



STARS

Defining the data requirements

Deliverable 1

Apr 2012

...



Project 832690

Project acronym: STARS

Project title:

Scoring Traffic at Roadworks

Deliverable 1 – Defining the data requirements

Start date of project: 01.11.2012

End date of project: 31.04.2013

Author(s) this deliverable:

Jill Weekley, TRL, UK

Iain Rillie, TRL, UK

Xavier Cocu, BRRC, Belgium

Kris Redant, BRRC, Belgium

Matthias Zimmerman, KIT, Germany

Alan O'Connor, TCD, Ireland

Anita Ihs, VTI, Sweden

Mojca Ravnikar Turk, ZAG, Slovenia

...

Version: draft 01

Table of contents

Abbreviations	4
1 Introduction	5
2 Methodology.....	5
3 Country-specific information	7
3.1 Type.....	7
3.2 Location	10
3.3 Timing.....	13
4 Proposed Definition of Terms	14
5 Data requirements.....	16
Appendix	19
Belgium.....	19
Germany.....	20
Sweden.....	21
Slovenia.....	22
UK	23
Republic of Ireland.....	24
Denmark	25
Norway	25

List of Tables

Table 1: Road works type definitions by country	7
Table 2: Information on section of road works by country	10
Table 3: Definition of road works type.....	14
Table 4: Definition of road works section	14
Table 5: Definition of road works stage.....	15

Abbreviations

ENR2	ERA-NET ROAD II
ERA-NET	European Research Area Network
LMCC	Lorry mounted crash cushion (same as TMA)
NRA	National Road Administration
TEN-T	Trans-European Network - Transport
TMA	Truck mounted attenuator (same as LMCC)

1 Introduction

ERA-NET ROAD II (ENR2) is a Coordination Action funded by the 7th Framework Programme of the EC (www.eranetroad.org). Within the framework of ENR2 this joint research project was initiated as answer to the call “Design – Rapid and Durable Maintenance Methods and Techniques” issued within a cross-border funded, trans-national joint research programme. The funding National Road Administrations (NRA) in this joint research project are Belgium, Germany, Denmark, Finland, Netherlands, Norway, Sweden, Slovenia and United Kingdom.

Individual aspects relating to road works management usually considered in isolation:

- Road user safety
- Road worker safety
- Network performance

STARs aims to develop a way that these three aspects can be scored interdependently. This will encourage national road authorities and their suppliers to take a holistic approach to managing safety risk and network performance

This document sets out the approach to the project and defines the data structure and requirements.

2 Methodology

STARs looks at the concept of risk in three risk areas:

- **Road workers:** Risk of injury
- **Road users:** Risk of injury
- **Network performance:** Risk of congestion

For each risk area there are three dimensions:

- What: scale / **type** of road works
- Where: spatial aspect of roadworks (**location** within the road works)
- When: temporal aspect of roadworks (**timing** of road works activity)

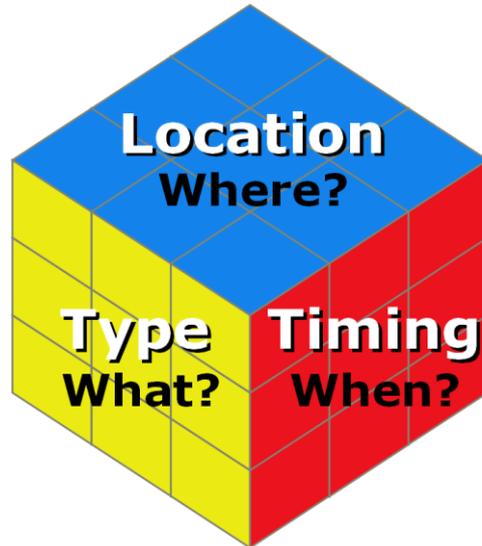


Figure 1: Three dimensions for each risk area

This gives 27 parameter combinations for each risk area – visually this can be represented as a three-by-three cube, as illustrated in Figure 1. There is a “cube” of parameter combinations for each of the three risk areas (road worker safety, road user safety, network performance). These parameter combinations will be used to develop the performance scales (see Section 5).

When the toolkit is used in reality to assess the performance of a given roadworks scheme, the roadworks ‘type’ will of course be known and fixed. Continuing the cube metaphor this means that there will be a ‘slice’ (i.e. 9 parameter combinations) for each of the three risk areas. The idea is that each element of each slice will then have a risk value awarded to it depending on the design of the roadworks, according to the scales that are developed in workpackages 3, 4 and 5 of the project. These risk values will then be used to set star ratings for the three risk areas and combined into a single overall score.

The scope of the project is limited to motorways on the Trans-European Network – Transport and scheduled/planned works only, rather than reactive incident management.

3 Country-specific information

Within the cubes there are three sets of parameters, for which data will be required. It is necessary therefore to clearly define the three categories such that they are applicable across countries and meaningful to all NRAs.

Information on current road works practices was therefore sought from all the ENR2 funding countries in addition to those in the consortium. The information received is summarized in the following tables. At the time of writing information has not been received from France, Finland and the Netherlands. The format and level of detail provided, and included in the table, varies by country; further country-specific information for the consortium partner countries is included in the Appendix of this report.

3.1 Type

Information was collected regarding how different types of road works were classified in each country. Table 1 shows a summary of the information gathered with a reference to the proposed term each would correspond with.

Table 1: Road works type definitions by country

Country	Type Terms	Definition	Proposed term
Belgium ¹	Category 1	Road works on motorways and roads with a speed limit above 90 km/h	Major
	Category 5	Works during daylight conditions and with normal visibility (200m)	Minor
	Category 6	Mobile road works hindering the traffic due to their low speed or frequent stops	Mobile
Denmark	Services and aesthetic	This is works that does not have any influence on safety, like gathering litter, work on areas not directly related to the road	Mobile
	Safety	This is works that have to do with the safety on the road, like important signs, markings on the asphalt,	Minor

¹ In Belgium, the legal basis for the categorisation of roadworks is determined by the decree of May 7th, 1999 concerning the signing of road work activities and other obstructions on public roads.

Country	Type Terms	Definition	Proposed term
		crash barriers etc	
	Preservation of investment	This is works that will protect the investments made in the infrastructure, like maintenance of bridges, new asphalt etc	Minor
	Construction	All new constructions	Major
Germany	Long Term Work Zone	Work zone with duration of minimum one calendar day and fixed position	Major
	Short Term Work Zone	Work zone with duration of limited number of hours, even if they will start again the next day; stationary	Minor
	Short Term Work Zone	Work zone with duration of limited number of hours, even if they will start again the next day; mobile	Mobile
Ireland	Type A	Full-time roadworks that remain in operation in all traffic flows and conditions	Major
	Type B	Part-time roadworks that are not in operation at certain flow levels	Minor
	Type C	Roadworks of short duration, involving the use of one or two vehicles, when capacity is not significantly impacted	Minor
	Mobile Lane Closure	Roadworks where the operations are mobile or only stationary for very short periods	Mobile
Norway	Brief work (Kortvarig arbeid)		Minor
	Movable work (Bevegeleig arbeid)		Mobile

Country	Type Terms	Definition	Proposed term
	Permanent work (Fast arbeid)		Major
Slovenia	“dolgotrajna zapora ceste”	‘Long-term work zone’: work zone with duration of more than the bright part of a day (that is including at night);	Major
	“kratkotrajna nepremična zapora ceste”	‘Short-term stationary work zone’ work zone with duration of less than the bright part of a day (that is excluding at night) on one location	Minor
	“kratkotrajna premična zapora ceste”	‘Short-term work zone’ mobile work zone with duration of less than the bright part of a day (that is excluding at night)	Mobile
Sweden	Minor Stationary Work (Liten Fast Arbetsplats)	Work that doesn’t require the use of more than single machine / equipment. The work has duration of maximum 8 hours including setting up and clearing away.	Minor
	Stationary Work (Fast Arbete)		Major
	Intermittent Work (Intermittent Arbete)	Work that is intermittently moved forward, occasional work of short term nature or work carried out with work vehicles at a speed that is significantly lower than the speed of the traffic.	Mobile
	Mobile Work	The work is carried out with or from a work vehicle continuously moving along the road (proceeds at the same or almost the same	Mobile

Country	Type Terms	Definition	Proposed term
		speed as the traffic).	
UK	Relaxation schemes	Relaxation schemes are appropriate for certain types of works for short term situations with good visibility and low traffic flows.	Minor
	Standard schemes	Standard schemes are for works carried out in all weather, visibility and traffic conditions	Major
	Mobile lane schemes	Mobile lane closures are used where short term access is required to the carriageway at multiple locations over a long (<4km) section of carriageway	Mobile

3.2 Location

Information was also collected regarding how different countries define sections or zones of road works in terms of traffic management etc. Table 2 shows a summary of the information gathered with a reference to the proposed category each would correspond with.

Table 2: Information on section of road works by country

Country	Location Terms	Definition	Proposed term
Belgium	Advance warning	Depending on the category of the road works, advance warning signs and/ or TMAs must be installed at specified distances before the actual start of the work zone	Approach/ Merge
	Start of work zone	Actual start of the work zone requires installation of specific signing and/	Approach/ Merge

Country	Location Terms	Definition	Proposed term
		or TMAs.	
	Work zone	Delineation of the work zone, often by using cones or fencing	Works Zone
	End	Sign to indicate end of the work zone	Works End
Denmark	Signing Zone		Approach/ Merge
	Work Zone		Works Zone
Germany	Approach Zone	With/ without congestion	Approach/ Merge
	Interconnecting zone	With lane changes	Approach/ Merge
	Work zone	Zone including barriers and where the work takes place	Works Zone
	End of work zone	Sign to indicate end of the work zone only at major work zones	Works End
Ireland	Approach zone	From the first roadworks ahead sign to the start of the first taper	Approach / Merge
	Transition zone	From the start of the first taper to the end of the final taper, where capacity reduction is complete	Approach / Merge
	Safety zone	Longitudinal safety zone from the end of final taper to start of work zone	Work zone
	Work zone	The zone required for the contractor to carry out the works	Work zone
	End zone	From the end of the work zone to the 'End of roadworks' sign	Works end
Slovenia	"Območje najave,	Announcement section,	Approach / Merge

Country	Location Terms	Definition	Proposed term
	območje opozarjanja“	warning section	
	“Začetno območje, območje umirjanja, območje preusmeritve“	Starting section, traffic calming section, lane change zone	Approach / Merge
	“Območje delovišča“	Works zone	Works zone
	“Zaključno območje“	End of works zone - lane change zone continues to the last sign	Works end
	“Iztek“	Speed up zone (after the last sign)	Works end
Sweden	Road work area	A road segment that has been committed for road works and that affects the passing traffic.	Approach/Merge + Works zone + Works end
	Road work site	The road work site begins where the first traffic control and safety arrangement after the warning sign is placed. (Merge + works zone)	Approach/Merge + Works zone
	Work zone	Zone within the road work site where the work takes place	Works zone
	Buffer zone	Longitudinal safety zone prior to the work zone	Works zone
	Safety zone (upstream)	Zone prior to the buffer zone where warning signs are placed and lane capacity reduced	Approach/Merge
	Safety zone (downstream)	Zone after the work zone where lanes are reinstated	Works end
UK	Approach Zone	Approach zone starts at the first sign and continues to 100 m upstream of the first sign requiring a lane change	Approach/ Merge

Country	Location Terms	Definition	Proposed term
		decision	
	Lane Change Zone	Lane change zone starts at 100m upstream of the first sign requiring a lane change decision, and continues to the point at which all lane changes should have been completed.	Approach/ Merge
	Lead-in Zone	Lead-in zone starts at the point at which all lane changes, if required, should have been completed and continues to the beginning of the longitudinal safety zone	Approach / Merge
	Works Zone	Works zone starts at the beginning of the longitudinal safety zone and continues to the end of the works area	Works Zone
	End of Works Zone	End of works zone starts at the end of the works area and continues to the last sign.	Works End

3.3 Timing

The third parameter that needs to be defined is 'timing' i.e. the stage of road works activity. Information was not explicitly collected from all countries regarding timing as this is a more general concept and not subject to individual country-specific regulation. It is proposed that the following terms are used for the three stages of road works:

- Before: setting up the road works
- During: whilst the road works are taking place
- After: clearing away the road works

It was agreed that initially no consideration would be given to seasonality of road works. However this information will be collected during the data collection phase, via the date/time, and if necessary it will be considered later in the project.

4 Proposed Definition of Terms

The proposed definition of terms for 'type', 'location' and 'timing' are given in Table 3, Table 4 and Table 5 respectively.

Table 3: Definition of road works type

Type:	Definition
Mobile	Mobile and intermittent road works of limited duration carried out using, for example, vehicles and / or mobile devices (such as TMA / LMCC) to create a safe working environment for short-term access to specific sections of the road.
Minor	Stationary (i.e. not mobile) road works that can only be carried out where conditions meet defined criteria in the appropriate national guidance. Definitions may be given in terms of traffic flow, visibility and/or the duration of the work.
Major	Road works that are in place for long periods, where workers may be behind an approved safety barrier and / or different equipment, layouts or techniques are used to manage traffic and safety compared to minor works.

Table 4: Definition of road works section

Location:	Definition
Approach/ Merge	The area from where the first advance warning sign is placed to warn of the presence of the road works to the end of the zone where any required lane changes are made by road users
Works Zone	The zone where the works take place which is delineated by cones, cylinders, panels or barriers. Road capacity through the works zone will usually be restricted to smaller and/or fewer lanes than normal (the latter due to the closure of one or more lanes for use as the work zone). This zone includes the safety or buffer zone.
Works End	The area at the end of the work zone where normal carriageway capacity is restored and any traffic restrictions (e.g. temporary speed limits) are removed

Table 5: Definition of road works stage

Timing:	Definition
Before	The period during which the road works are being established. This period commences when the first equipment for the approach/merge zone is installed for the road works and ends when all the equipment necessary to set up the work zone (see above) has been completely installed. During this time road capacity will be reduced to the level required for the 'during' period.
During	The period during which the road works are in place and road capacity is reduced by the closure of lane(s). The road works zone may be occupied by road workers for some or all of this time and road work vehicles may access/leave the working area.
After	The period during which the road works are being removed. This period starts when all construction equipment and work zone installation equipment starts to be removed. It ends after complete removal of this equipment and when all lanes are available for traffic. Capacity of the road will increase back to full during this period.

5 Data requirements

For all the data requirements, we need core data, which is common across all partner countries and potential users of the scale. The proposal is to develop a data proforma for each of the three risk areas, as part of workpackages 3, 4 and 5.

For each risk area, the work package leader will provide a set of questions for each of the 27 combinations in the parameter cube, which will be used to gather the information needed. The parameter combinations are illustrated in Figure 2.

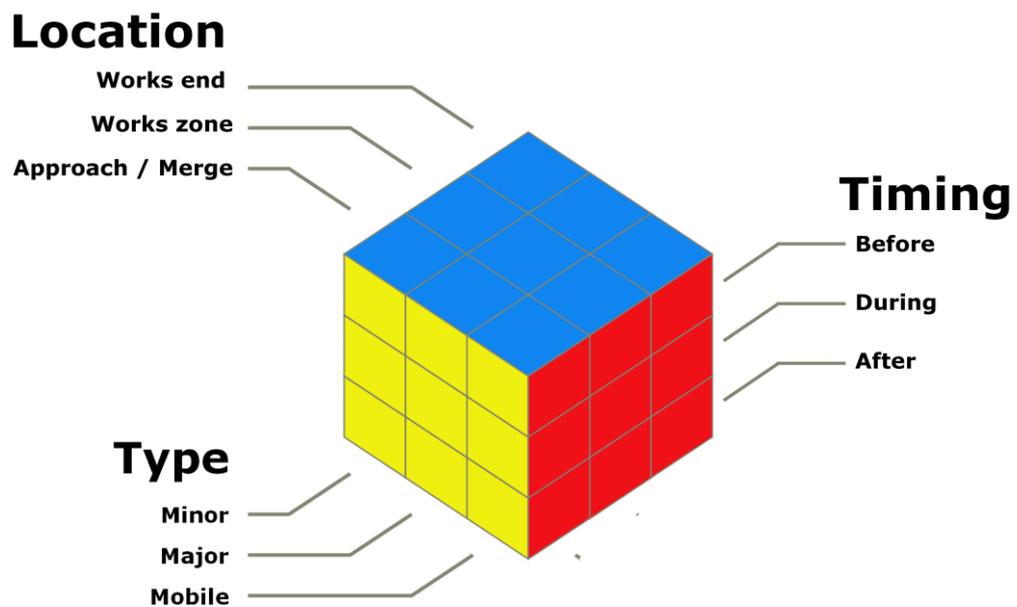


Figure 2: All parameter combinations

Each combination of parameters will then be considered in turn for each risk area as illustrated in Figure 3

Location

Approach / Merge

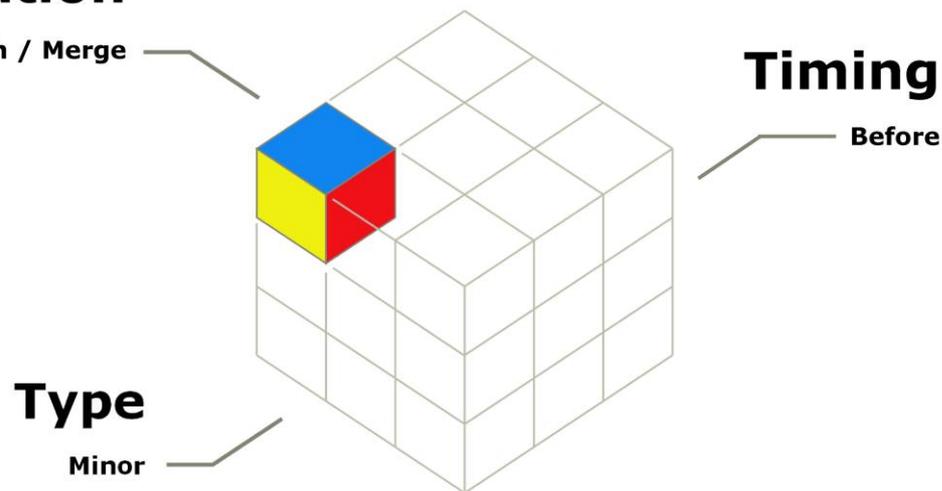


Figure 3: Single parameter combination

An example of some possible questions for road worker safety (WP 4) is included here for clarity; note that these are merely illustrative.

Parameter combination:

- Type: Minor
- Location: **Approach/Merge**
- Timing: Before

Type of questions to answer:

- Number of people involved in this activity
- Approximate time taken (<1hr, 1hr – 5hr, >5hr)
- When does this usually happen? (overnight, peak, off-peak, anytime)
- Does it involve walking across carriageways that are in use (Yes / No)
- What high visibility clothing is worn (waistcoat, jacket, jacket + trousers)

Parameter combination:

- Type: Minor
- Location: **Works zone**
- Timing: Before

Type of questions to answer:

- Number of people involved in this activity
- Approximate time taken (<1hr, 1hr – 5hr, >5hr)
- When does this usually happen? (overnight, peak, off-peak, anytime)
- What equipment is used to close the lane (cones, vehicle, trailer)?
- How are the road workers protected while setting up the road works?

There will be overlap between questions in the different combinations, for example the number of people involved during setting out and clearing away will be required for all three zones. There will also be cases where data are likely to be minimal or zero, however these will be included to maintain the data structure.

Each data field will be given a value to allow for easy coding into the database and these will also be defined as part of Work Packages 3, 4 and 5

Appendix

Belgium

I. Categorisation of roadworks

In Belgium, the legal basis for the categorisation of roadworks is determined by the decree of May 7th, 1999 concerning the signing of road work activities and other obstructions on public roads. The regulation mentions the measures that should be applied for each category of road works and, within each category, for each zone. The federal regulation is complemented by regional guidelines which give additional details concerning the measures to apply with respect to the existing federal categorization. Regional guidelines provide detailed information on how road work activities should be signaled for different site characteristics (median separation, number of lanes, etc). The regional guidelines sometimes give additional requirements to the decree of May 7th, 1999 (e.g. use of a truck mounted attenuator in some circumstances).

Categorisation of works:

- category 1: road works on motorways and roads with a speed limit above 90 km/h
- category 2: road works on roads with a speed limit between 50 and 90 km/h
- category 3: road works on road with a speed limit not above 50 km/h
- category 4: works planned outside the traffic area but hindering pedestrians and other vulnerable road users
- category 5: works during daylight conditions and with normal visibility (200m)
- category 6: mobile road works hindering the traffic due to their low speed of frequent stops.

For the STARS-project road works made following the regulations of categories 1, 5 and 6 should be considered. These categories correspond to the 3 levels given by the ARROWS project as follows:

- MAJOR: category 1
- MINOR: category 5 (because of the visibility requirements the duration of these works is limited to +/- 12 hours average - daytime conditions)
- MOBILE: category 6

II. Further details and spatial aspect of roadworks

For these categories the decree of May 7th, 1999 is further structured as follows:

Art.2 - Category 1

2.1. Road works having a severe impact on traffic flow

2.1.1. On motorways (speed limit of 120 km/h) – Relevant for STARS

2.1.2. On other roads (speed limit between 90 and 120 km/h) – Not relevant for STARS

2.2. Road works having a moderate impact on traffic flow

2.2.1. On motorways (speed limit of 120 km/h) – Relevant for STARS

2.2.2. On other roads (speed limit between 90 and 120 km/h) – Not relevant for STARS

Art.6 - Category 5

6.1. On motorways and roads with a speed limit above 90 km/h – [Relevant for STARs](#)

6.1.1. Road works having a severe impact on traffic flow (similar rules as for 2.1.1. & 2.1.2.)

6.1.2. Road works having a moderate impact on traffic flow

6.2. On roads with a speed limit between 50 and 90 km/h – [Not relevant for STARs](#)

6.3. On roads with a speed limit not above 50 km/h – [Not relevant for STARs](#)

Art.7 - Category 6

7.1. Road work executed totally or partially on a trafficked lane and/or on the bicycle lane and close to the trafficked lane (< 0,5m)

7.1.1. On roads with a speed limit not above 50 km/h – [Not relevant for STARs](#)

7.1.2. On roads with a speed limit between 50 and 90 km/h – [Not relevant for STARs](#)

7.1.3. On roads with a speed limit above 90 km/h – [Relevant for STARs](#)

For all the categories, the following road work zones are defined in the regulations (decree of May 7th, 1999 + regional guidelines).

- Advance warning: depending on the category of the road works, advance warning signs and/or TMAs must be installed at specified distances before the actual start of the work zone
- Start of work zone: actual start of the work zone requires installation of specific signing and/or TMAs
- Work zone: delineation of the work zone, often by using cones or fences
- End: sign to indicate end of the work zone.

Germany

Details of how roadworks are categorised in GERMANY

General categories for design of safeguarding (RSA 95: Guideline for the safety of workzones):

- Long-term workzone: workzone with duration of minimum one calendar day and fixed position (example: DI/1)
- Short-term workzone: workzone with duration of limited number of hours, even if they will start again at next day; they can be stationary or mobile (example: DIII/2b)

Details of how many 'zones' roadworks are generally divided into in GERMANY (in the national Roadworks Manual or equivalent) and how they are described

In Germany work zones are not officially divided in zones, however the regular schedule plans contain design rules for approach, the barrier, the work zone itself and the end of work zone.

Experience with safety analysis of work zones is that only the use of police documents with detailed course description can help to divide the accidents into three zones: Approach zone (with/without congestion), interconnecting zone (with lane changes), workzone itself.

National statistic data of the number and distribution of workzones is not available. For Hessen analysis of the influence of the safety barrier position (left lane, right lane, hard shoulder) and the number of reduced lanes, resulted in a calculation of about 65000 'workzone hours' in a four year period for their 1000km motorway network, the main part of them used a reduction of one lane. One of the results of the analysis has been that a reduction of two lanes happens seldom, but the accident rates showing a much higher risk.

These examples show that both detailed accident information and workzone details in combination with the relevant traffic are important to calculate the different risks of workzone layouts.

Sweden

Classification of the Swedish state road network

Depending on this classification there are different requirements for use of road signs, safety barriers, TMA, etc.

Skyddsklassad väg ("Protection classified" road)

- Speed limit 70 km/h or higher
- 2000 AADT or higher
- Other roads can also be in this class for other specific reasons (determined by the Transport Administration)
- Enhanced protection for the personnel is required for road works on these roads

Normalklassade vägar (Normally classified roads)

- 250 – 2000 AADT
- Basic requirements for the safety arrangements

Lågklassade vägar (Low classified roads)

- Less than 250 AADT
- Some relief in the basic requirements may be done provided that no unprotected personnel are on the road.

Classification of road works

Fast arbete (Stationary work)

There is really no differentiation in major or minor stationary road works. However there is a definition for "minor stationary work" defined as work with a duration of maximum 8 hours including setting up and clearing away.

Intermittent arbete (Intermittent work)

Work that is intermittently moved forward, occasional work of short term nature or work

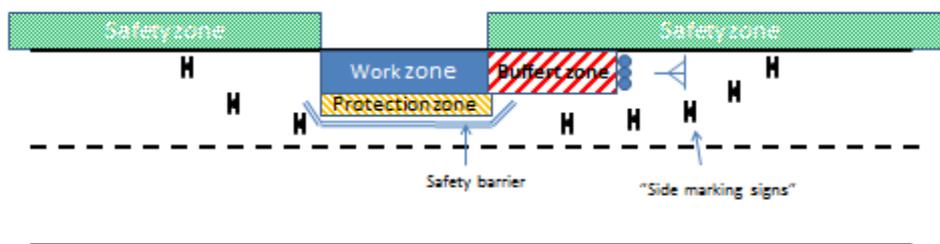
carried out with work vehicles at a speed that is significantly lower than the speed of the traffic.

Rörligt arbete (Mobile work)

The work is carried out with or from a work vehicle continuously moving along the road (proceeds at the same or almost the same speed as the traffic), for example snow removal. Only warning lamps are used on the vehicle, no other warning signs.

Definition of zones

The figure below illustrates the zones (not made to scale) that are defined for road works, and for which there are specific requirements depending on speed limit (among other things)..



Tungt skydd (Heavy protection)

Heavy protection is a safety arrangement ("traffic buffer" - usually "tire stacks", Truck Mounted Attenuator (TMA), Truck Attenuator (TA), safety barrier, etc) for the personnel that are within the work zone. The arrangement should effectively divert or hinder the traffic from entering the work zone.

Heavy protection should be used at stationary work on the whole state road network where the speed is 70 km/h or higher. At repaving or milling work the heavy protection may be replaced by a buffer zone that is twice the length of a normal buffer zone.

Slovenia

Details of how road works are categorized in SLOVENIA

General categories for design of safeguarding are set in 'P R A V I L N I K o načinu označevanja in zavarovanja del na javnih cestah in ovir v cestnem prometu', 14.11.2006 ('Regulations on the methods of marking and protection of roadworks of the public roads and of the other obstacles on roads', issued in 2006):

- "zapora ceste"- road closure = work zone
- "dolgotrajna zapora ceste"- Long-term work zone: work zone with duration of more than the bright part of a day (that is including at night);
- "kratkotrajna nepremična zapora ceste" Short-term stationary work zone: work zone with duration of less than the bright part of a day (that is excluding at night) on one location;

- “kratkotrajna premična zapora ceste” Short-term work zone: moving workzone with duration of less than the bright part of a day (that is excluding at night)

Details of how many ‘zones’ roadworks are generally divided into in SLOVENIA

Country	Location Terms	Definition	Proposed term
Slovenia	Območje najave, območje opozarjanja	Announcement section, warning section	Advance warning zone
Slovenia	Začetno območje, območje umirjanja, območje preusmeritve	Starting section, traffic calming section, lane change zone	Narrowing / lane change zone
Slovenia	Območje delovišča	Works zone	Works zone
Slovenia	Zaključno območje	End of works zone - lane change zone continues to the last sign	Works end
Slovenia	Iztek	Speed up zone (after the last sign)	Works end

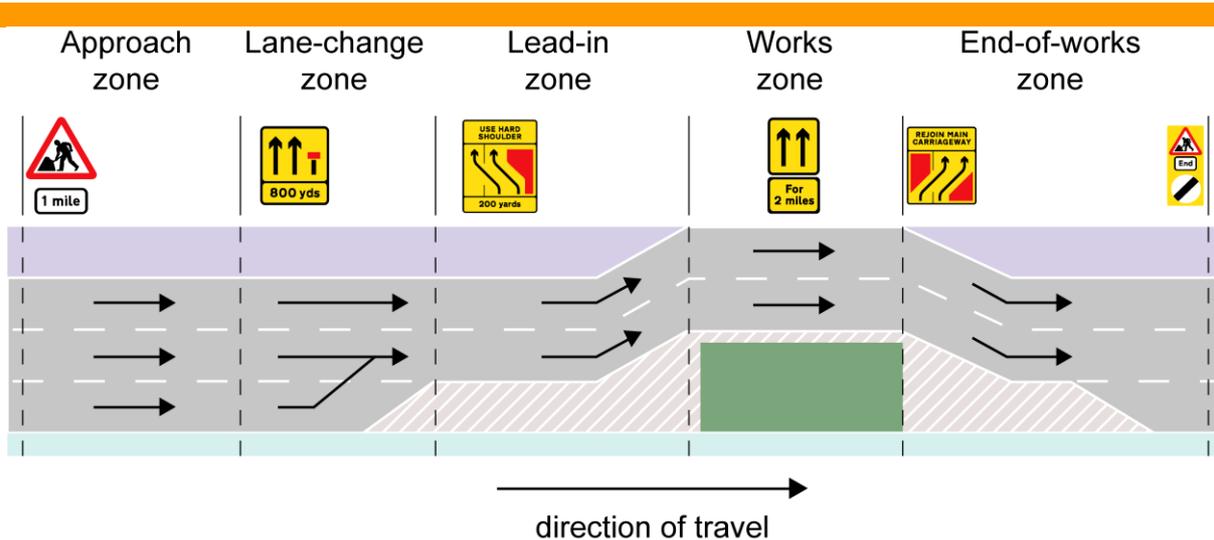
UK

The UK uses the Department for Transport’s “Traffic Signs Manual – Ch 8 Traffic Safety Measures and Signs for Road Works and Temporary Situations”.

Traffic management schemes for planned static road works are either “standard” schemes or “relaxation” schemes in the UK. The Traffic Signs Manual states:

- “Standard” schemes are appropriate for works carried out in all weather, visibility and traffic conditions.
- “Relaxation” schemes are appropriate for certain types of works for short-term situations with good visibility and low traffic flows.

The Traffic Signs Manual also provides the diagram below describing the five road design zones used for works on dual carriageways.



Republic of Ireland

The Republic of Ireland uses the Department of Transport's "Traffic Signs Manual - Ch 8 Temporary Traffic Measures and Signs for Roadworks" which states:

“There are three roadwork Types relating to static roadworks, depending primarily on their duration. The Types are:

- Type A – Full-time roadworks that remain in operation in all traffic flows and all visibility conditions. This type of works typically includes temporary traffic measures that will remain in position for a duration in excess of 24hrs.
- Type B – Part-time roadworks that remain in operation when the expected traffic flow is less than the available carriageway capacity. This type of works typically includes temporary traffic measures at off-peak times. With this type of works, the roadworks are such that they can be removed if necessary to minimise potential traffic delays.
- Type C – Roadworks that are of a short duration and involve the use of one or two vehicles, typically maintenance to utilities or street furniture, in all visibility conditions, when the expected traffic flow is less than the available carriageway capacity and the works do not reduce the carriageway width significantly.

In addition, two roadwork types may be used for operations of very short duration which are progressively moving along a road. These are:

- Semi Static Lane Closure (SSLC) – Roadworks where the operations are mobile or only stationary for very short periods, but where static warning signs and temporary traffic measures are used. SSLC is normally only suitable on single carriageway roads and in good visibility conditions, so is not generally relevant for STARS.
- Mobile Lane Closure (MLC) – Roadworks where the operations are mobile or only stationary for very short periods, where mobile (truck mounted) warning signs and temporary traffic measures are used. MLC is normally only suitable on motorways, dual carriageway roads and the larger single carriageway roads, in good visibility conditions.”

Although no official zoning structure, the following definitions from the Manual illustrate the zones that are used:

'Roadworks Ahead' Sign - the first temporary sign visible to the road user on the approach to any roadworks. At some sites, it is necessary to provide several such signs well in advance of the start of the roadworks indicating the distance to the start of the works.

End of Roadworks Sign - the 'End' sign is the last temporary sign visible to the road user leaving any roadworks. This 'End' plate marks the finish of all other roadworks warning signs used within the site.

Taper – The required length for the reduction in width of a single lane or hard shoulder. The taper length is calculated using the specified rate of taper multiplied by the hazard width, including lateral safety zones, and rounded up to the nearest cone spacing.

Transition Length – The distance required between the first taper and the start of the next taper for the reduction of a number of lanes on multi-lane carriageways. A transition length will be needed following each lane closed when two or more lanes are closed on the same carriageway.

Safety Zone – Longitudinal and Lateral Safety Zones are areas between the works and the cones or barriers adjacent to the running traffic lane. They are the minimum clear distances required for the safety of the workers and must be clearly defined and kept free of all operations, stationary vehicles or materials except for mobile lane vehicles or crash cushions. Longitudinal Safety Zone is measured from the end of the taper to the start of the works.

Denmark

In Denmark the common type of categorizing roadworks is:

- Services and esthetic, this is works that does not have any influence on safety, like gathering of litter, work on areas not directly related to the road.
- Safety, this is works that have to do with the safety on the road, like important signs, markings on the asphalt, crash barriers, etc.
- Preservation of investment, this is works that will protect the investments made in the infrastructure, like maintenance of bridges, new asphalt, etc.
- Construction, i.e. all new constructions.

To the best of knowledge there are only two zones related to road works - the signing zone and the work zone. The merge zone will be included in the signing zone in Denmark.

Norway

Information received was from Handbook/manual no. 051 – Requirements and guidelines for warning and safeguarding for work on and along roads

Here is an overview over how different types of road work is handled on motorways

We distinguish between work which takes a long time (called permanent) and short-lasting (brief) work.

For motorways with speed level above 50 km/h (Flerfeltsveger med fartsnivå over 50 km/t)

- Establishment and removal of signs and equipment - Utsetting og fjerning av utstyr (eksempel) -
- Permanent work in right lane on 4 lane road - Fast arbeid i høyre felt på 4-feltsveg -
- Permanent work in right lane on 4 lane road, one lane leading over to oncoming traffic - Fast arbeid i høyre felt på 4-feltsveg, ett felt ledet over i motgående retning -
- Permanent work in left lane on 4 lane road - Fast arbeid i venstre felt på 4-feltsveg -
- Permanent work in both lanes on 4 lane road - Fast arbeid i begge felt på 4-feltsveg -
- Permanent work in right lane on 6 lane road - Fast arbeid i høyre felt på 6-feltsveg -
- Permanent work in right and middle lane on 6 lane road - Fast arbeid i høyre og midtre felt på 6-feltsveg -
- Brief work in right lane on 4 lane road - Kortvarig arbeid i høyre felt på 4-feltsveg -
- Brief work in left lane on 4 lane road - Kortvarig arbeid i venstre felt på 4-feltsveg -
- Brief work in right lane on 6 lane road - Kortvarig arbeid i høyre felt på 6-feltsveg -
- Brief work in right and middle lane on 6 lane road - Kortvarig arbeid i høyre og midtre felt på 6-feltsveg -
- Brief work in one lane on 4 lane road without shoulder - Kortvarig arbeid i ett felt på 4-feltsveg uten skulder -
- Brief work at exit ramp - Kortvarig arbeid ved avkjøringsrampe -
- Movable work in right lane on 4 lane road - Bevegelig arbeid i høyre felt på 4-feltsveg -
- Movable work in left lane on 4 lane road - Bevegelig arbeid i venstre felt på 4-feltsveg -
- Closed exit ramp - Avkjøringsrampe stengt -
- Road closed, detour via exit ramp - Vegen stengt, omkjøring via rampe -
- Traffic in both directions at exit ramp - Tovegskjøring ved påkjøringsrampe -