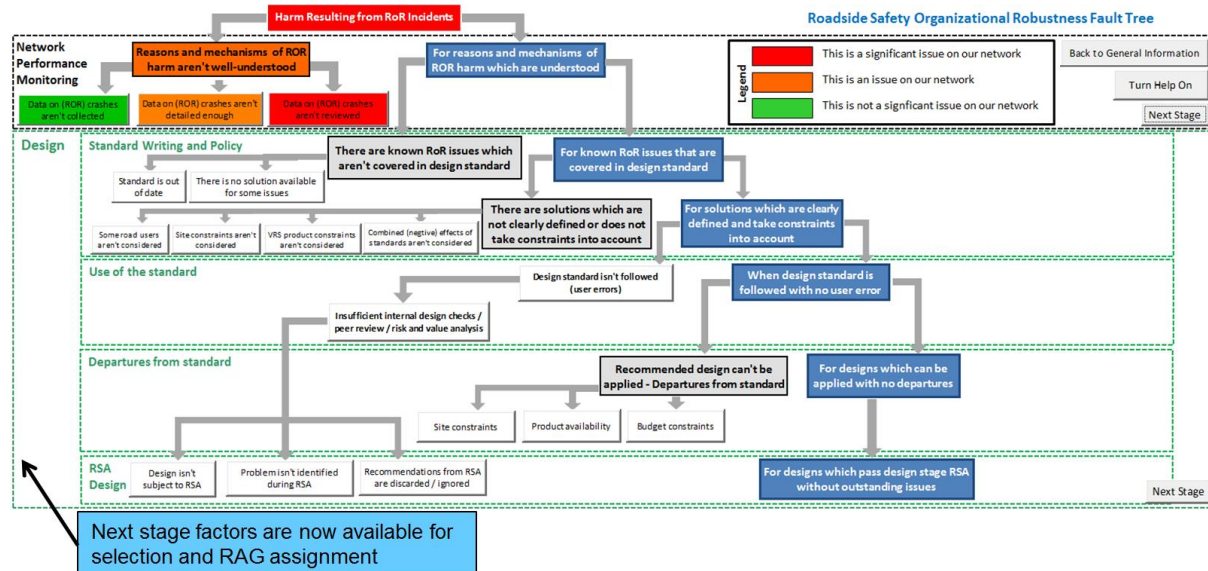
NOTE: The positive and negative conditions are not assessed for level of relevance and will remain clear (i.e. no relevance applied as per step 2 below).

- 2 All the contributory factor white boxes will need to be assigned a Red, Amber or Green (RAG) Rating; the relevance of the colour coding is detailed in the legend within the main screen and repeated below.

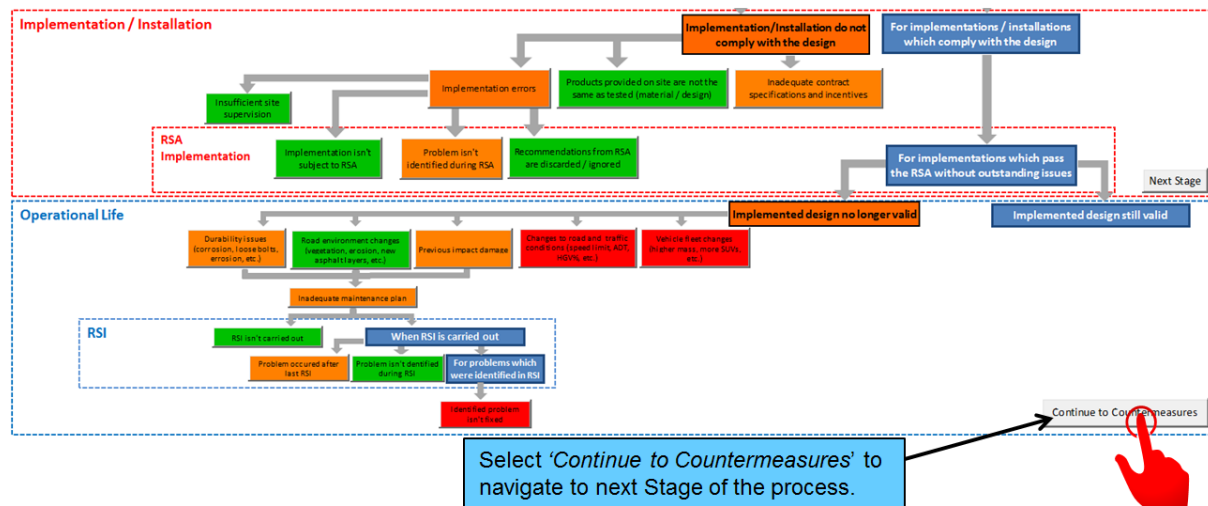


- 3 Use a mouse to left click each contributory factor box until the desired RAG colour is displayed. If none of the factors apply, or are known not to be an issue, it will be necessary to set all the contributory factors to green.
- 4 Grey coloured boxes are not clickable. Their colour will change based on the combination of the colours assigned to the branching out contributory factors.
- 5 Once all the contributory factors for each Stage have been assigned a RAG Rating, select the 'Next Stage' button which will allow access to the next Stage of the process.



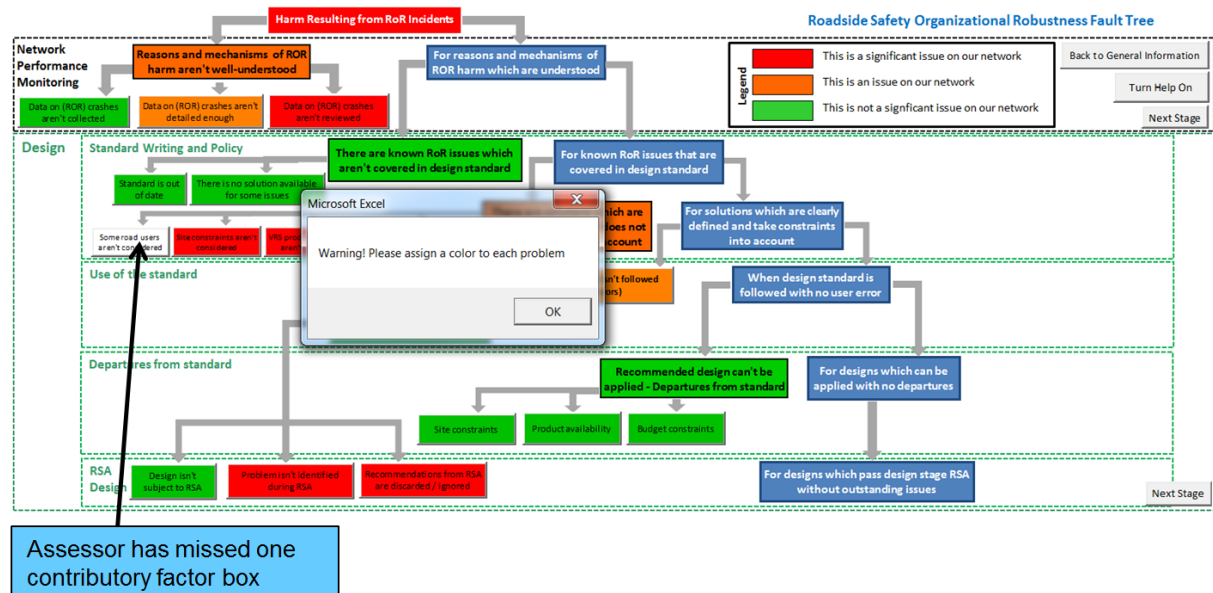


- Complete the RAG assignment for all four Stages until all the white contributory factors boxes have been assessed.
- On completion of four Stages select 'Continue to countermeasures' to navigate to the next Stage in the process.



NOTE: It is necessary to assess and provide a RAG Rating for each contributory factor. If one or more factors are not completed then an error warning will appear and it will not be possible to move on to the next Stage in the process.

If the warning appears, review all contributory factor boxes and assign the relevant RAG Rating.



4.1.5 Step 3: Identify and declare countermeasures

4.1.5.1 Step 3 Overview

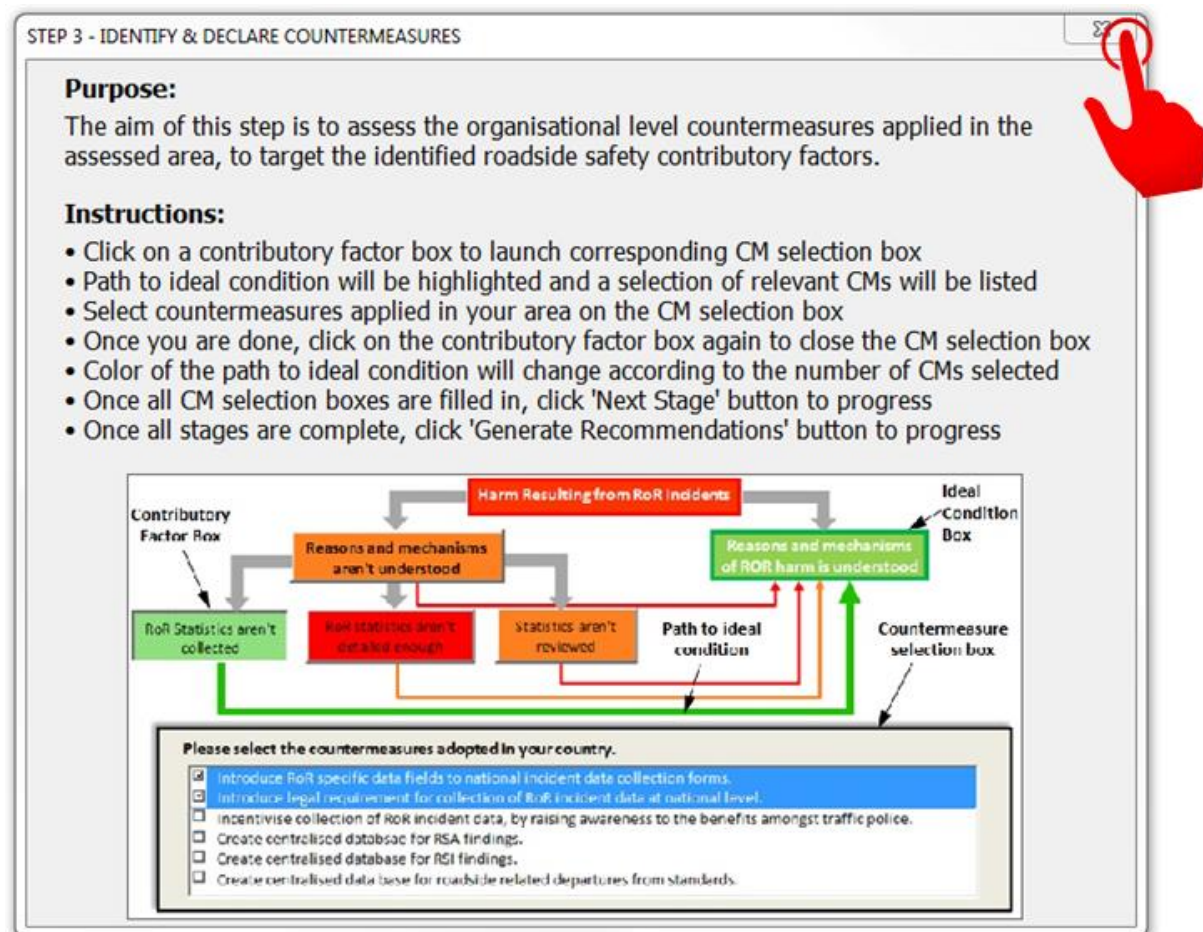
This Step of the process provides the assessor the ability to select countermeasures that are currently employed by the organisation. By selecting the current countermeasures, if any, will aid in the development of possible countermeasure treatments that could be applied, see Step 4 in Section 4.1.6.

The Step follows the same process and fault tree stage based approach as Step 2, i.e. split in four distinct stages that need to be completed in full before progressing to the next stage. The stages of the fault tree are:

- 1 Network Performance Monitoring
- 2 Design
- 3 Implementation and installation
- 4 Operational Life

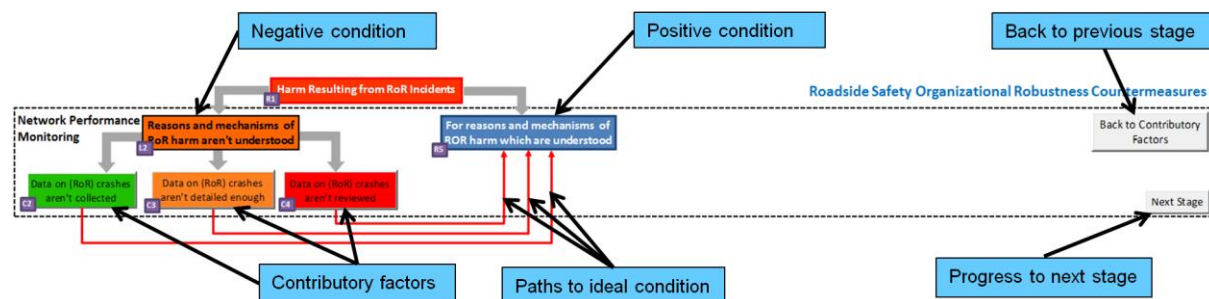
4.1.5.2 Step 3 Instructions

At the start of Step 3 an initial help screen is provided detailing the purpose and short form instructions. This can be closed by selecting the close icon at the top right corner of the screen.



This Step follows the same pattern as Step 3 with a near identical screen layout and process to follow. The contributory factors that were assessed in Step 2 will automatically be assigned the RAG within Step 3. There is one significant change to the Step 3 process and this is the inclusion of *paths to ideal condition*. This is shown for Stage 1 in the figure below which denotes:

- Both the negative and positive conditions
- Contributory factors
- Paths to ideal condition
- Back to previous stage (allows access to Step 2, contributory factors, and alteration if items have been miscoded)
- Next stage icon, allows progress to next Stage in the fault tree

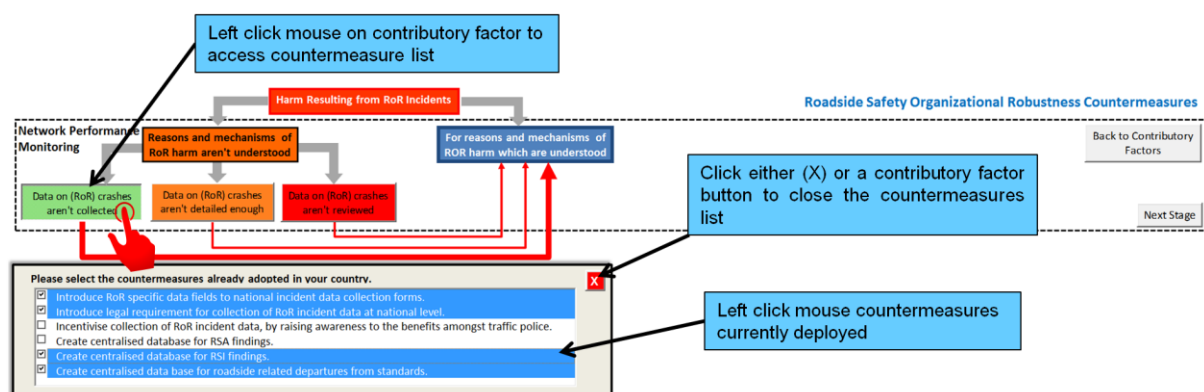


4.1.5.3 Step 3 Process

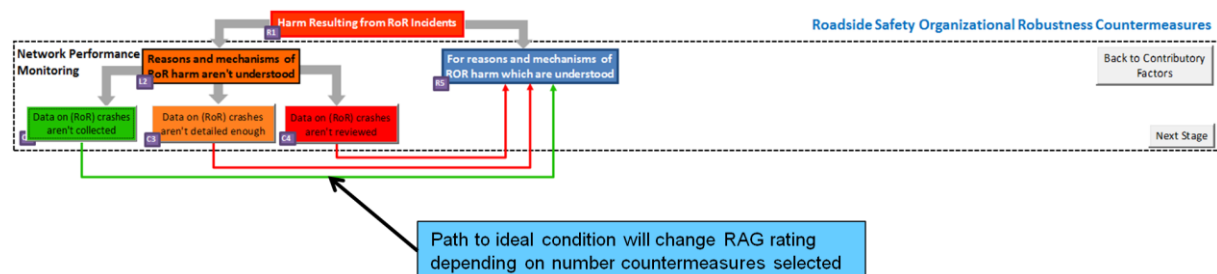
The following process will need to be applied for each Stage of Step 2.

- 1 All the contributory factors will need to be assessed and the currently employed countermeasures selected.
- 2 For each contributory factor left click on the mouse and this will open a new dialog box where list of common countermeasures are displayed. The path to ideal condition will be highlighted once the contributory factor is selected.

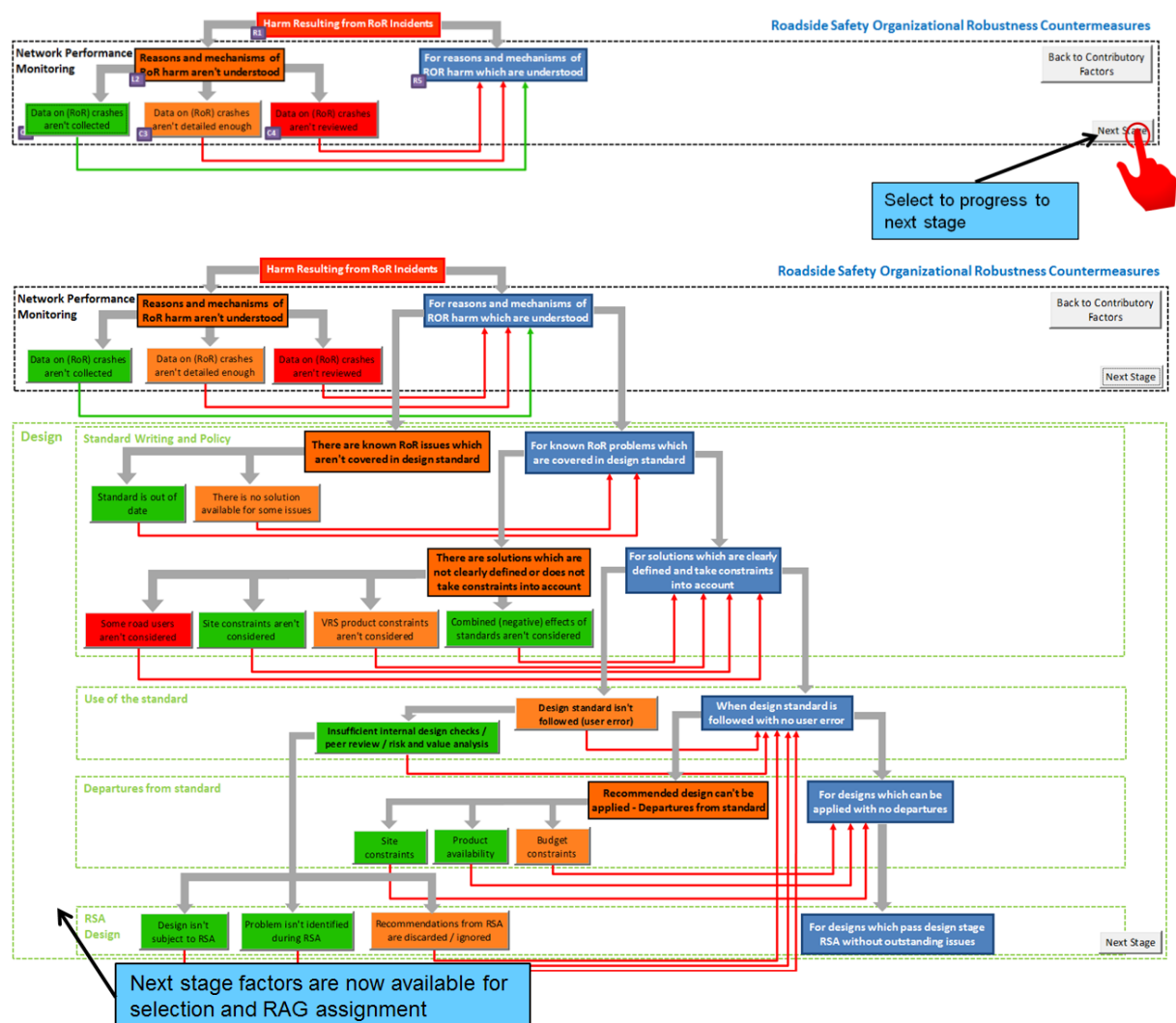
Select all those countermeasures currently employed for the selected contributory factor



- 3 If a countermeasure currently employed is not listed, use the 'Other' option and details can be added in Step 4 (Section 4.1.6).
- 4 Once all the relevant countermeasures have been selected left click on the contributory factor box again to close the countermeasure dialog box (alternatively you can also click the red [X] on top right corner of the box or you can click on another contributory factor box, which will close the currently open countermeasure box and open the one relevant to the clicked box). The path to ideal condition RAG Rating may alter depending on the number of counter measures selected.

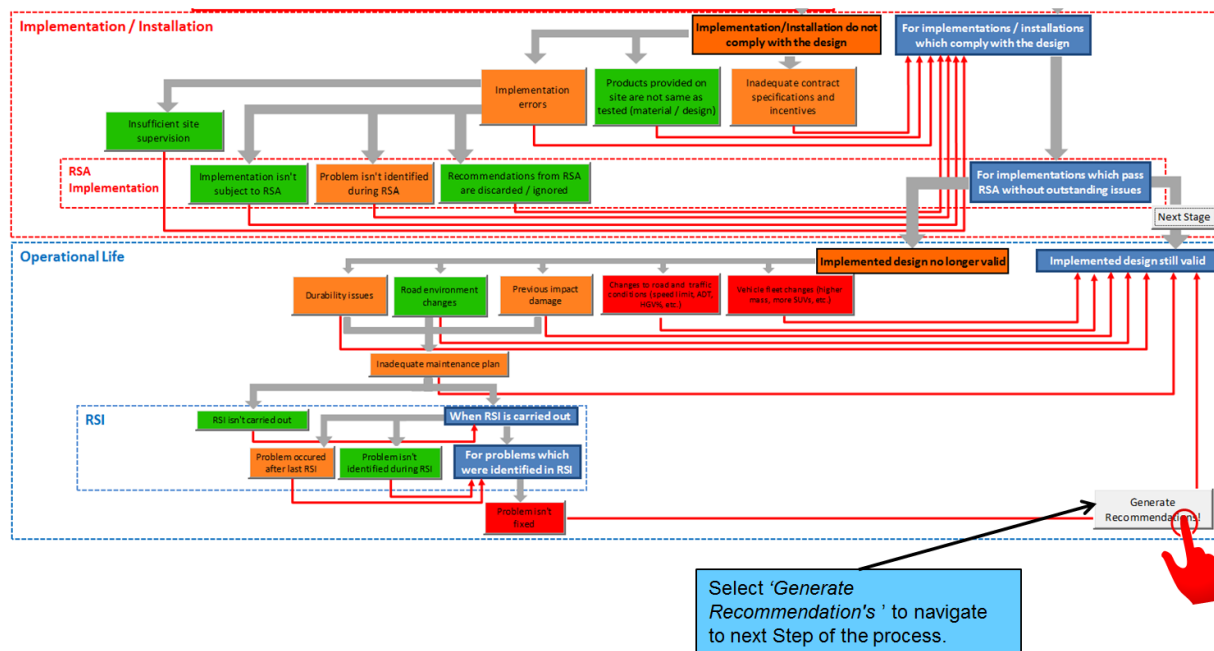


- 5 Repeat Steps 2, 3 and 4 for each contributory factor in turn and ensure all relevant countermeasures are selected. Once complete select the 'Next stage' button which will allow access to the next Stage of the process.



- 6 Complete the countermeasure selection for all four Stages.

- 7 On completion of four Stages select '*Continue to countermeasures*' to navigate to the next Stage in the process.



4.1.6 Step 4: Generate recommendations

4.1.6.1 Step 4 Overview

The final Step of the process is the generation of recommendations; this provides a list of potential measures that could be applied to contributory factors assessed as part of Steps 1 and 2.

On selection of the '*Generate Recommendations*' button from Step 3 a new tab in the spreadsheet is automatically populated with potential recommendations for improvements to a road authority's current processes.

The list of recommendations is prioritised based on the selection from the previous Steps, with negative conditions deemed to be of greater risk listed first, along with the potential recommended countermeasures that could be employed to reduce risk.

For example, following the example of the file detailed in the images within this guide, the highest rated risk condition is **Installation errors**.

This is deemed the condition to be of greatest risk as none of the current common countermeasures within the model have not been selected, nor has the Other option. This indicates that presently that is no formal training or certification for installers and that one or more of the potential recommended countermeasures could be employed.

The generated recommendations can be used by road authorities to consider the introduction of new processes to increase the organisational robustness to help improve roadside safety.

Recommendations		
Date of Assessment: 20/04/2019 Assessed by: A Example Organisation: Road Authority Assessed Area: Area 5 - Strategic Network		
Priority	# Contributory Factor	Recommended Countermeasures to be Considered
1	1 Some site constraints are not considered in the design standard	1 Ensure soil and foundation conditions are considered within the roadside design manual 2 Introduce requirements to ensure VRS are installed on as-tested soil conditions. 3 Introduce BIM Level 2 approach so more information about the roadside, including all infrastructure in the vicinity are available 4 Ensure installations on roadside surfaces (such as kerbs) take effective barrier height into consideration.
1	2 Some VRS product constraints are not considered in the design standard	1 Introduce requirements to ensure VRS tested length are taken into consideration 2 Introduce requirements to ensure availability of approved transitions are taken into consideration 3 Introduce requirements to ensure availability of approved terminals are taken into consideration 4 Introduce requirements to ensure durability of VRS are taken into consideration, in relation to local climate 5 Introduce requirement to ensure vehicle intrusion is taken into consideration
1	3 Problem is not identified during RSA	1 Introduce guidelines for RSAs to take common issues relating to the latest roadside safety requirements into account 2 Introduce training for road safety auditors in issues specific to road side safety design 3 Ensure road safety auditors are qualified to the necessary standards
1	4 Installation errors	1 Introduce a mandatory training and certification programme for roadside infrastructure installers 2 Ensure infrastructure installers are qualified to the necessary standards 3 Introduce a procedure to enable reporting of cases where installers arrive to a site which isn't as described in the design
1	5 Vehicle fleet changes (increased mass, SUVs, etc.)	1 Regularly review vehicle fleet composition and assess its effects on VRS 2 Incentivise VRS manufacturers to develop systems which are compatible with modern vehicle types such as SUVs 3 Update European VRS standards to ensure impact test vehicles are representative of modern fleet 4 Monitor performance of historic VRS for real world impacts by modern vehicles
1	6 Problem identified in RSI is not fixed	1 Problem wasn't fixed properlyCM1
2	7 RoR Statistics are not reviewed	1 Regularly (ex. annually) review RSI findings to identify roadside safety issues. 2 Regularly (ex. annually) review RSA findings to identify roadside safety issues. 3 Regularly (ex. annually) review departures from standards to identify common issues. 4 Regularly (ex. annually) review in-depth on site incident data to identify RoR issues.
2	8 Design standard is not followed (user errors)	1 Provide sufficient applied examples in the design guide / manual 2 Introduce a mandatory training programme for designers 3 Introduce mandatory road safety audit process at design stages

Automated list of recommendations

4.1.7 Repeat assessments

Assessment of the same area can be repeated on a regular basis to monitor robustness over time as new processes and procedures are introduced and act a means of providing organisational audit trail.