HIGHWAYS AGENCY

Information for Managing Safety on the Highways Agency Network

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1. Introduction

This document is 'Safety Risk Profile of the HA Network'. It reports on safety risk levels for all populations who either use or work on the Strategic Road Network (SRN).

The main differences, from other annual safety reports produced by the HA, are that this document:

- Presents information in terms of Fatalities and Weight Injuries (FWI) and FWI risk, FWIs give a combined measure of fatal, serious and slight casualties based on a 1:10:100 ratio and for risk this is normalised by a measure of exposure)
- Presents the picture for road users and workers (including Traffic Officers and Supply Chain)
- Presents results for the current SRN (as opposed to the 2004 baseline network)
- Provides more detailed information about the types of accidents (accident sequences) and root causes (contributing factors) that different populations are involved in
- Identifies what proportion of the current levels of risk fall within HA control or influence

As this is the first issue of this document, it focuses on developing an initial understanding of safety risk on the HA network in terms of:

- What are the current levels of safety risk relative to any established benchmarks or baselines, and across populations
- What is driving the current levels of safety risk
- What proportion of the current levels of safety risk can HA realistically influence

This may change in the future, when this document may have more of a focus on reporting trends and changes from previous years.

2. Approach to Calculating Safety Risk on the SRN

The HA Safety Risk Model (SRM)

The risk levels presented in this document have been calculated from the HA's Safety Risk Model (SRM). This is a computer-based model that includes all reasonably foreseeable safety risks associated with the operation, maintenance and improvement of the SRN.

Safety risks that are out of scope for the SRM (and therefore this report) are:

- 'Greenfield' construction i.e. new sites/off-line from the operational network
- HA staff driving for work (other than Traffic Officers)
- Occupational health issues
- Terrorist activity
- 'Force majeure' events
- Safety risks not on the SRN i.e. risks associated with:
  - HA offices
  - National and Regional Control Centres
  - Traffic Officer control rooms
  - Maintenance compounds
  - Service Stations

The SRM is **network** level model only at this point in time; it does not produce results by geographical region, area or route

Structure of the SRM

The SRM takes accident and casualty data from existing HA sources and maps this onto the high-level dimensions of:

- When and where they happened (year and road types)
- Who was involved (road user or worker type - termed as accident 'Actors' within the SRM)
- Accident type (termed as 'Accident Sequence' within the SRM)
- Accident root causes (termed as 'Contributing factors' within the SRM)

A detailed breakdown of SRM parameters under each of these main dimensions is set out in Table 2.1; further detail of how individual fields from the various data sources are mapped onto these parameters is provided in the document "SRM Data Assumptions".

The SRM then allows comprehensive analysis against any of these parameters or dimensions.

Years	Road Types	Actors	Accident Sequences	Contributing Factors
• 2007 • 2008 • 2009 • 3-year total (2007-2009)	• Motorway • Dual carriageway A • Single carriageway A	• Car occupants • PTW riders or passengers • LGV occupants • HGV occupants • Bus/coach occupants • Cyclists • Pedestrians (including workers on foot) • Other or unknown road users • Traffic Officers • Supply chain, including: ▪ Known road workers ▪ Known construction & maintenance ▪ Unknown supply chain • Other workers	• Single vehicle leaves carriageway, hits nearside barrier • Single vehicle leaves carriageway, hits offside barrier • Single vehicle leaves carriageway, hits other object • Single vehicle leaves carriageway, comes to rest • Single vehicle hits object in carriageway • Single vehicle comes to rest in carriageway • **All single vehicle accidents**[1] • Two vehicle rear end shunt, including hitting a stopped vehicle • Two vehicle head on impact • Two vehicle side impact • Two vehicle side swipe • Two vehicle other impacts • **All two vehicle accidents**[1] • Multiple vehicle front and rear shunts • Multiple vehicle side impacts • Multiple vehicle other (mix of front, rear, side	• Unknown • Road user: alcohol or drugs • Road user: speed or aggression • Road user: fatigue • Road user: illness • Road user: judgement (young) • Road user: judgement (other) • Road user: inattention, distraction or carelessness • Road user: illegal manoeuvre • **All 'road user' contributing factors**[2] • Conditions: Road adhesion • Conditions: Visibility • Conditions: Worksite conditions • **All 'conditions' contributing factors**[2] • Vehicle: vehicle defect • Vehicle: foreign vehicle • Surroundings: object in road • Surroundings: pedestrian in road

[1] All Accident Sequences shown in bold are also termed as Accident Sequence 'categories'

[2] All Contributing Factors shown in bold are also termed as Contributing Factor 'categories'

Years	Road Types	Actors	Accident Sequences	Contributing Factors
			impacts) • **All multiple vehicle accidents**[1] • Vehicle-person accidents • Worker accident involving assault • Worker accident involving a moving vehicle • Worker accident involving machinery or equipment • Worker accident involving manual handling • Worker accident involving a slip/trip • Worker accident involving a fall from height • Other types of worker accident, or unknown worker accidents • **All worker accidents**[1]	• Surroundings: roadworks • Surroundings: HA infrastructure defect • Surroundings: HA operations defect • **All vehicle/surroundings contributing factors**[2] • Worker: alcohol-drugs • Worker: fatigue • Worker: illness • Worker: judgement • Worker: inattention, distraction or carelessness • Worker: non-compliance • **All 'worker' contributing factors**[2]

Table 2.1 - SRM dimensions and parameters

Different types of accident and casualty record within the SRM also have special data 'flags' attached to them that identify additional information about:

- The specific location, in terms of whether they occurred (road user incidents only):
  - On a main carriageway
  - At or near a junction, roundabout, slip road or lay-by
  - Within a hardshoulder or lay-by
  - At roadworks
- The time of day, in terms of whether they occurred during:
  - Times of peak or off-peak traffic
  - The hours of daylight or darkness
  - During a dayshift or nightshift (workers only)
- Any secondary accident sequences, including (for road user incidents only):
  - Seatbelts not worn in at least one vehicle
  - At least one vehicle greater than or equal to 20 years old
  - One or more vehicles rollover
  - One or more vehicles towing
  - Two vehicle accident on hardshoulder; casualties in one vehicle only

The SRM then supports more focussed analyses of the relationships between a limited number of:

- Contributing Factors (or Contributing Factor categories)
- Accident Sequences (or Accident Sequence categories)
- Secondary Accident Sequences
- and the additional 'Location' and 'Time of Day' dimensions detailed above.

Risk measures

The SRM produces outputs in terms of:

- Numbers of accidents per year
- Numbers of casualties per year, broken down by the following severity categories:
  - Fatal
  - Serious
  - Slight
- Numbers of Fatalities and Weighted Injuries (FWIs) per year

Within the SRM, an FWI is defined as:

(Number of fatalities) + 0.1 x (Number of serious casualties) + 0.01 x (Number of slight casualties)

This definition reflects the approximate ratios between the costs of fatal, serious and slight casualties given in the DfT's WebTAG (Unit 3.4.1).

Measures of FWI produced by the SRM are then normalised by exposure to calculate risk. Different measures of exposure are used for different populations on the SRN. For road users, the SRM measures exposure in terms of the number of:

- Vehicle miles travelled

For workers, the SRM measures exposure in terms of the number of:

- Hours worked

This results in risk measures of:

- FWIs per billion vehicle miles (road users)
- FWIs per 100,000 hours worked (workers)

Data sources

The SRM makes use of the following data sources:

- Validated STATS19 data (supplied by DfT and describing data collected by a Police Officers when personal injury road accidents are reported to them)
- On The Spot (OTS) data (provided by DfT and describing the results of more detailed investigations into a representative sample of road accidents in the United Kingdom)
- Accident and Incident Reporting System (AIRS) - describing incidents involving the HA supply chain
- Incident Reporting and Investigation System (IRIS) - describing incidents involving Traffic Officers and other HA staff
- HA Traffic Information System (HATRIS) - providing data on traffic levels on the SRN
- DfT Transport Statistics - providing data on the distribution of vehicle types on the SRN
- HA Pavement Management System (HAPMS) - providing data on the infrastructure that comprises the SRN
- Data collected from these sources generally needs to be 'cleaned' before entry into the SRM. General issues associated with this process, and solutions adopted within the SRM are noted below; more specific issues with individual data sources are described in the document "SRM Data Preparation Guide":

- Some incidents are captured in more than one data source e.g. accidents involving road users and supply chain workers. The SRM identifies these duplicate records and removes any double counting
- Not all model dimensions are captured directly by all data sources; for example, the SRM contains 18 contributing factors for road users, whereas the underlying STATS19 contains approximately 80 contributory factors. This requires the STATS19 data to be mapped onto the SRM model parameters. The detail of this mapping is recorded in the document "SRM Data Assumptions Document".
- Not all model parameters are captured by all data sources; where this is the case, a record is classified as 'not known' against the particular model parameter or dimension of interest
- Not all of the relevant or required fields are completed for all records (so-called 'null' fields); where this is the case, a record is classified as 'not known' against the particular model parameter or dimension of interest
- Some model parameters have only very small numbers of incidents recorded against them. Where this is the case, data may be combined over several years, and the model uses an average value for the defined period.

Data and model validation

- The SRM has been validated as far as is practicable. This has included validation of:
- the queries used to extract data from the supporting database in order to produce the SRM database
- the SRM database
- the numerical queries and calculations performed by the SRM
- the final outputs

Further detail is provided in the document "Validation of the HA SRM".

Main assumptions, limitations and uncertainties

- The main assumptions, limitations and uncertainties associated with the current version of the SRM that forms the basis for this document are:
- The SRM results reflect the specific mappings from the various raw data sources to the SRM structure. This particularly affects:
  - Counts of 'serious' and 'slight' accidents and casualties for Traffic Officers and Supply Chain (as the raw data for these populations is not captured against these specific definitions)
  - Counts of accidents and casualties against individual contributing factors and accident sequences (as the raw data for these populations is not captured against these specific definitions)
- Results for pedestrians can only be presented in terms of FWIs, as there is no available data on numbers of miles walked by pedestrians on the HA network

- Results presented in terms of FWIs per vehicle mile do not take account of vehicle occupancy and so are measures of collective risk for the stated populations of vehicle occupants, and not of individual risk (per vehicle occupant)
- Whilst all reasonable efforts have been made to map supply chain data onto the sub-population categories of 'road workers' and 'construction & maintenance workers' this has not been possible for a significant proportion of supply chain incidents, and where it has been done, the results are subject to quite significant uncertainties in some cases. As a result, many results from the SRM are presented only in terms of the overall population of 'supply chain' workers.
- Similarly, the SRM data describing the numbers of hours worked by supply chain workers is subject to significant uncertainties, with no definitive data source to describe this data, and estimates made from different sources resulting in significantly different values. The SRM addresses this by reporting against 'mean', 'upper bound' and 'lower bound' values for results related to this parameter.

3. Calculated Network-Level Safety Risk Levels

This section reports the calculated safety risk levels for the different populations who use or work on the HA network.

Network level collective risk for road users

Figures 3.1 and 3.2 present network level FWIs and FWIs per billion vehicle miles for road users for 2009.

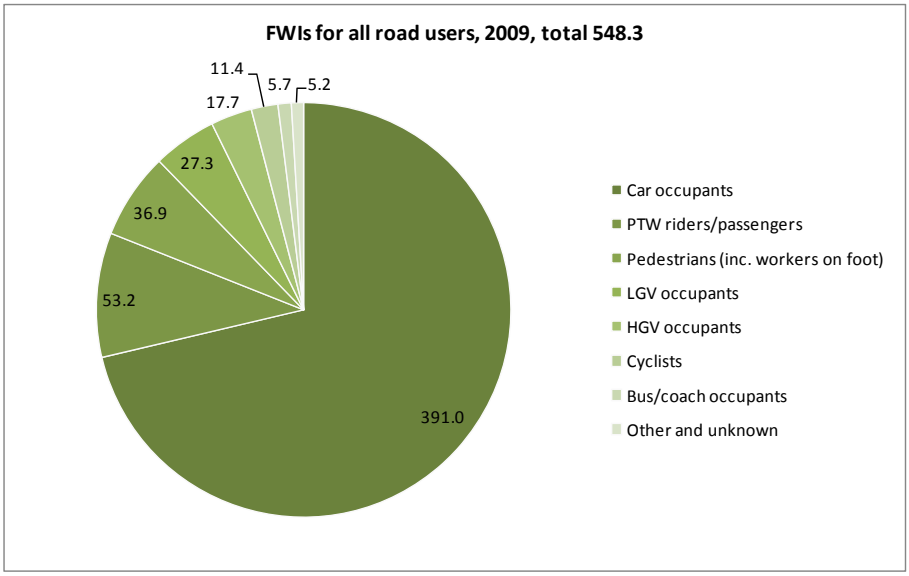


Figure 3.1 - FWIs for all road users

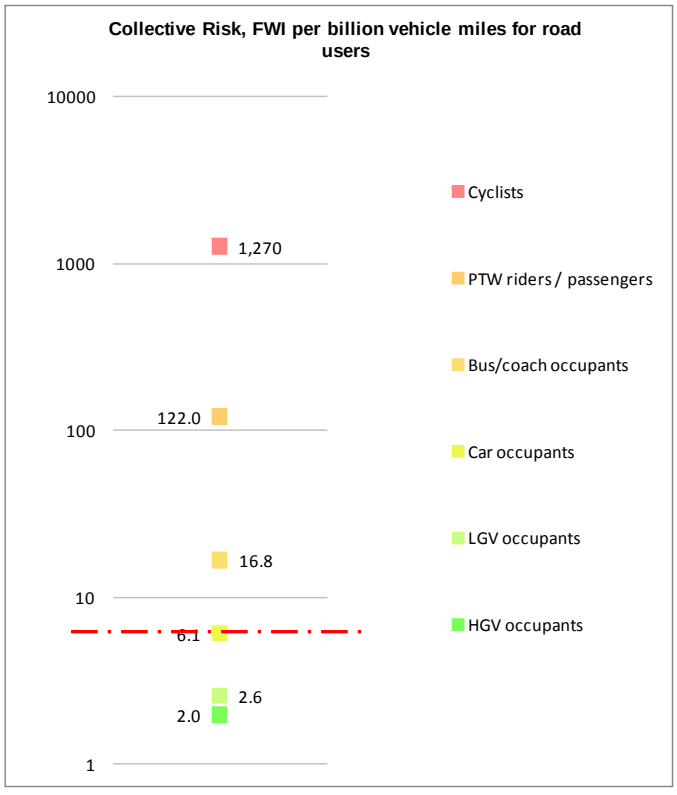


Figure 3.2 - FWIs per billion vehicle miles (bvms) for road users

The dashed red line on Figure 3.2 denotes the national average collective risk level, which is calculated from other model outputs as 6.4 FWIs/bvm. From this, it is calculated that PTWs have a risk level that is roughly 20 times the national average for all road users on the HA road network; cyclists have a risk level that is almost 200 times the national average.

Network level individual risk for workers

Figure 3.3. presents network level individual risk of FWI values for workers. This figure would normally be presented in terms of individual fatality risk. However, as there have been no fatalities to date within the Traffic Officer Service, it is presented here in terms of FWIs, which are taken as representative of the numbers of *statistical* fatalities.

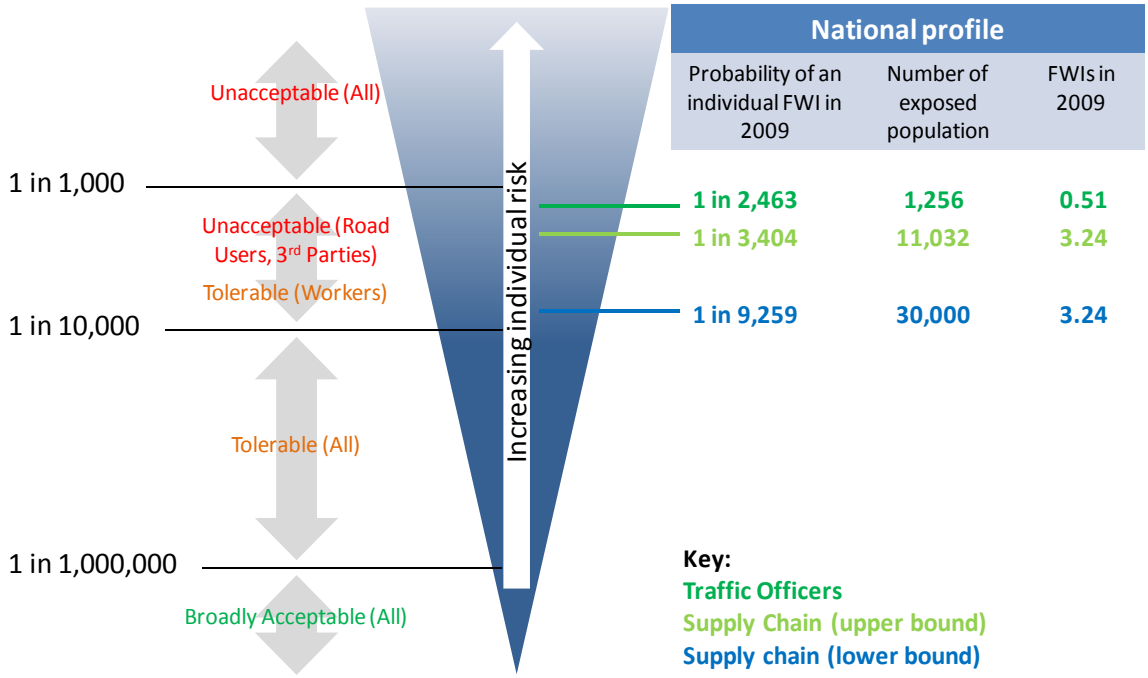


Figure 3.3 - Individual FWI risk for workers

The risk values for supply chain workers are presented in two forms - 'upper bound' and 'lower bound'. The 'upper bound' results are the upper bounds estimates of risk (calculated from the lower bound estimates of exposure). The 'lower bound' results are the lower bound estimates of risk (calculated from the upper bound estimates of worker exposure).

Individual risk profile for road users and workers

Figure 3.4 presents the profile of FWIs per thousand hours of network exposure. This measure allows risk levels for road users and workers to be compared alongside each other. Risks for road users presented in Figure 3.4 are calculated from data on vehicle miles travelled and the average speeds of different types of road users on the HA network.

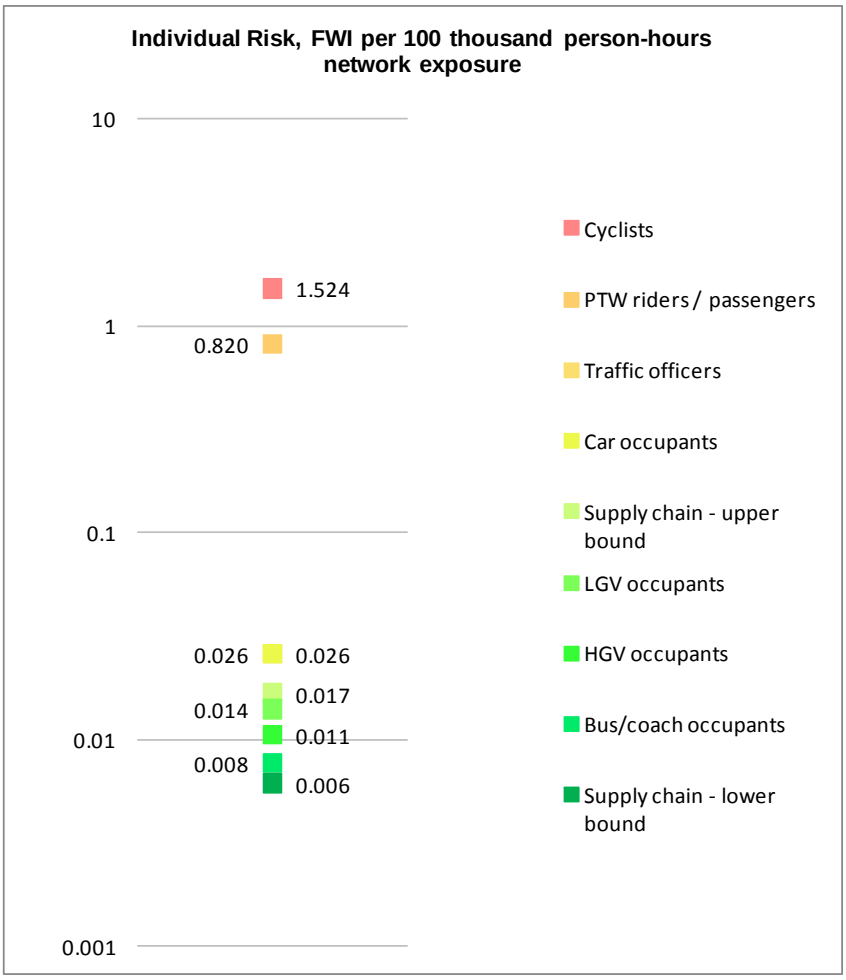


Figure 3.4 - Individual risk levels for road users and workers

Discussion

Road Users

When considered in terms of FWIs/year, car occupants are subject to by far the highest risk. However, when FWIs are normalised by any unit of exposure, this picture changes and car occupants become one of the lowest risk groups.

Including a measure of exposure puts cyclists to the top of the risk profile, followed by PTWs. The remaining rank order of road users then depends upon the unit of exposure. If vehicle miles are used, then bus and coach occupants are ranked the next highest risk group (after PTWs), followed by LGV occupants, then car occupants and then HGV occupants. However, if the number of hours exposed is used, then bus and coach occupants become the safest group, although the rank order of the other populations stays the same. This is because the normalisation measure of 'hours exposed' takes account of vehicle occupancy, whereas vehicle miles does not. The normalisation measure of 'hours exposed' also provides a measure of individual risk for road users, whereas vehicle miles gives a measure of collective risk (to the various populations of vehicle occupants).

Workers

Individual risk levels for Traffic Officers and supply chain workers are relatively similar, if compared on the basis of the 'upper bound' estimate for supply chain risk. If they are compared on the basis of the 'lower bound' supply chain risk, then supply chain individual risk is significantly lower than for Traffic Officers. Risks for all populations (and particularly for supply chain (upper bound) and Traffic Officers) are all towards the upper part of the ALARP 'tolerable' region.

Comparison of road users and workers together

Combining road user and workers together, using the measure of FWIs per 100,000 person-hours network exposure, shows that individual risks for both populations are comparable. Cyclists are subject to by far the highest risk, followed relatively closely by PTWs. There is then a considerable gap in risk terms to the next two populations, who are Traffic Officers and car occupants. Supply chain (upper bound) are the next population in individual risk terms, followed by LGV occupants, then HGV occupants and then buses and coaches. Buses and coaches are subject to significantly lower risk against this measure, because it takes account of vehicle occupancy.

Supply chain (lower bound) has the lowest individual risk against this measure.

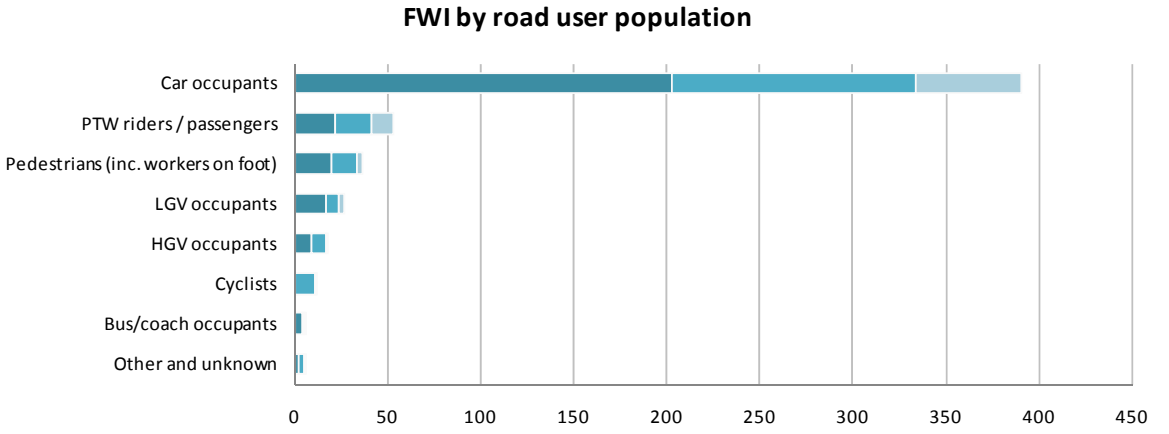
- The risk 'picture' is different for the different risk measures of FWIs, FWIs/bvm and FWIs/100,000 hours exposure
- For road users, high risk tends to correlate with low vehicle miles
- Three out of six road user populations have risk levels above the national average
- All populations of workers have individual risk levels within (but towards the top of) the ALARP tolerable region
- When considered in terms of FWIs/100,000 person-hours exposure, worker risk levels are comparable to road users

4. Top-Level Safety Risk Profiles

This section presents the 'top-level' safety risk profiles for road users and workers on the HA network.

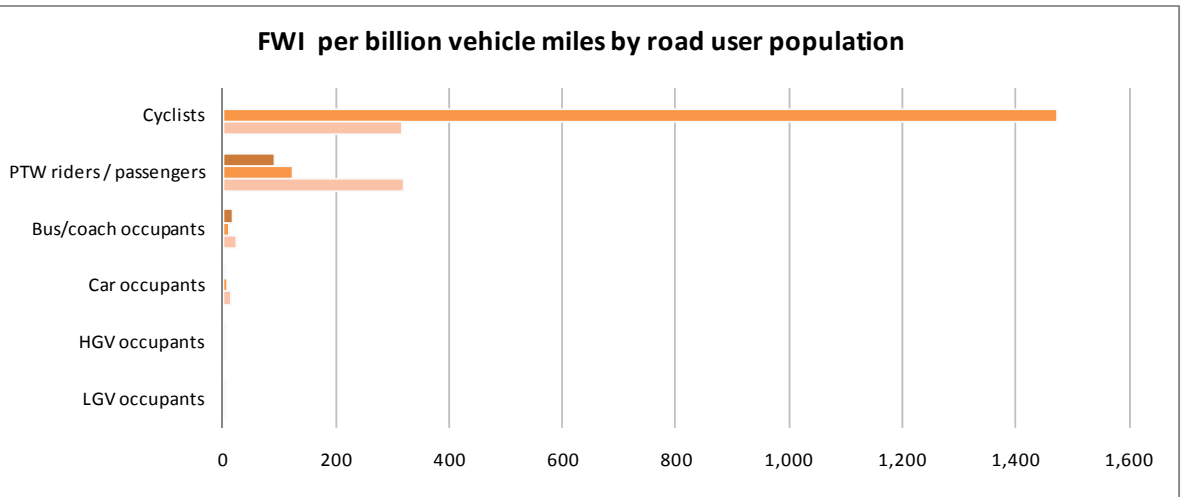
Road Users

Profiles by user population and road type



	Other and unknown	Bus/coach occupants	Cyclists	HGV occupants	LGV occupants	Pedestrians (inc. workers on foot)	PTW riders / passengers	Car occupants
Motorway	2	4	0	9	17	20	22	203
Dual A Road	3	1	11	8	7	14	19	131
Single A Road	0	1	1	1	4	3	12	57

Figure 4.1



	LGV occupants	HGV occupants	Car occupants	Bus/coach occupants	PTW riders / passengers	Cyclists
Motorway	3	1	5	18	92	
Dual A Road	2	4	7	11	123	1473
Single A Road	5	1	14	25	320	316

Figure 4.2

Comparing Figures 4.1 and 4.2 shows that the relative order of the population groups in each figure is quite different.

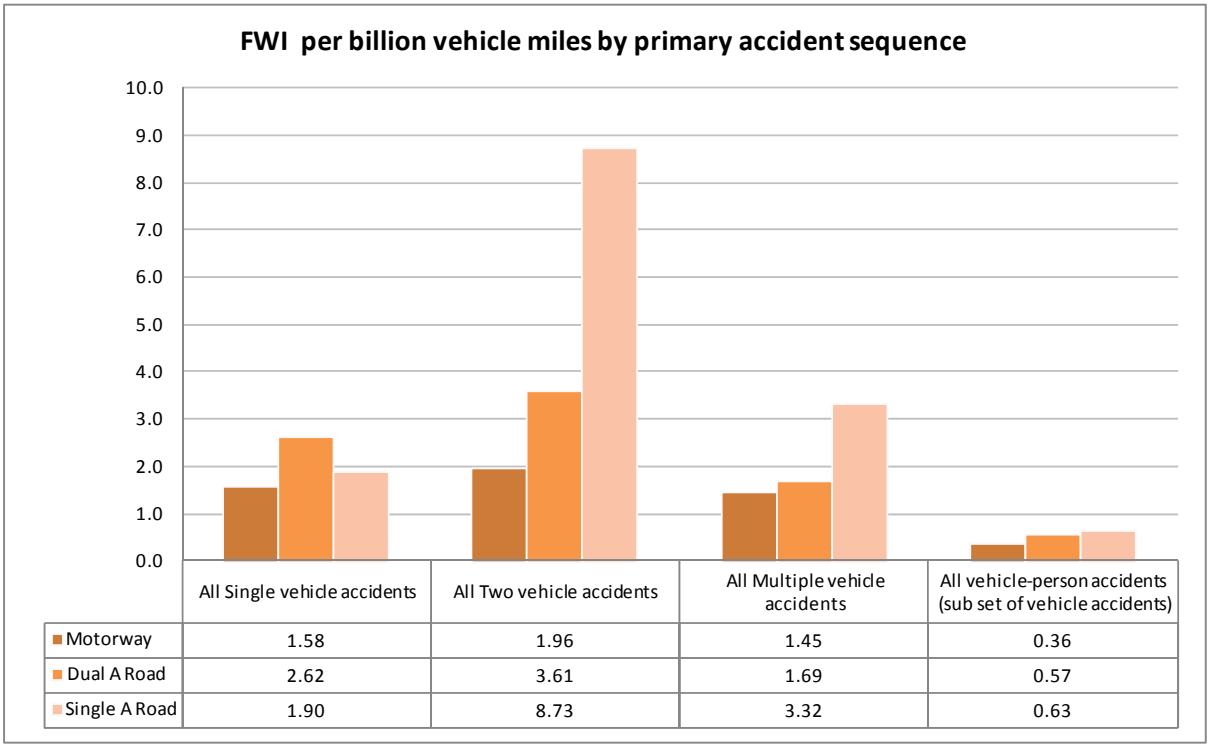
Figure 4.1 presents absolute numbers of FWIs for each category of road user. The group with the largest number of FWIs is car occupants and this reflects the much larger number of car occupants on the SRN, compared to the numbers of people in other groups. For users of motorways, the number of FWIs for all groups is greater on motorways than on dual carriageway A roads. In turn, the number of FWIs on dual carriageway A roads is greater than on single carriageway A roads.

However, when the number of vehicle miles driven by each group on the SRN is factored in, a quite different picture appears. This is shown on Figure 4.2 where it becomes apparent that the safety risk to cyclists riding on dual carriageway A roads is much higher than the safety risk to any other group. Cyclists are not permitted to ride on motorways and the highest safety risk group on motorways are riders and passengers of powered two wheelers (PTWs). Indeed, the safety risk to this group on motorways is greater than the collective safety risk associated with all other motorway users groups. Figures 4.1 and 4.2 also show that for riders and passengers of PTWs the safety risk increases on dual carriageways (relative to motorways) and is even higher on single carriageway A roads.

Figure 4.2 also shows that the safety risk for most groups is lower on motorways than on A roads. There is one exception to this: bus/coach occupants; where the safety risk on motorways is higher than on dual carriageways.

- Results from these top level profiles reinforce the messages from the network-level analysis regarding the main causes of FWIs and FWI/bvm for different user types and road types
- They also reinforce the message that the risk 'picture' differs greatly according to the risk measure used

Profiles by primary accident sequence



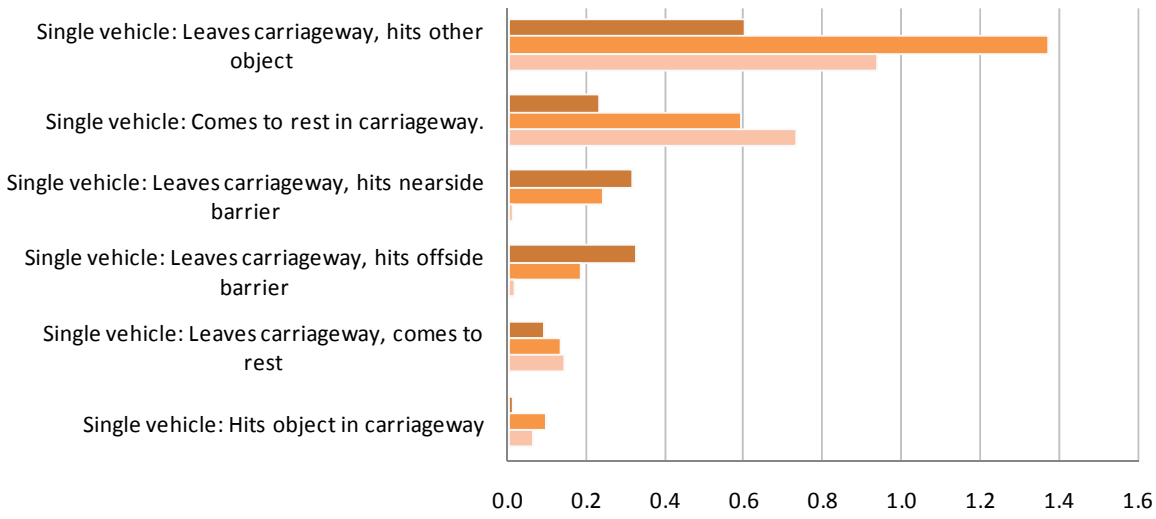
	All Single vehicle accidents	All Two vehicle accidents	All Multiple vehicle accidents	All vehicle-person accidents (sub set of vehicle accidents)
Motorway	1.58	1.96	1.45	0.36
Dual A Road	2.62	3.61	1.69	0.57
Single A Road	1.90	8.73	3.32	0.63

Figure 4.3

Figure 4.3 shows that, when vehicle miles are factored in to give a measure of the safety risk associated with each type of accident, motorways are the safest type of road per vehicle mile driven. The highest safety risk is associated with two vehicle accidents on single carriageway A roads.

Note that the number of FWIs does not increase as the number of vehicles involved in the accident increases. Reasons for this are being investigated further but one explanation may be that the consequences associated with single vehicle accidents are higher than they are when there are multiple vehicles involved. The chance of a fatal accident does appear to be higher for single vehicle accidents but this may be distorted by the number of PTW users in this group.

Profiles by accident sequences for single vehicle accidents

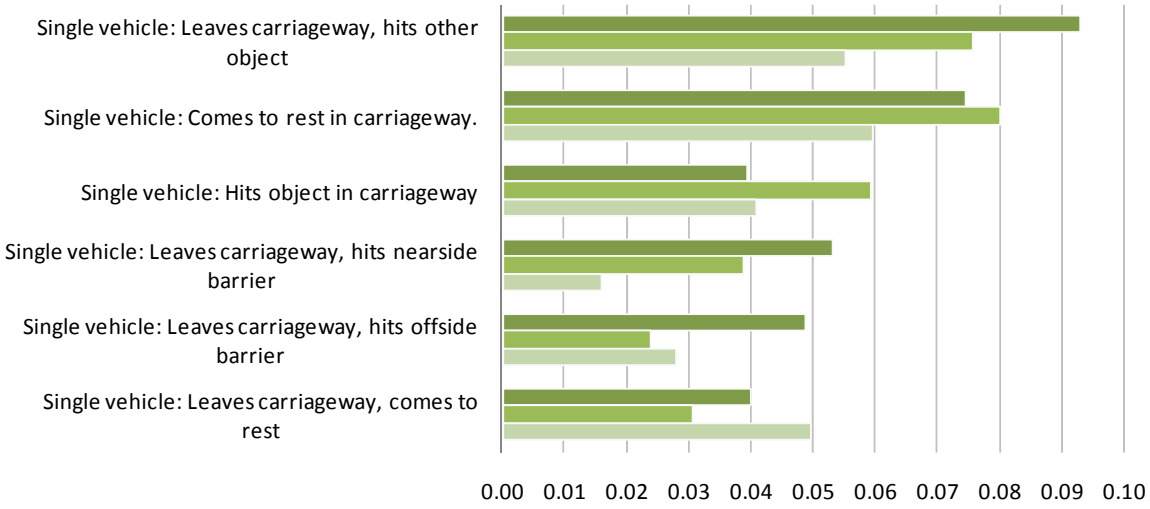


	Single vehicle: Hits object in carriageway	Single vehicle: Leaves carriageway, comes to rest	Single vehicle: Leaves carriageway, hits offside barrier	Single vehicle: Leaves carriageway, hits nearside barrier	Single vehicle: Comes to rest in carriageway.	Single vehicle: Leaves carriageway, hits other object
Motorway	0.01	0.09	0.32	0.31	0.23	0.60
Dual A Road	0.10	0.14	0.18	0.24	0.59	1.37
Single A Road	0.06	0.14	0.02	0.01	0.73	0.94

Figure 4.4

Figure 4.4 shows that the highest risks for single vehicle accidents are associated with vehicles that leave the carriageway and then impact with an object off the carriageway that is not protected by a safety barrier on dual carriageway A roads, closely followed by the same accident sequence on single carriageway A roads. Objects off the carriageway include roadside furniture such as electrical junction boxes, lighting columns and trees. This is potentially important as this is something that, in principle, the Highways Agency could do something about. The next highest risk is associated with single vehicles coming to rest in the carriageway of single carriageway A roads.

It is noted that the risks associated with leaving the carriageway and hitting the nearside or offside barrier are almost identical.

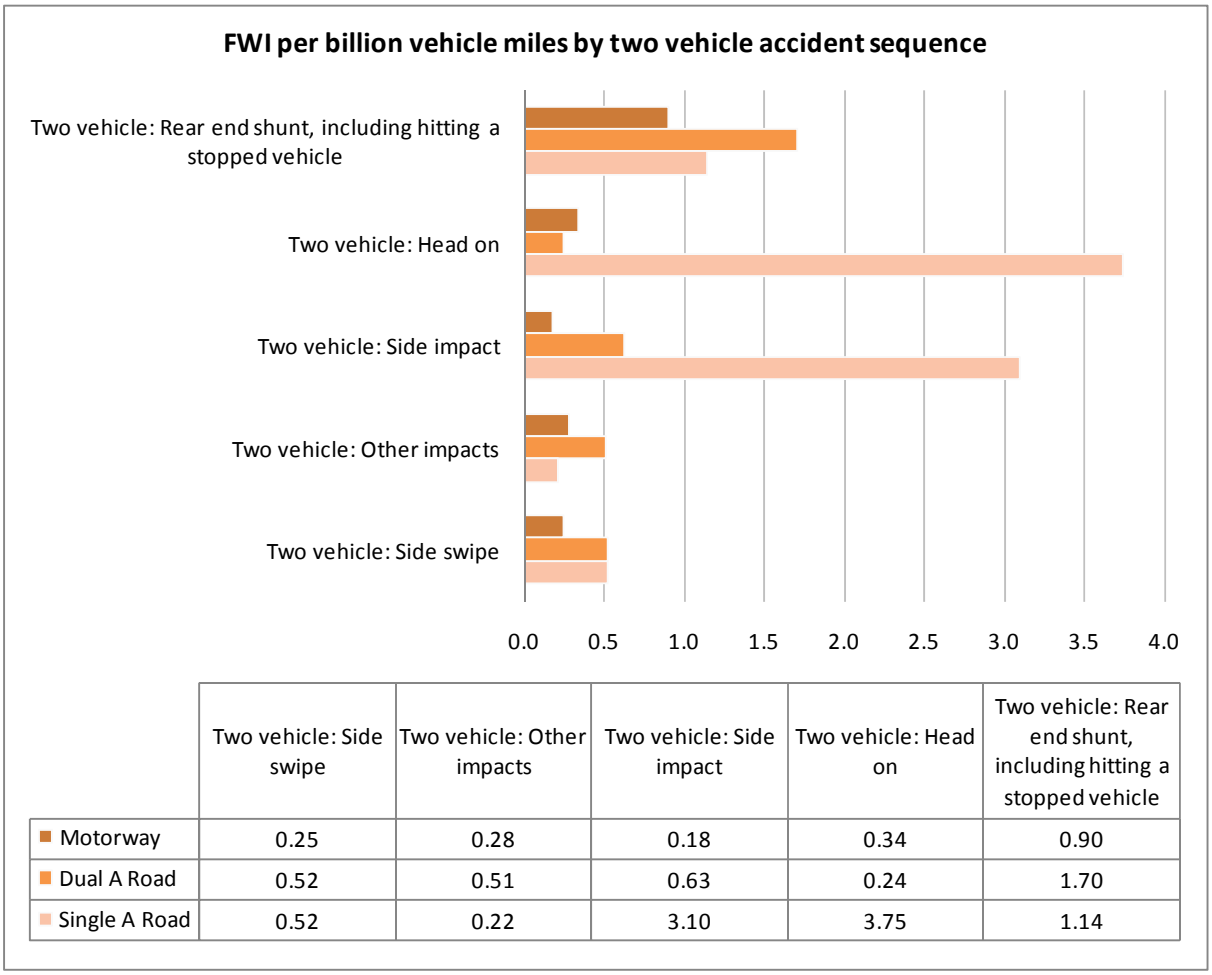


	Single vehicle: Leaves carriageway, comes to rest	Single vehicle: Leaves carriageway, hits offside barrier	Single vehicle: Leaves carriageway, hits nearside barrier	Single vehicle: Hits object in carriageway	Single vehicle: Comes to rest in carriageway.	Single vehicle: Leaves carriageway, hits other object
Motorway	0.04	0.05	0.05	0.04	0.07	0.09
Dual A Road	0.03	0.02	0.04	0.06	0.08	0.08
Single A Road	0.05	0.03	0.02	0.04	0.06	0.06

Figure 4.5

Figure 4.5 shows that accidents involving road users hitting objects off the carriageway carry the highest FWIs per accident and that the value of FWIs per accident for these types of accidents is approximately ***twice*** that for leaving the carriageway and hitting a nearside or offside barrier. Values of FWIs per accident for vehicles hitting objects in the carriageway are only slightly higher than those for hitting a barrier. Values for coming to rest in the carriageway are generally worse than for coming to rest off the carriageway.

Profiles by accident sequence for two vehicle accidents



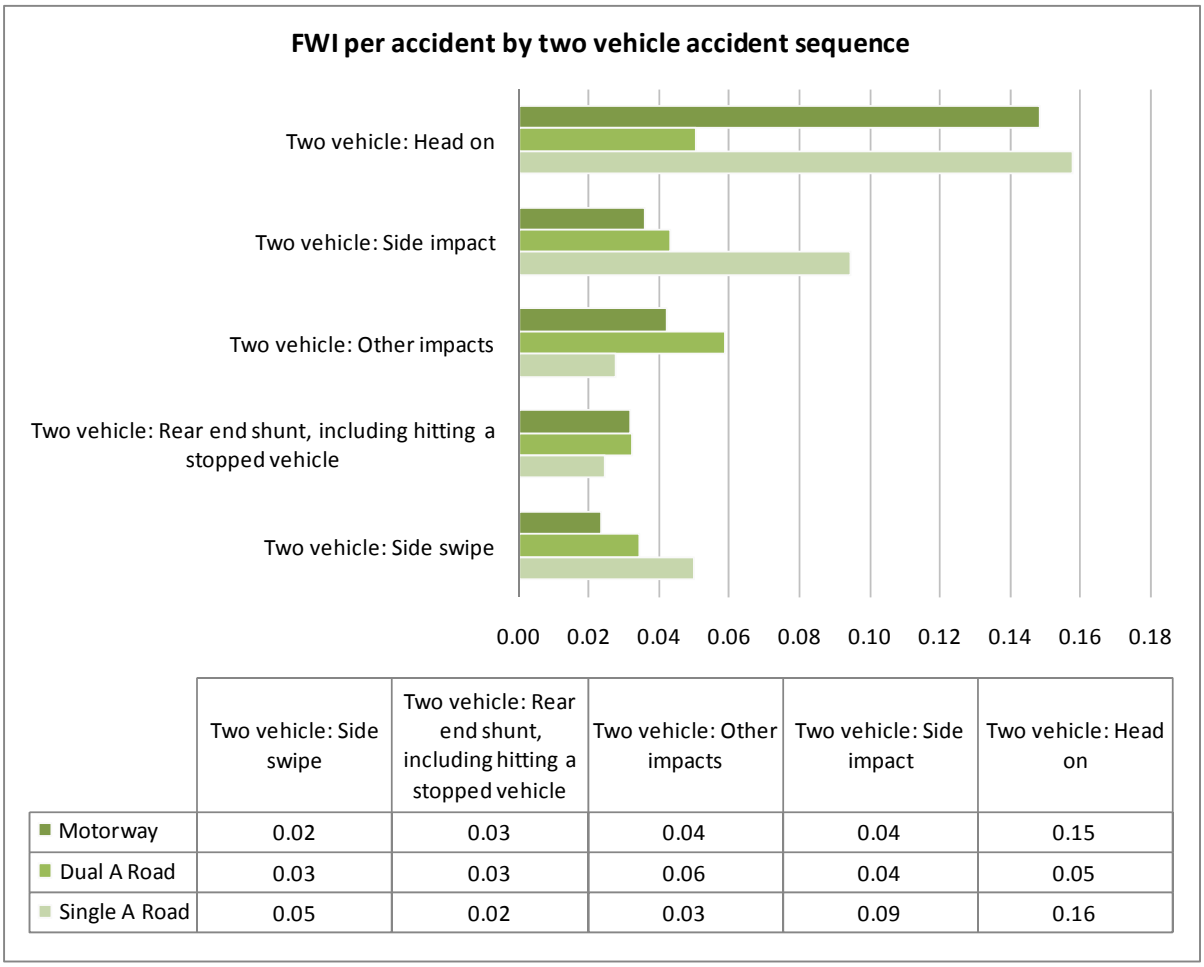
	Two vehicle: Side swipe	Two vehicle: Other impacts	Two vehicle: Side impact	Two vehicle: Head on	Two vehicle: Rear end shunt, including hitting a stopped vehicle
Motorway	0.25	0.28	0.18	0.34	0.90
Dual A Road	0.52	0.51	0.63	0.24	1.70
Single A Road	0.52	0.22	3.10	3.75	1.14

Figure 4.6

Figure 4.6 shows that side impacts and head on collisions on single carriageway A roads are associated with the biggest risks in two-vehicle accidents. The safety risk associated with head on collisions is over ten times worse on single carriageways in comparison to dual carriageways and motorways.

The safety risk of side impact accidents is about a factor of five higher for single carriageways in comparison to dual carriageways.

For motorways and dual carriageways rear end shunts are associated with the biggest risks.

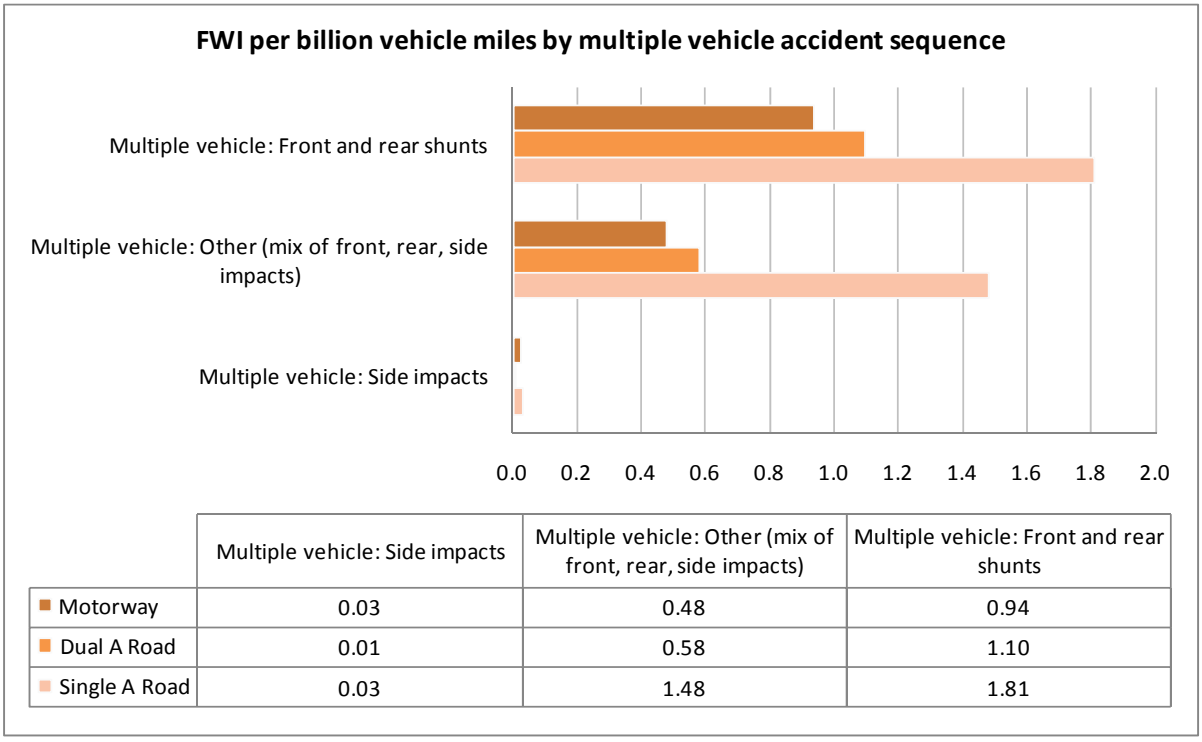


	Two vehicle: Side swipe	Two vehicle: Rear end shunt, including hitting a stopped vehicle	Two vehicle: Other impacts	Two vehicle: Side impact	Two vehicle: Head on
Motorway	0.02	0.03	0.04	0.04	0.15
Dual A Road	0.03	0.03	0.06	0.04	0.05
Single A Road	0.05	0.02	0.03	0.09	0.16

Figure 4.7

Figure 4.7 shows that the highest FWIs per accident are associated with head on collisions on motorways and single carriageway A roads. These are followed by side impacts on single carriageway A roads.

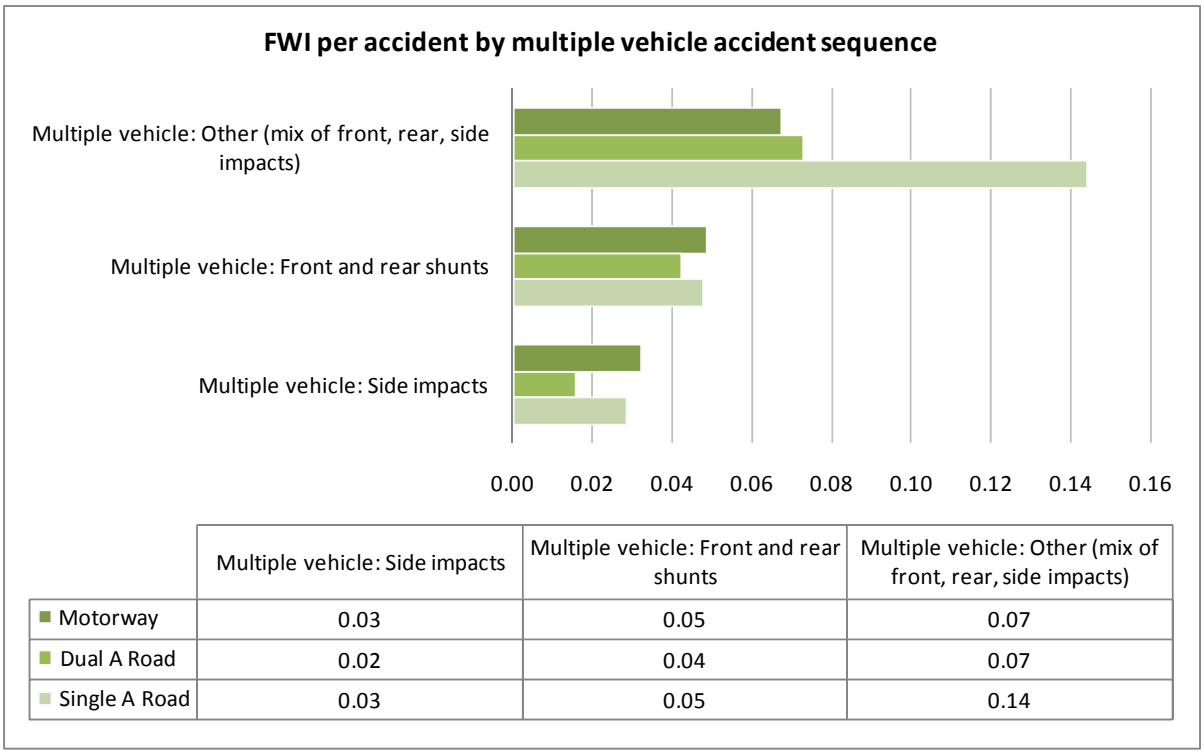
Profiles by accident sequence for multiple vehicle accidents



	Multiple vehicle: Side impacts	Multiple vehicle: Other (mix of front, rear, side impacts)	Multiple vehicle: Front and rear shunts
Motorway	0.03	0.48	0.94
Dual A Road	0.01	0.58	1.10
Single A Road	0.03	1.48	1.81

Figure 4.8

Figure 4.8 shows that FWIs/bvm are much higher for front and read end shunts and other types of multiple vehicle accident when they occur on single carriageway A roads; risks associated with multiple vehicle side impacts are much lower for all road types.



	Multiple vehicle: Side impacts	Multiple vehicle: Front and rear shunts	Multiple vehicle: Other (mix of front, rear, side impacts)
Motorway	0.03	0.05	0.07
Dual A Road	0.02	0.04	0.07
Single A Road	0.03	0.05	0.14

Figure 4.9

Figure 4.9 indicates that the FWIs per accident involving multiple vehicles are similar irrespective of which type of road the accident occurs on. The one exception to this is for FWIs associated with a mixed multiple vehicle accident on single carriageway A roads, where FWIs per accident are twice as high as for other road types.

Data for vehicle-pedestrian accidents

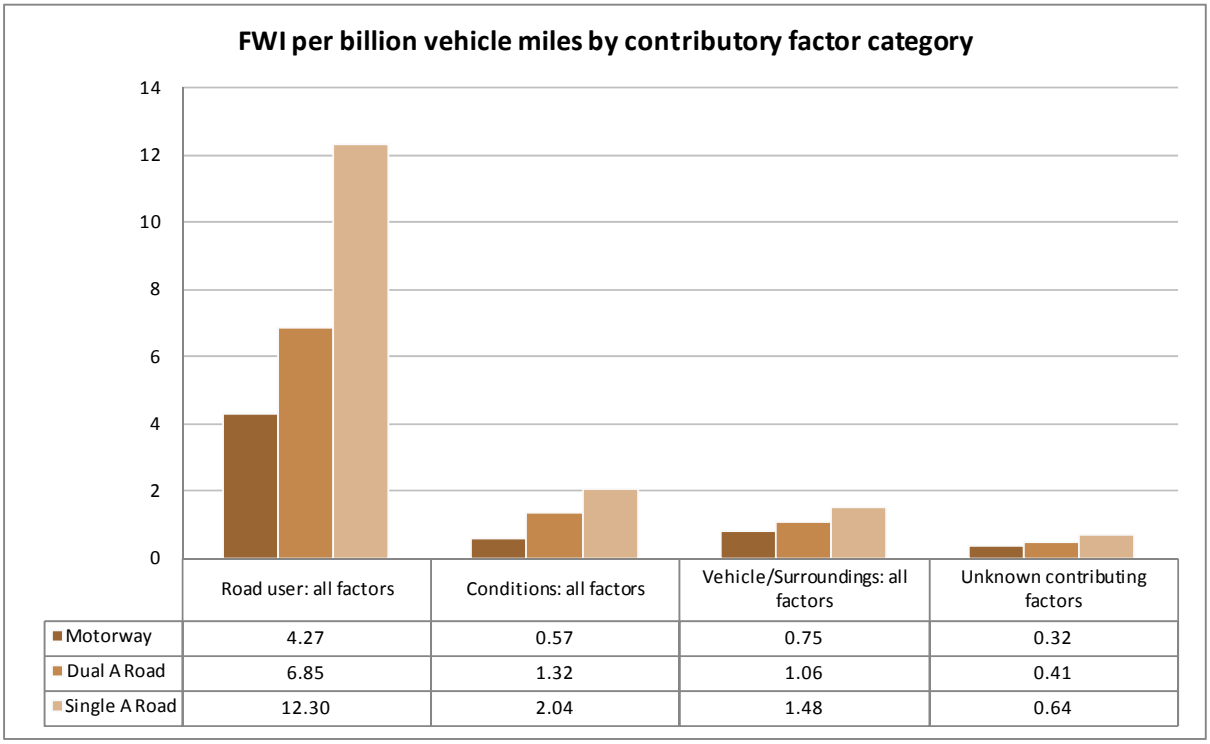
	FWI	FWI/bvm	FWI/accident
Motorway	20.29	0.36	0.37
Dual carriageway A Road	13.98	0.57	0.21
Single carriageway A Road	3.50	0.63	0.08

Table 4.1 - Data for vehicle-pedestrian accidents

Table 4.1 shows that the highest numbers of vehicle-pedestrian FWIs occur on motorways, followed by dual carriageway A roads; vehicle-pedestrian FWIs on single carriageway A roads are a factor of four and three lower than motorways and dual carriageway A roads, respectively. However FWIs/bvm are highest on single carriageway A roads. FWIs per accident are worst on motorways.

- Two vehicle accidents are the highest contributors to FWIs, followed by single vehicle accidents and then multiple vehicle accidents
- Risk (in terms of FWIs/bvm) are worst for two vehicle accidents on single and dual carriageway A roads, followed by multiple vehicle accidents on single carriageway A roads
- Risk is then similar across all other accident types and road types
- FWIs/accident are highest by far for vehicle-pedestrian accidents on motorways and dual carriageway A roads

Profiles by contributing factor category



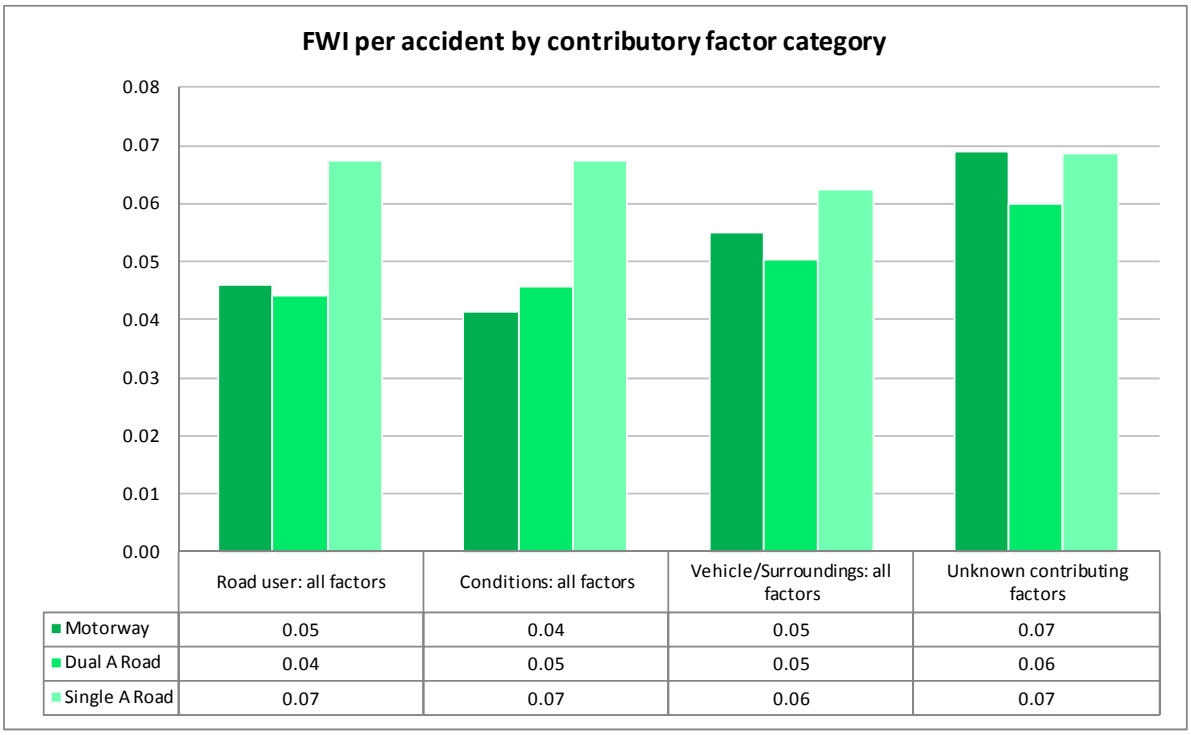
	Road user: all factors	Conditions: all factors	Vehicle/Surroundings: all factors	Unknown contributing factors
Motorway	4.27	0.57	0.75	0.32
Dual A Road	6.85	1.32	1.06	0.41
Single A Road	12.30	2.04	1.48	0.64

Figure 4.10

Figure 4.10 clearly shows that the contributing factors associated with road users are by far the most dominant. The risks associated with road user contributing factors are more than those associated with all the other categories put together.

The relative proportions of FWIs per billion vehicle miles contributed by the different categories of contributing factor are reasonably similar across all road types.

The safety risk associated with each of the contributing factor categories is lowest for motorways and highest for single carriageway road types.

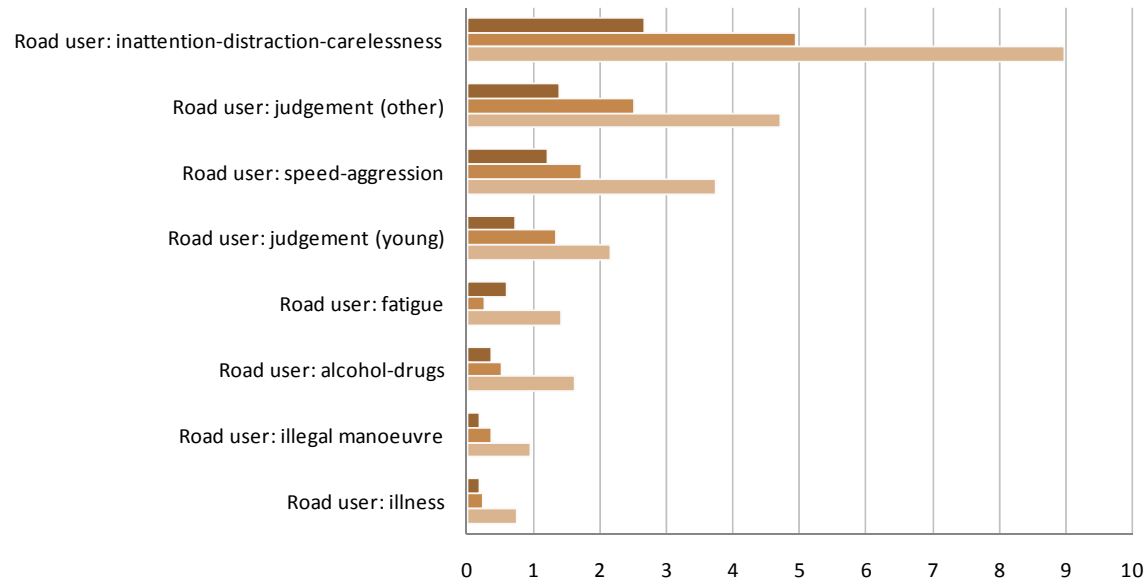


	Road user: all factors	Conditions: all factors	Vehicle/Surroundings: all factors	Unknown contributing factors
Motorway	0.05	0.04	0.05	0.07
Dual A Road	0.04	0.05	0.05	0.06
Single A Road	0.07	0.07	0.06	0.07

Figure 4.11

Figure 4.11 shows that for single carriageway A roads, where the FWIs per accident are relatively high, all contributing factors have a similar outcome. For motorways, the highest risks are associated with accidents where the contributing factors are unknown, but the variation across contributing factors is relatively small.

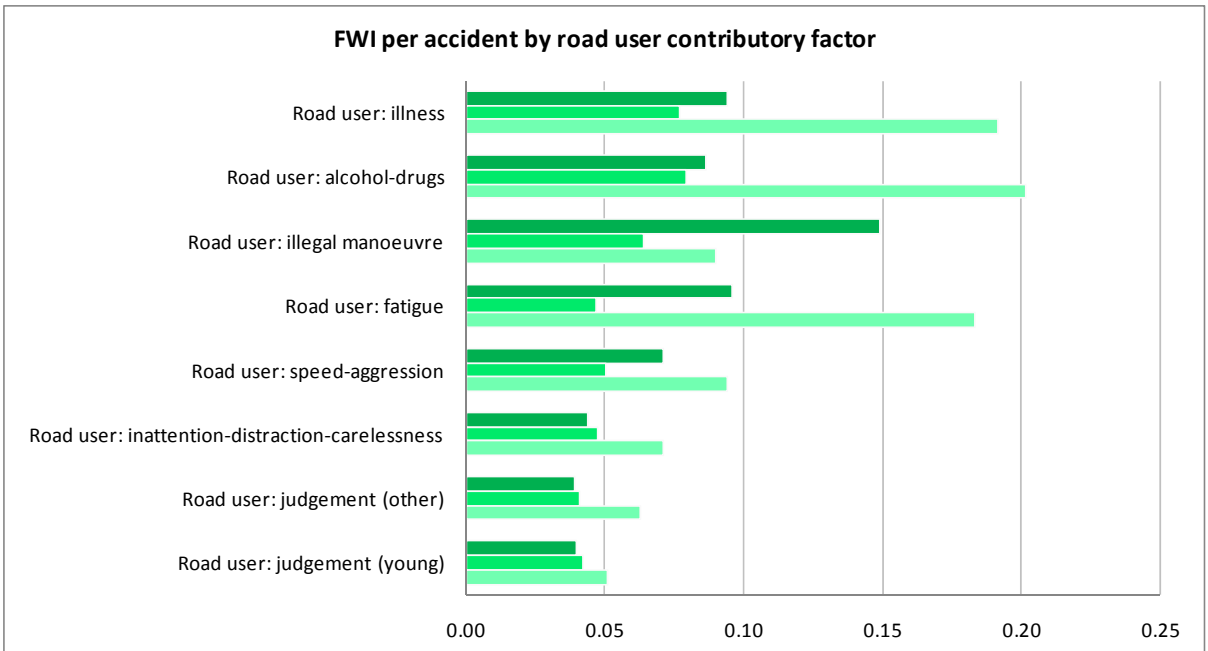
Profiles by road user contributing factor



	Road user: illness	Road user: illegal manoeuvre	Road user: alcohol-drugs	Road user: fatigue	Road user: judgement (young)	Road user: speed-aggression	Road user: judgement (other)	Road user: inattention-distraction-carelessness
Motorway	0.19	0.20	0.36	0.59	0.73	1.22	1.40	2.67
Dual A Road	0.23	0.36	0.53	0.27	1.34	1.71	2.52	4.95
Single A Road	0.75	0.96	1.61	1.42	2.15	3.74	4.70	8.98

Figure 4.12

From Figure 4.12 it can be seen that the safety risks arising from road user contributing factors are highest on single carriageway A roads and lowest on motorways. The biggest risks are associated with road user inattention-distraction-carelessness, judgement and speed and aggression.

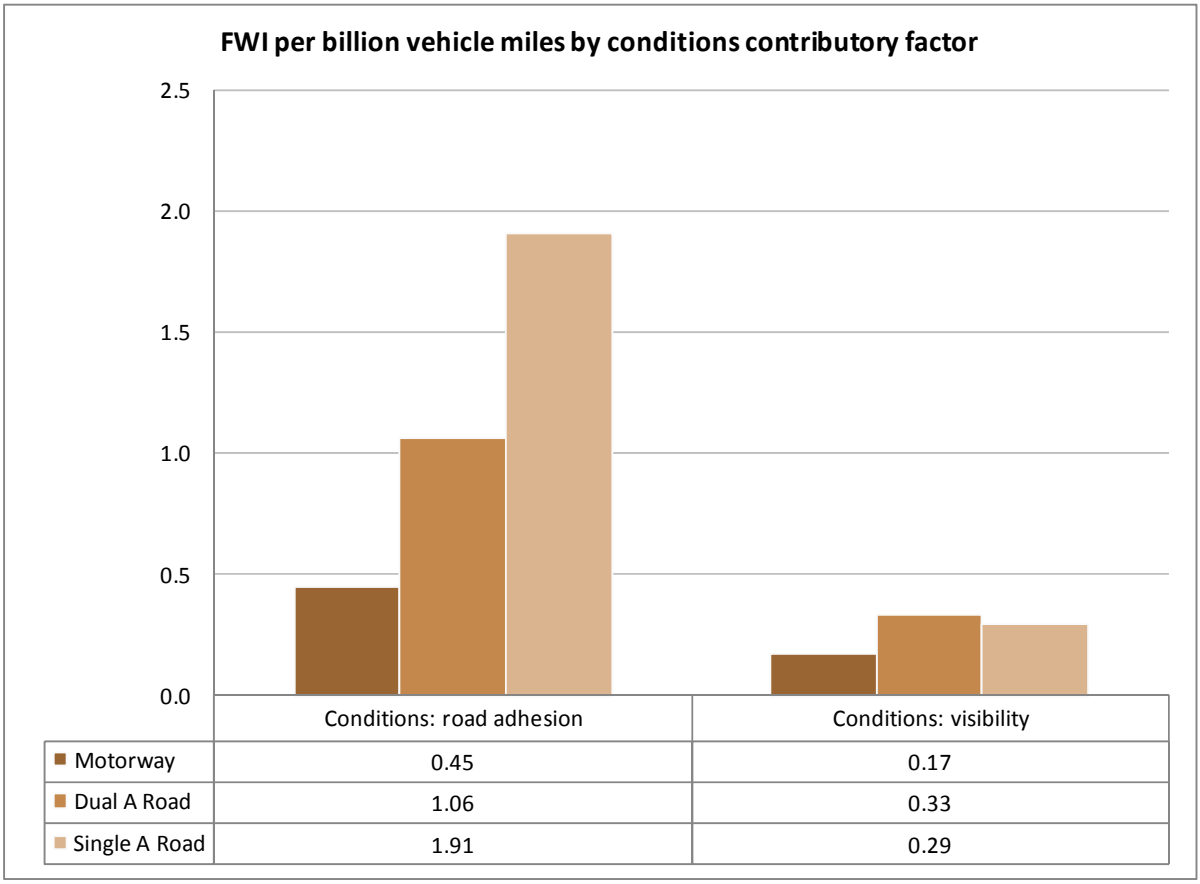


	Road user: judgement (young)	Road user: judgement (other)	Road user: inattention-distraction-carelessness	Road user: speed-aggression	Road user: fatigue	Road user: illegal manoeuvre	Road user: alcohol-drugs	Road user: illness
Motorway	0.040	0.039	0.044	0.071	0.096	0.149	0.086	0.094
Dual A Road	0.042	0.041	0.047	0.051	0.047	0.064	0.080	0.077
Single A Road	0.051	0.063	0.071	0.094	0.183	0.090	0.202	0.191

Figure 4.13

The number of FWIs per accident on single carriageway A roads appears to be higher for road user: illness; alcohol-drugs; and fatigue. All others are very similar with the exception of illegal manoeuvres on motorways which also appear to be relatively high in comparison to the others.

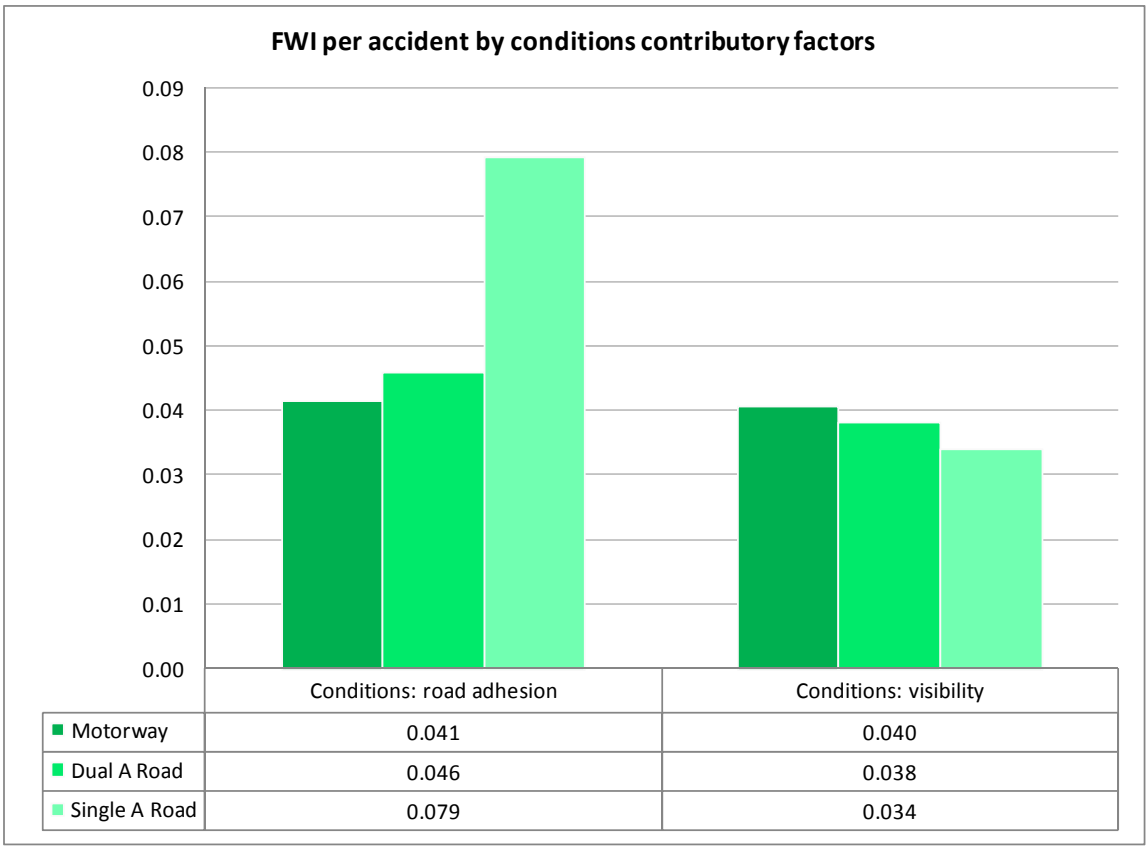
Profiles by conditions contributing factor



	Conditions: road adhesion	Conditions: visibility
Motorway	0.45	0.17
Dual A Road	1.06	0.33
Single A Road	1.91	0.29

Figure 4.14

Figure 4.14 shows that road adhesion is a bigger contributor to safety risk than visibility (e.g. weather related). When vehicle miles are taken into account, the safety risk associated with road adhesion on motorways is the lowest, with the safety risk on single carriageway A roads the highest. For visibility, the safety risk is at least a factor of three lower than road adhesion and is much less variable across the three road types.

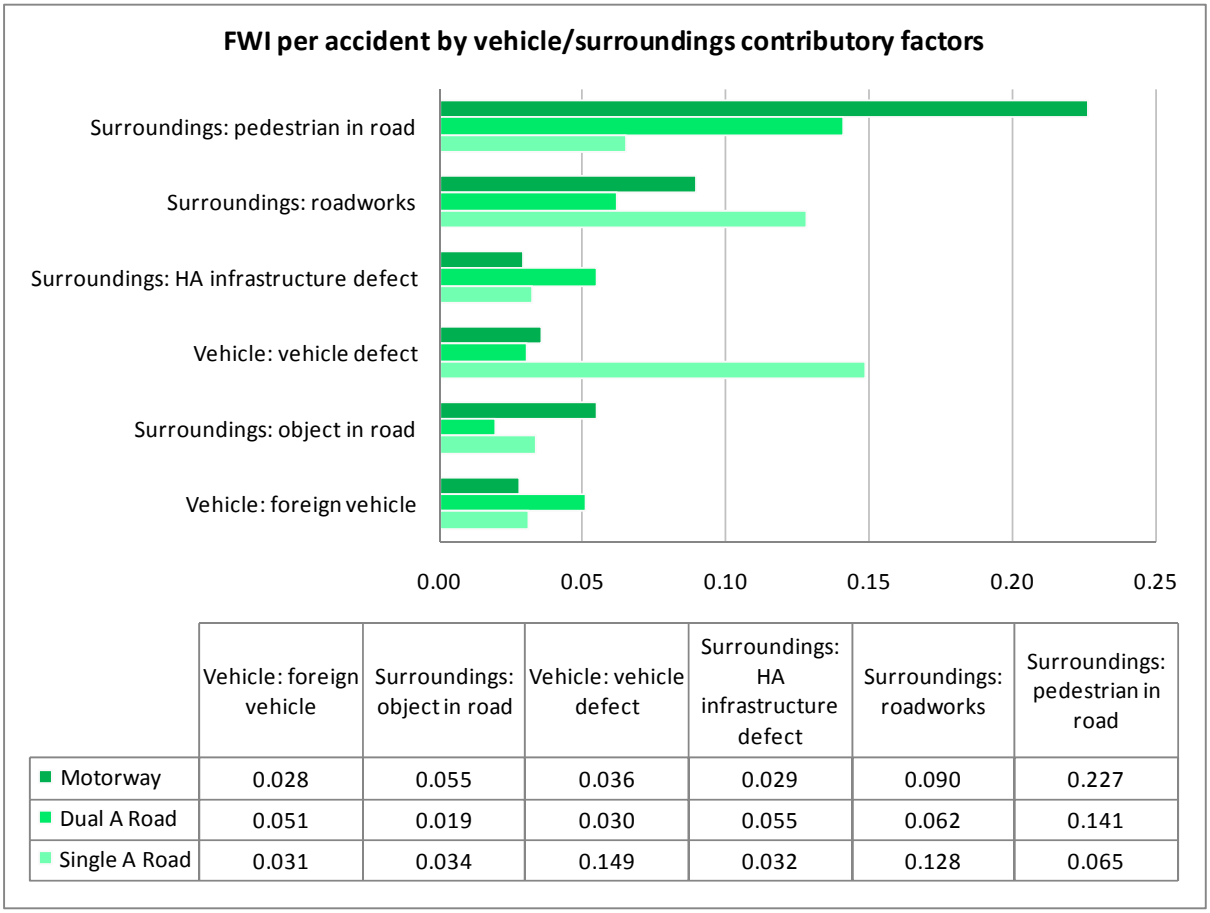


	Conditions: road adhesion	Conditions: visibility
Motorway	0.041	0.040
Dual A Road	0.046	0.038
Single A Road	0.079	0.034

Figure 4.15

The FWI per accident value associated with road adhesion for single carriageway A roads is highest. FWIs per accident are then similar for all other types of 'conditions' contributing factors across all road types.

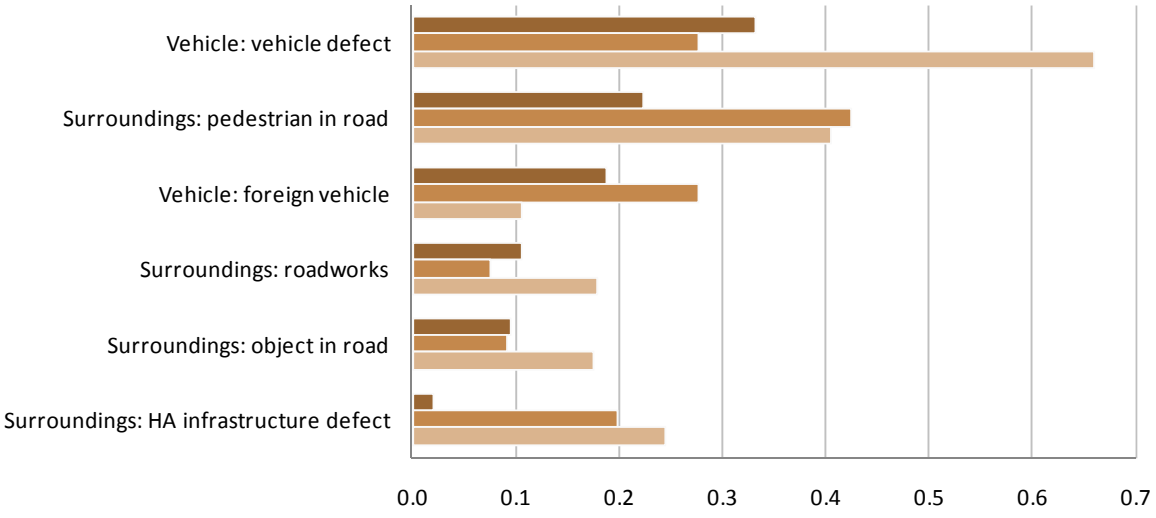
Profiles by vehicle/surroundings contributing factor



	Vehicle: foreign vehicle	Surroundings: object in road	Vehicle: vehicle defect	Surroundings: HA infrastructure defect	Surroundings: roadworks	Surroundings: pedestrian in road
Motorway	0.028	0.055	0.036	0.029	0.090	0.227
Dual A Road	0.051	0.019	0.030	0.055	0.062	0.141
Single A Road	0.031	0.034	0.149	0.032	0.128	0.065

Figure 4.16

The largest FWI per accident where 'vehicle/surroundings' have been identified as a contributing factor is associated with vehicles hitting pedestrians on motorways and dual carriageway A roads. For single carriageway A roads the 'surroundings: roadworks' and 'vehicle: vehicle defect' are the dominant contributing factors to the overall level of FWIs per accident.



	Surroundings: HA infrastructure defect	Surroundings: object in road	Surroundings: roadworks	Vehicle: foreign vehicle	Surroundings: pedestrian in road	Vehicle: vehicle defect
Motorway	0.02	0.10	0.11	0.19	0.22	0.33
Dual A Road	0.20	0.09	0.08	0.28	0.42	0.28
Single A Road	0.24	0.18	0.18	0.11	0.41	0.66

Figure 4.17

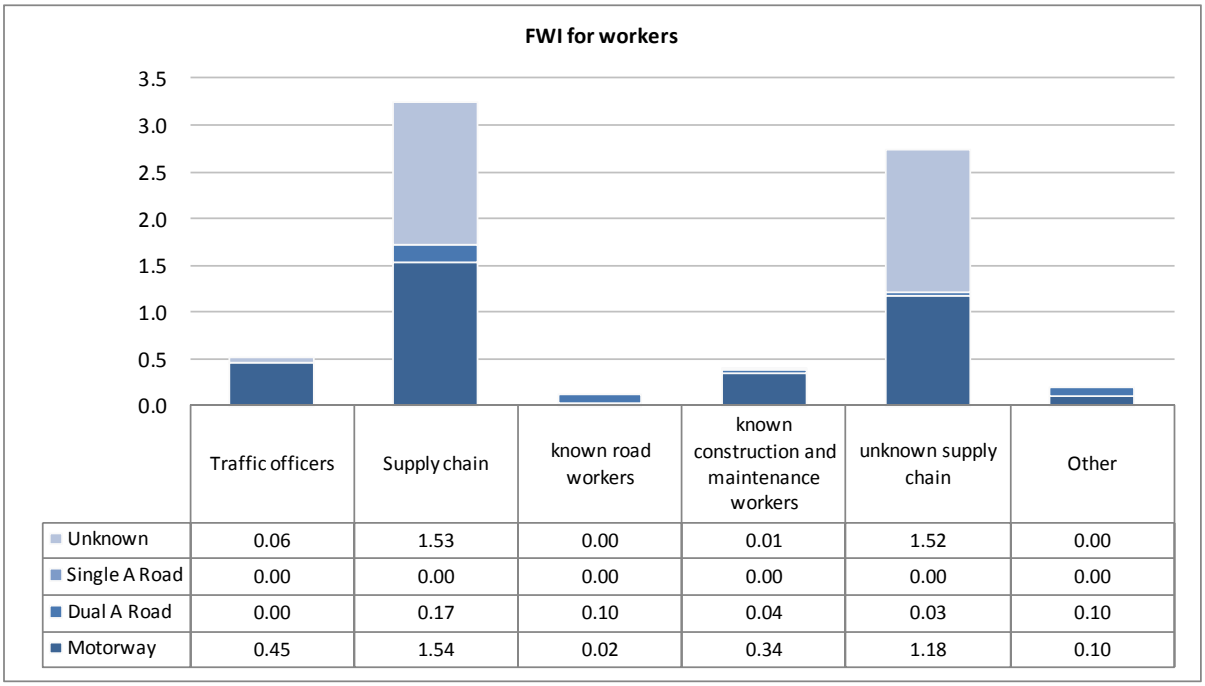
In terms of FWI per billion vehicle miles, 'vehicle defect' on single carriageway A roads is identified as being the largest contributor to the vehicle/surroundings contributing factor. 'Roadworks' is also identified as a significant contributor on both single carriageway and dual carriageway roads

- Road users are by far the highest contributors to safety risk; they contribute more than all of the other contributing factor categories combined
- Vehicle/surroundings contribute proportionately more to the total number of FWIs on motorways than on other road types.

Workers

Profiles by population and road type

Figure 4.18 and 4.19 show the profiles of FWIs and FWIs per 100,000 hours worked for workers.



	Traffic officers	Supply chain	known road workers	known construction and maintenance workers	unknown supply chain	Other
Unknown	0.06	1.53	0.00	0.01	1.52	0.00
Single A Road	0.00	0.00	0.00	0.00	0.00	0.00
Dual A Road	0.00	0.17	0.10	0.04	0.03	0.10
Motorway	0.45	1.54	0.02	0.34	1.18	0.10

Figure 4.18

	Traffic officers	Supply chain - lower bound	Supply chain - upper bound
Total	0.026	0.006	0.017

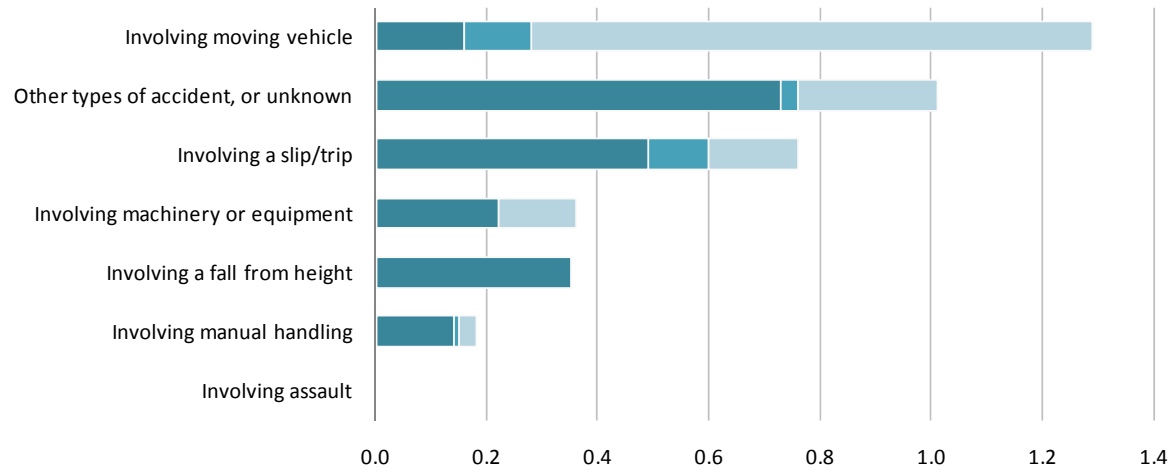
Figure 4.19

Workers have been categorised in the data as Traffic Officers (TO), Supply Chain workers or Other (including, for example, HA National Vehicle Recovery Operatives). Supply chain workers are split into three categories: road workers, construction & maintenance workers and supply chain workers whose role is unknown. The annual FWI for the workforce is shown split out by these worker categories. The supply chain workforce suffers the majority of the fatalities and weighted injuries experienced by the workforce, however in most cases it is not known which groups of workers in the supply chain were affected. Where road type is known, it is on motorways where the workforce has incurred the majority of the FWIs. However it should be noted that the road type is not known for a significant proportion of the incident data.

In risk terms the picture is somewhat different. Looking at the FWI on an exposure basis (per 100 thousand hours worked) shows that the Traffic Officers are exposed to higher risk than the supply chain workforce. However, it should be noted that there were no Traffic officer Fatalities in 2009 and so this calculation is based on the statistical FWI measure only. For the supply chain there are currently very broad estimates of the total hours worked annually. Supply chain risk is therefore presented as an upper and lower bound, based on corresponding estimates of hours worked. Data is not available for hours worked by road type, only a total for each workforce group.

- Fatalities and weighted injuries per year are dominated by the supply chain, however
- Traffic Officers are exposed to greater risk when the number of hours worked is taken into account
- Workforce data, including hours worked, is sparse and the quality of the data is poor compared with that available for road users.
- Hours worked are not available broken down by road type.

Profiles by accident sequence



	Involving assault	Involving manual handling	Involving a fall from height	Involving machinery or equipment	Involving a slip/trip	Other types of accident, or unknown	Involving moving vehicle
Motorway	0.00	0.14	0.35	0.22	0.49	0.73	0.16
Dual A Road	0.00	0.01	0.00	0.00	0.11	0.03	0.12
Single A Road	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	0.03	0.00	0.14	0.16	0.25	1.01

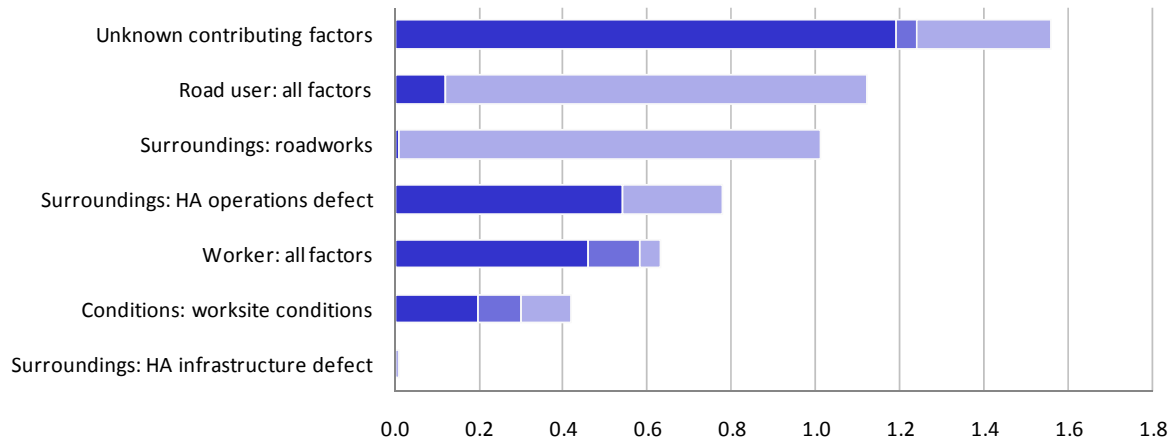
Figure 4.20

Examining FWIs for all workers by primary accident sequence shows that the highest risk comes from accidents involving moving vehicles. This is followed by unclassified accidents (usually where the type is not known), with accidents involving slips and trips the third most risky. No incidents involving assaults were recorded in 2009.

The majority of the FWIs associated with moving vehicles occurred on roads where the type was unrecorded. The majority of FWIs associated with all other types of incident occurred on motorways.

- Accidents involving moving vehicles are the biggest risk in terms of worker FWI.
- There are significant numbers of accidents where the type of accident has not been recorded
- The total number of recorded incidents is very small, so the picture can be dominated by a single incident

Profiles by contributing factor



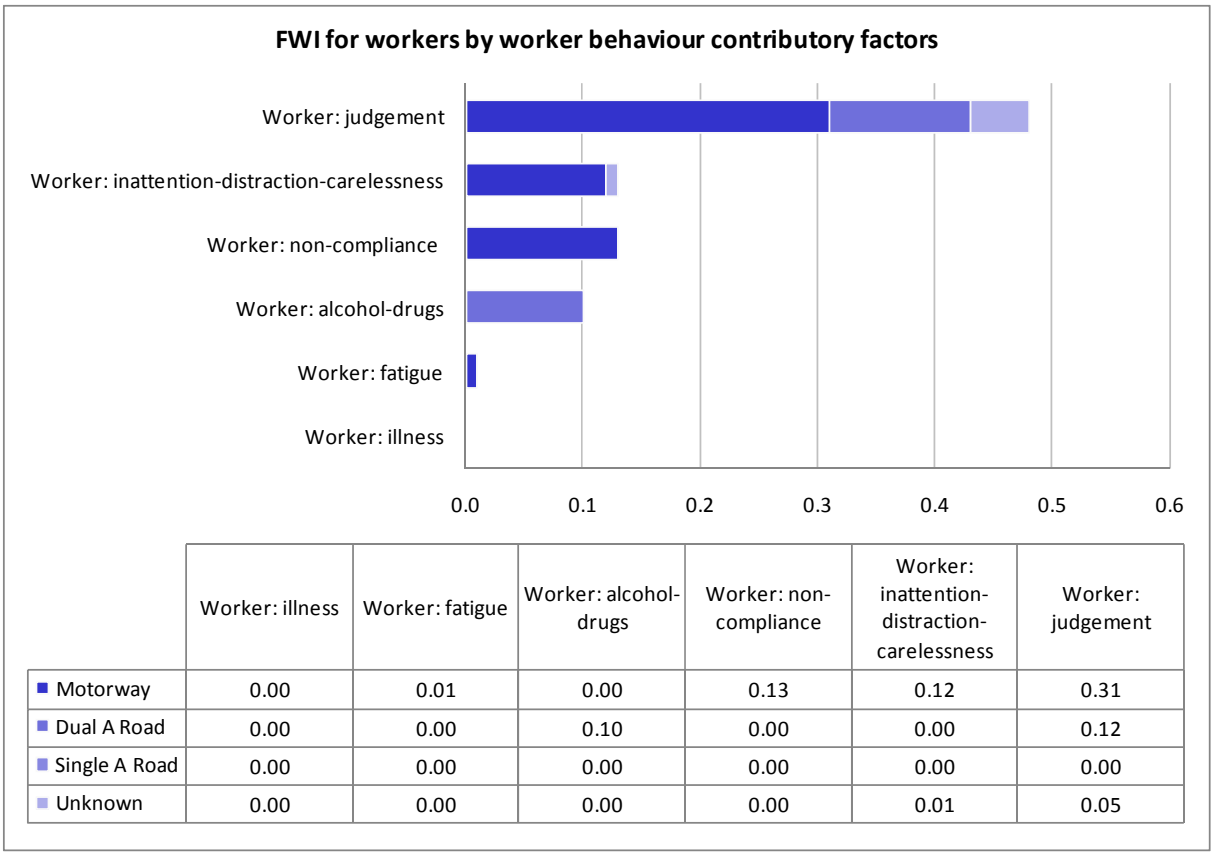
	Surroundings: HA infrastructure defect	Conditions: worksite conditions	Worker: all factors	Surroundings: HA operations defect	Surroundings: roadworks	Road user: all factors	Unknown contributing factors
Motorway	0.00	0.20	0.46	0.54	0.01	0.12	1.19
Dual A Road	0.00	0.10	0.12	0.00	0.00	0.00	0.05
Single A Road	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0.01	0.12	0.05	0.24	1.00	1.00	0.32

Figure 4.21

Examining the factors that contributed to the worker accidents, at a top level the biggest grouping is unknown contributing factors to accidents on motorways. Road users presented the next largest risk to workers, while 'surroundings: roadworks' (road types largely unknown) and 'surroundings: HA operations defects' (mostly motorways) were the next largest. Incidents where workers contributed to the incident appear to be recorded in more detail, with almost all of them being recorded against a road type (mainly motorways).

The small number of incidents is dominated by an even smaller number of fatalities. Examining the FWIs on a per accidents basis according to contributing factor we found two contributing factors have led to fatal incidents. It must be noted that as contributing factors are not mutually exclusive, and there was only 1 worker fatality in 2009, these would have both contributed to the same fatal incident. Therefore In this case all can be said is that road users and surroundings have contributed to a fatal worker incident.

The following graphs present a more detailed examination of those contributing factors for which there is a more detailed breakdown in the data.



	Worker: illness	Worker: fatigue	Worker: alcohol-drugs	Worker: non-compliance	Worker: inattention-distraction-carelessness	Worker: judgement
Motorway	0.00	0.01	0.00	0.13	0.12	0.31
Dual A Road	0.00	0.00	0.10	0.00	0.00	0.12
Single A Road	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.00	0.00	0.01	0.05

Figure 4.22

Looking in more detail at the known data for contributing factors related to the workers themselves, poor worker judgement is by far the biggest contributing factor to FWIs, with inattention-distraction-carelessness, failure to comply with rules and alcohol-drugs issues providing similar but smaller contributions. In this dataset the only incidents to which alcohol-drugs contributed took place on dual carriageway A roads, while the other incidents almost all took place on motorways.

- The key contributing factors to worker accidents in terms of risk within the 2009 dataset are: road user, roadworks, HA operations defects and worker judgement.
- Many incidents were recorded without capturing the contributing factors.
- The rarity of these events makes it difficult to draw any strong conclusions.

5. Detailed Analysis

This section provides a detailed analysis of current levels of safety risk for road users. At this time, data is not available to support an equivalent detailed analysis for workers.

The figures below show the profiles of road user risk, by FWIs (5.1) and FWI/billion vehicle miles (5.2).

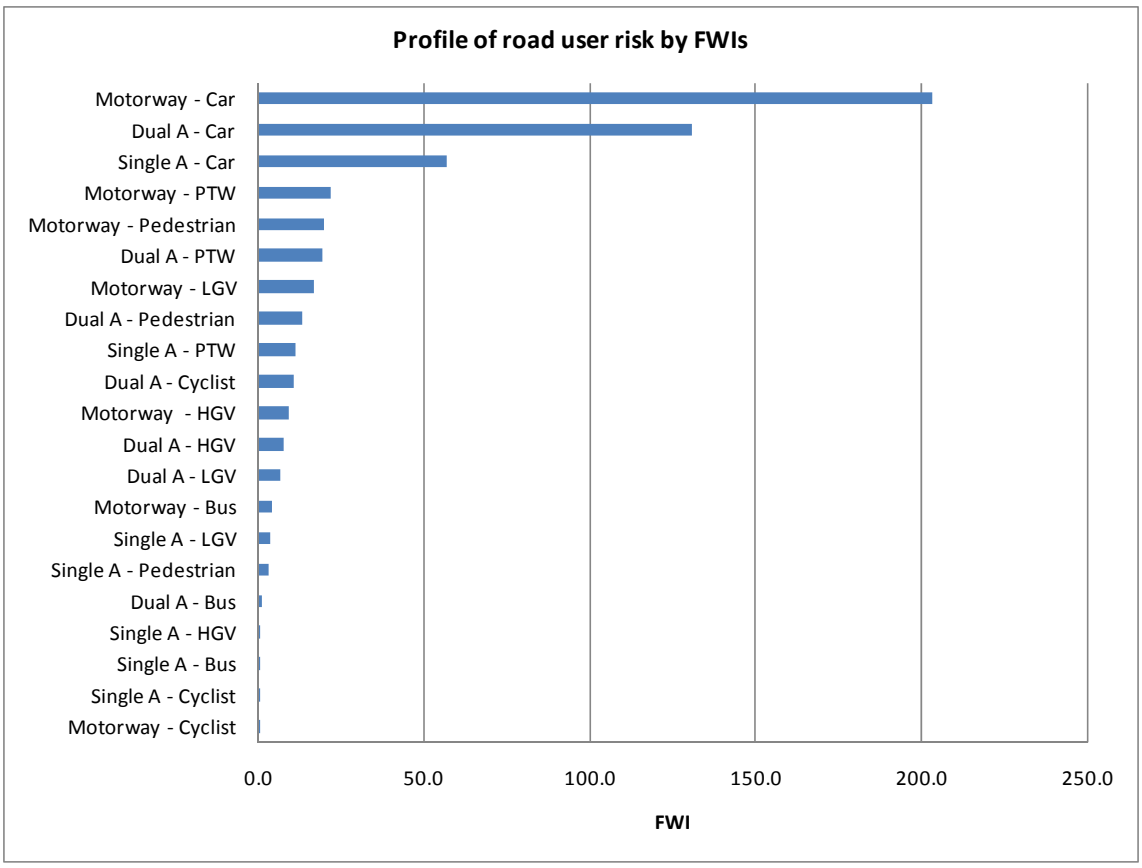


Figure 5.1

Figure 5.1 shows that on FWI's alone, car occupants form the top three profile groups. However, Figure 5.2 shows that when normalised by exposure, cyclists and PTW's become the top risk groups. .

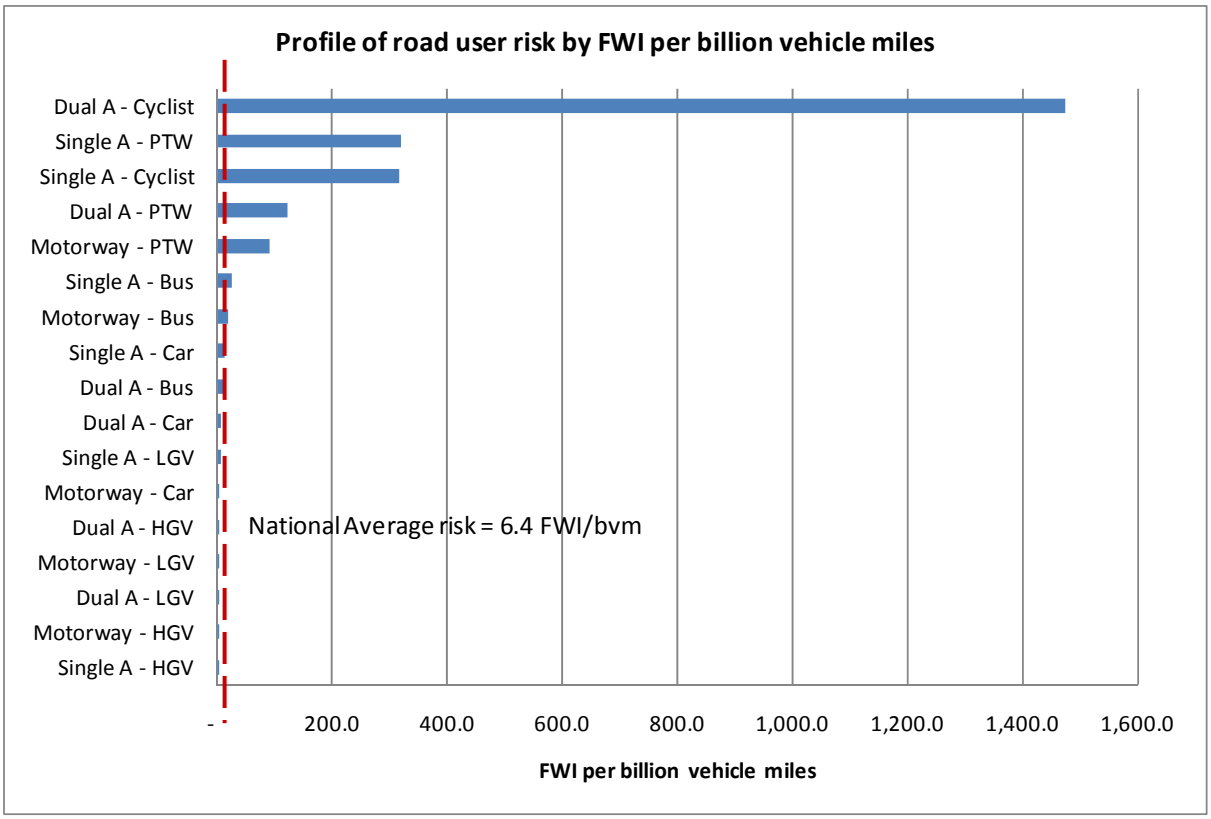


Figure 5.2

This remainder of this section provides a more detailed analysis of the 'Top 9' road user risks, defined as combinations of road user type and road type and in terms of their calculated values of FWI/billion vehicle miles.

The top five of these all have values of FWI/billion vehicles miles that are more than a factor of ten above the network average; the next three all have FWI/bvm values that are between a factor of two and a factor of four (approximately) greater than the national average.

The final risk group is pedestrians (all road types). These are included for completeness, even though there are no calculated values for their risk (because there is no mileage data for them). However they have the third highest number of FWIs from the complete list of road user type.

The complete list of Top 9 road user risks are therefore:

1. Cyclists on dual carriageway A roads
2. Powered Two Wheelers (PTWs) on single carriageway A roads
3. Cyclist on single carriageway A roads
4. PTWs on dual carriageway A roads
5. PTWs on motorways
6. Buses & coaches on single carriageway A roads
7. Buses and coaches on motorways
8. Cars on single carriageway A roads
9. Pedestrians (all road types)

Profiles of FWIs and FWIs/bvm by accident sequences and contributing factors are presented for each risk group in Appendix 1.

The data presented in these profiles has been compared for specific user types (for any similarities or material differences across road types) and then for specific road types (for any similarities of material differences across user types).

Main observations

The main observations from the profiles of accident sequence are:

- Two vehicle and multiple vehicle accident sequences involving rear end shunts, side impacts and side swipes contributed the highest numbers of FWIs and highest FWIs/bvm across all of the combinations of user type and road type examined.
- In addition, two vehicle head on accidents were the top accident sequence for all 'vehicle' accidents on single carriageway A roads, i.e. for cars, buses and LGVs; they were the third highest cause of FWIs and FWIs/bvm for PTWs on single carriageway A roads; they were a relatively minor cause for cyclists on these roads.
- Buses only ever seem to hit the nearside barrier on motorways; there is very little risk associated with them hitting offside barrier.

The main observations from the profiles of contributing factors are:

- Road user inattention-distraction-carelessness, judgement (young and old) and speed-aggression were significant contributing factors to all combinations of road user and road type examined.
- The main other contributing factors to feature relatively highly within the profiles were:
- Road adhesion, notably for PTWs on dual carriageway and single carriageway A roads, and cars on single carriageway A roads)
- Road user fatigue for buses on motorways and cars on single carriageway A roads
- Road user alcohol-drugs for cars on single carriageway A roads.

Comparison by user type

Comparing the profiles across similar user types shows:

Cyclists - the profiles of accident sequences and contributing factors were very similar for dual carriageway and single carriageway A roads. However, the number of FWIs and value of FWIs/bvm was significantly higher on the dual by approximately a factor of 10. The main accident sequences were two vehicle and multiple rear end shunts, side swipes and side impacts; the main contributing factors were road user inattention-distraction-carelessness, judgement (young and old) and speed-aggression. Pedestrians in the road were also a relatively high contributing factor for cyclists on single carriageway A roads.

PTWs - the profiles of accident sequences and contributing factors are reasonably similar across all road types; the main accident sequences relate to rear end shunts, side impacts and side swipes; the main contributing factors are road user inattention-distraction-carelessness, judgement (young and old) and speed-aggression; road adhesion was also a reasonably high contributing factor on dual and single carriageway A roads. Levels of FWIs and FWIs/bvm are very similar on motorways and dual carriageway A roads. However, they are approximately three to four times higher on single carriageway A roads.

Buses & Coaches - the profiles of accident sequence and contributing factor are quite different for buses and coaches on motorways, compared with on single carriageway A roads. On motorways, the main accident sequences are rear end shunts, single vehicle hits nearside barrier and two vehicle side and other impacts; on single carriageway A roads the main accident sequences are two vehicle head on and single vehicle comes to rest in the carriageway, followed by multiple and two vehicle rear end shunts, side and other impacts. On motorways, the main contributing factors are road user speed-aggression, fatigue, inattention-distraction-carelessness and judgement, plus vehicle defects; on single carriageway A roads, HA infrastructure defects are also a relatively significant contributing factor, however the contribution of road user fatigue is much reduced. Levels of FWIs and FWIs/bvkm are similar on motorways and single carriageway A roads.

Pedestrians - the profiles of accident sequence and contributing factor are relatively similar for motorways and dual carriageway A roads. The main accident sequences appear to involve accidents that happen on the main carriageway (as opposed to as a result of vehicles leaving the carriageway). The main contributing factors are then road user speed-aggression, inattention-distraction-carelessness and fatigue; road adhesion, visibility and roadworks are also relatively significant contributing factors. On single carriageway A roads, accident sequences involving single errant vehicles contribute proportionately more FWIs; vehicle defects are also a more significant contributing factor.

Comparison by road type

Comparing the profiles across similar road types shows:

Motorways - profiles of accident sequence and contributing factors are quite different for different user types suggesting that these are related more to user type than to road type (the comparison looked at PTWs and buses & coaches). Levels of FWIs and FWIs/bvm are also quite different for the different user types.

Dual carriageway A - profiles of accident sequence and contributing factor are quite different, even though the two user types compared are relatively similar (cyclists and PTWs). Levels of FWIs and FWIs/bvm are also very different (as cyclists have approximately an order of magnitude higher risk in terms of FWI/bvm than PTWs).

Single carriageway A- observations regarding profiles of accident sequence and contributing factors, risk levels and FWIs on single carriageway A roads are generally grouped around the following categories of road users :

- PTWs and cyclists
- cars
- buses and coaches

Accident sequences and contributing factor profiles for PTWs and cyclists are reasonably similar; profiles for cars and for buses and coaches are then quite different, both to each other and compared with PTWs and cyclists.

Risk levels for PTWs and cyclists are also reasonably similar, but are approximately an order of magnitude higher than for buses and coaches; risk levels for cars are slightly lower than for buses and coaches.

Numbers of FWIs are highest for cars, followed by PTWs, then buses and coaches and then cyclists.

This suggests that accident sequences and contributing factors vary by road user type and road type. Therefore interventions need to be targeted at the specific root causes and accident types experienced by individual road user populations on a particular road type, i.e. not generic.

6. Special Topics

This section presents the results from a small number of detailed analyses conducted using the SRM. These are:

- Differences between day and nightshift working on the SRN
- Differences between peak and offpeak safety risks to cyclists on the SRN
- Fatigue-related accidents on the hardshoulders of motorways
- Profile of accident sequences resulting from the contributing factor 'Worker: judgement'

Differences between day and nightshift working on the SRN

This study investigated the differences between levels of risk associated with nightshift and dayshift working on the SRN, for supply chain and Traffic Officers.

Results are presented in Tables 6.1 and 6.2 below.

Supply Chain	**All day**	**Dayshift**	**Nightshift**	**Ratio (Nightshift:Dayshift)**
Accidents	99	73	26	0.36
FWIs	3.44	1.56	1.88	1.21
FWIs/100,000 hours worked*	0.0065	0.0040	0.014	3.50

Table 6.1 - Comparison of dayshift and nightshift risk levels for supply chain

Traffic Officers	**All day**	**Dayshift**	**Nightshift**	**Ratio (Nightshift:Dayshift)**
Accidents	33	26	7	0.27
FWIs	0.51	0.35	0.16	0.46
FWIs/100,000 hours worked*	0.026	0.0239	0.0328	1.37

Table 6.2 - Comparison of dayshift and nightshift risk levels for Traffic Officers

* Calculated using the 'high' estimate for hours worked

The distribution of working hours between the day and night shifts was taken into consideration within the calculations. This suggests that nightshift working is 3.5 times more risky than dayshift working for supply chain workers, compared with 1.37 more risky for Traffic Officers.

Differences between peak and off-peak safety risks to cyclists on the SRN

This study investigated differences in safety risk for cyclists during the peak and off-peak periods. This was intended to test a theory that the high levels of safety risk experienced by cyclists on the SRN was driven by leisure cyclists, who are potentially less familiar with the roads they are cycling on, cycling at off-peak times, when traffic is likely to be travelling at higher speeds.

Results are presented in Tables 6.3 and 6.4 below.

Dual carriageway A roads	**All day**	**Peak**	**Off-peak**	**Ratio (Offpeak:Peak)**
Accidents	104	41	63	1.54
FWIs	10.86	3.76	7.09	1.89
FWIs/million cycle miles	1.48	1.58	1.43	0.91

Table 6.3 - Comparison of peak and off-peak risks to cyclists on dual carriageway A roads

Single carriageway A roads	**All day**	**Peak**	**Off-peak**	**Ratio (Offpeak:Peak)**
Accidents	22	11	11	1.00
FWIs	0.61	0.24	0.37	1.54
FWIs/million cycle miles	0.37	0.46	0.33	0.72

Table 6.4 - Comparison of peak and off-peak risks to cyclists on single carriageway A roads

This suggests that cycling during the off-peak period is actually less risky than cycling at peak times for both dual and single carriageway A roads.

Fatigue-related accidents on the hardshoulders of motorways

This study investigated fatigue-related accidents on the hardshoulders of motorways, including:

- Frequency
- Severity
- Variation in frequency and severity between hours of daylight and darkness

Because of the low numbers of incidents recorded in the data for individual years, the investigation considered 3-year average data for the period 2007-2009.

Results are presented in Table 6.5.

3-year average (2007-2009)	**All day**	**Daylight**	**Darkness**	**Ratio (Darkness:Daylight)**
Accidents	14.33	7.67	6.67	0.87
FWIs	3.05	2.01	1.04	0.52
FWIs/accident	0.21	0.26	0.16	0.62

Table 6.5 - Comparison of fatigue-related accidents on hardshoulders of motorways

This suggests that there are not many incidents of this type per year, but when they happen, the consequences are generally quite severe (compared with other types of accident). The results also suggest that these types of accidents are more serious when they occur during the hours of daylight, as opposed to the hours of darkness.

Profile of accident sequences resulting from the contributing factor 'Worker: judgement'

This study investigated the profile of accident sequences resulting from the contributing factor 'Worker: judgement'.

Because of the low numbers of incidents recorded in the data for individual years, the investigation considered 3-year average data for the period 2007-2009.

Results are presented in Table 6.6.

3-year average (2007-2009)	Accidents	FWIs	FWIs/accident
Assault	0	0	0
Moving vehicle	1	0.04	0.04
Machinery/equipment	1.33	0.04	0.03
Manual handling	0.33	0.003	0.01
Slip or trip	0.33	0.0003	0.01
Fall from height	0.67	0.04	0.06
Other or unknown	1	0.07	0.07

Table 6.6 - Profile of accident sequences resulting from the contributing factor 'Worker: judgement'

This suggests that the most frequent types of accident resulting from worker judgement are those involving machinery or equipment; the most serious types of accidents (in terms of FWIs/accident) are those currently categorised as 'other or unknown', closely followed by 'falls from height'

7. HA Controls and Influence

Whilst the Agency owns all of the safety targets for the SRN, it cannot control or influence all of the causes of safety risk. Tables 7.1 and 7.2 list the main contributing factors that it is considered HA can:

- Control itself (HA)
- Control indirectly through its contracts and procurement arrangements (Contracts)
- Influence through lobbying of external departments, Agencies or other organisations (Lobbying)

It also reports the number of FWIs associated with each contributing factor and what percentage this represents of the total FWIs for the relevant populations on the HA network.

The data within Tables 7.1 and 7.2 is also colour coded to highlight the level of contribution to the total FWIs for each contributing factor and road user/worker type according to the following scheme:

Factor represents <1% of total FWIs
Factor represents between 1 and 5% of total FWIs
Factor represents between 5 and 50% of total FWIs
Factor represents >50%% of total FWIs

From this, it is concluded that, for road users, those contributing factors that HA has direct control over contribute to only a relatively low proportion of the total road user FWIs on the network. By far the largest contributions come from those factors that HA can only influence through lobbying (predominantly related to road user behaviour).

For workers, the HA has more control, either directly or through its contracts or procurement processes. Here, the results suggest that only a relatively small proportion of the total worker FWIs could be influenced by lobbying (although again, the main influence would be over road user behaviour).

Contributing Factors (Road Users)	Type of HA control or influence	FWIs associated with factor (% of total FWIs for Road Users)								
		Car occupants	HGV occupants	LGV occupants	Bus/coach occupants	PTW riders/passengers	Cyclists	Pedestrians	Other and unknown	Total
Conditions: Road adhesion	HA	50.79 (9.3%)	0.42 (0.1%)	3.24 (0.6%)	0.09 (0.02%)	4.09 (0.8%)	0.11 (0.02%)	2.56 (0.5%)	0.07 (0.01%)	61.36 (11.2%)
Conditions: Visibility	HA	13.27 (2.4%)	0.23 (0.04%)	0.82 (0.2%)	0.08 (0.01%)	2.57 (0.5%)	0.12 (0.02%)	2.03 (0.4%)	0.01 (0.01%)	19.11 (3.5%)
Surroundings: object in road	HA	5.82 (1.1%)	0.18 (0.03%)	0.44 (0.1%)	0.06 (0.01%)	0.78 (0.1%)	0.03 (0.01%)	1.02 (0.2%)	0.21 (0.04%)	8.53 (1.6%)
Surroundings: pedestrian in road	HA	1.52 (0.3%)	0.02 (0.00%)	0.08 (0.01%)	0.01 (0.00%)	0.20 (0.04%)	0.08 (0.01%)	23.14 (4.2%)	0.01 (0.00%)	25.05 (4.6%)
Surroundings: roadworks	HA	4.13 (0.8%)	0.04 (0.01%)	0.18 (0.03%)	0.04 (0.01%)	2.58 (0.5%)	- -	1.80 (0.3%)	- -	8.77 (1.6%)
Surroundings: HA infrastructure defect	HA	4.45 (0.8%)	0.21 (0.04%)	0.17 (0.03%)	0.10 (0.02%)	1.38 (0.3%)	0.98 (0.2%)	0.07 (0.01%)	- -	7.35 (1.3%)
Road user: all	Lobbying	352.34 (63.3%)	15.65 (2.9%)	22.96 (4.2%)	5.11 (0.9%)	46.60 (8.5%)	10.29 (1.9%)	16.48 (3.0%)	3.88 (0.7%)	473.31 (86.3%)
Vehicle: vehicle defect	Lobbying	20.44 (3.7%)	0.71 (0.1%)	0.74 (0.1%)	0.64 (0.1%)	3.72 (0.7%)	0.07 (0.01%)	1.01 (0.2%)	1.56 (0.3%)	28.89 (5.3%)

Table 7.1 - Contributing factors toward road user risk that HA can control or influence

Contributing Factors (Workers)	Type of HA control or influence	FWIs associated with factor (% of total FWIs for Workers)			
		Traffic Officers	Supply Chain	Other	Total
Surroundings: roadworks	HA	0.01 (0.2%)	1.00 (23.8%)	- -	1.01 (24.0%)
Surroundings: HA infrastructure defect	HA	- -	0.02 (0.5%)	- -	0.02 (0.5%)
Surroundings: HA operations defect	HA	- -	0.80 (19.0%)	- -	0.80 (19.0%)
Worker: all factors	HA (Traffic Officers) Contracts (Supply Chain)	- -	0.66 (15.7%)	0.10 (2.4%)	0.76 (18.1%)
Conditions: Worksite conditions	Contracts	- -	0.42 (10.0%)	- -	0.42 (10.0%)
Road user: all	Lobbying	0.07 (1.7%)	1.06 (25.2%)	- -	1.13 (26.8%)

Table 7.1 - Contributing factors toward worker risk that HA can control or influence

The HA can also control or influence certain accident sequences, predominantly through:

- the provision (or not) of barriers
- the design and positioning of roadside objects
- the removal of objects from the carriageway
- worker training, procedures and equipment provision
- decisions that influence the types of tasks that workers are required to undertake or the circumstances under which they are required to undertake them (for example, working at height because the type of equipment specified by the HA requires this, or working adjacent to live traffic because of constraints imposed by the HA on network availability)

Tables 7.3 and 7.4 show the level of FWIs associated with these accidents sequences. It must be noted that the HA could only partially impact the total number of FWIs reported against each accident sequence in Tables 7.3 and 7.4; this is because road users, workers and supply chain employers will all also have an impact on safety risk, through their behaviour or working practices.

For road users, Table 7.3 suggests that the HA can only control or influence a relatively small proportion of the overall safety risk on the SRN.

From Table 7.4, HA can potentially influence a greater proportion of worker risk, however this is still the minority of risk compared with that which is influenced by factors outside of HA's control.

Accident Sequences (Road Users)	FWIs associated with factor (% of total FWIs for Road Users)								
	Car occupants	HGV occupants	LGV occupants	Bus/coach occupants	PTW riders/passengers	Cyclists	Pedestrians	Other and unknown	Total
Single vehicle: Leaves carriageway, hits nearside barrier	19.88 (3.6%)	0.50 (0.1%)	0.83 (0.2%)	0.57 (0.1%)	1.72 (0.3%)	- -	- -	0.01 (0.00%)	23.51 (4.3%)
Single vehicle: Leaves carriageway, hits offside barrier	18.31 (3.3%)	0.62 (0.1%)	1.20 (0.2%)	0.02 (0.00%)	2.44 (0.4%)	- -	- -	0.01 (0.00%)	22.60 (4.1%)
Single vehicle: Leaves carriageway, hits other object	66.11 (12.1%)	1.45 (0.3%)	1.39 (0.3%)	0.04 (0.01%)	2.88 (0.5%)	0.01 (0.00%)	0.26 (0.05%)	0.02 (0.00%)	72.17 (13.2%)
Single vehicle: Hits object in carriageway	1.05 (0.2%)	0.23 (0.04%)	0.02 (0.00%)	0.01 (0.00%)	2.05 (0.4%)	- -	0.10 (0.02%)	- -	3.45 (0.6%)
Total	105.35 (19.2%)	2.80 (0.5%)	3.44 (0.6%)	0.64 (0.1%)	9.09 (1.7%)	0.01 (0.00%)	0.36 (0.07%)	0.04 (0.1%)	121.73 (22.2%)

Table 7.3 - Road user accident sequences that HA can control or influence

Accident Sequences (Workers)	Type of HA control or influence			FWIs associated with factor (% of total FWIs for Workers)			
	Traffic Officers	Supply Chain	Other	Traffic Officers	Supply Chain	Other	Total
Worker: involving assault	HA	-	-	(0) (0)	-	-	(0) (0)
Worker: involving moving vehicle	HA	-	-	0.01 (0.2%)	-	-	0.01 (0.2%)
Worker: involving machinery or equipment	HA	-	-	(0) (0)	-	-	(0) (0)
Worker: involving manual handling	HA	Specification	Specification	0.04 (0.95%)	0.24 (5.7%)	(0) (0)	0.28 (6.7%)
Worker: involving a slip/trip	HA	Constraints or Specification	Constraints or Specification	0.23 (5.5%)	0.58 (13.8%)	(0) (0)	0.81 (19.2%)
Worker: involving a fall from height	HA	Constraints or Specification	Constraints or Specification	(0) (0)	0.36 (8.6%)	(0) (0)	0.36 (8.6%)
Worker: involving other types of incident (or unknown)	HA	-	-	0.23 (5.5%)	-	-	0.23 (5.5%)
Total	-	-	-	0.51 (12.1%)	1.18 (28.0%)	(0) (0)	1.69 (40.1%)

Table 7.4 - Worker accident sequences that HA can control or influence

8. Trends and Changes

This section presents key high level trends and differences observed between the 2009 data discussed in detail in previous sections, and the 2007-2009 3-year average data.

All graphs presented in this section relate to the overall period 2007-2009.

Road user collective risk

Figures 8.1a and 8.1b show the network level collective risk profiles for road users for 2009 and for the period 2007-2009..

The ordering of risk exposure for the 2007-2009 period is similar to that for 2009; the only exception is for LGV and HGV occupants where the order is reversed for the 2007-2009 3-year average. Risks levels are also generally lower in 2009 compared with the 2007-2009 3-year period; the only exception to this is cyclists, for whom the risk in 2009 was higher.

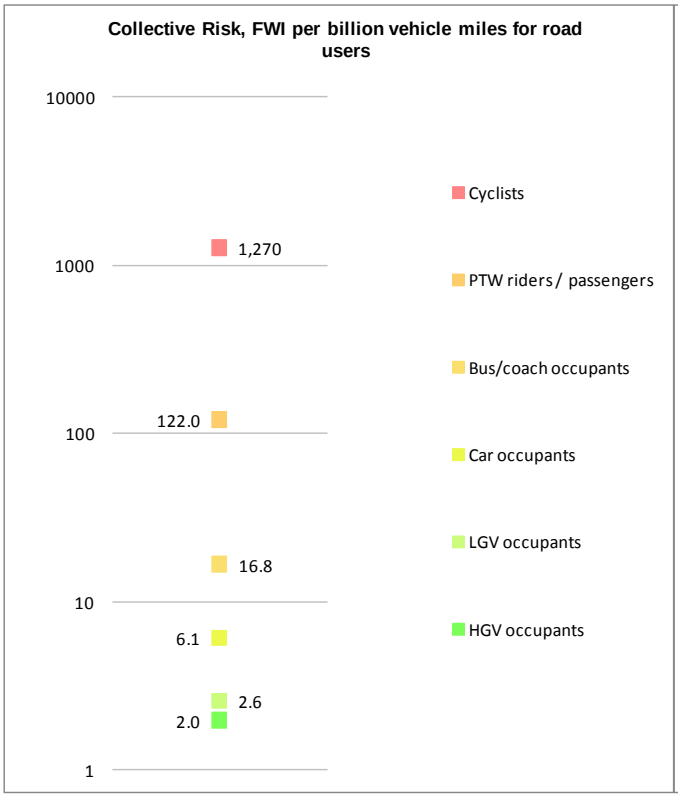


Figure 8.1a - Network level collective risk profile for road users for 2009

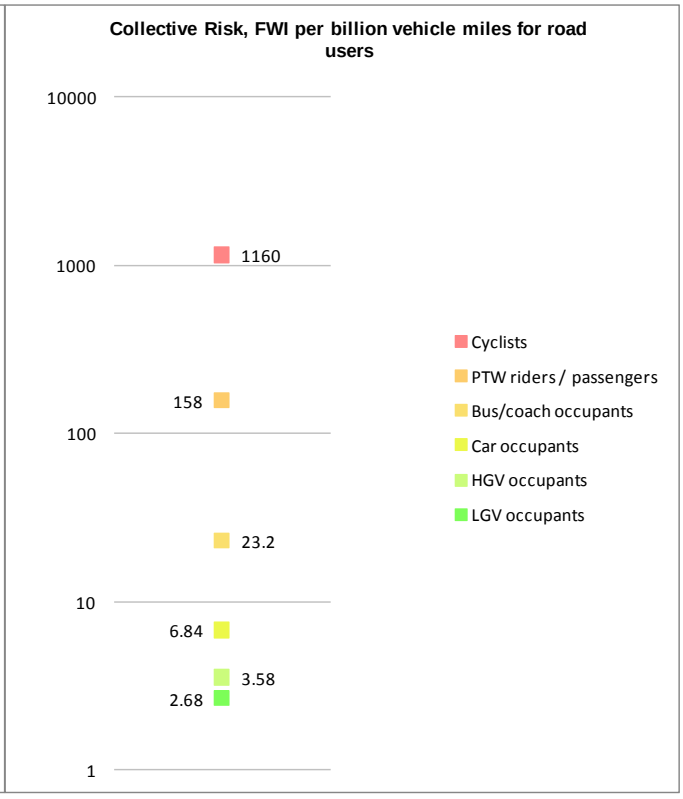


Figure 8.1b - Network level collective risk profile for road users for 2007-2009

Worker individual risk

Figure 8.2a shows the annual individual risk levels for workers for 2009; Figure 8.2b shows estimated average annual individual risk levels for workers for the period 2007-2009.

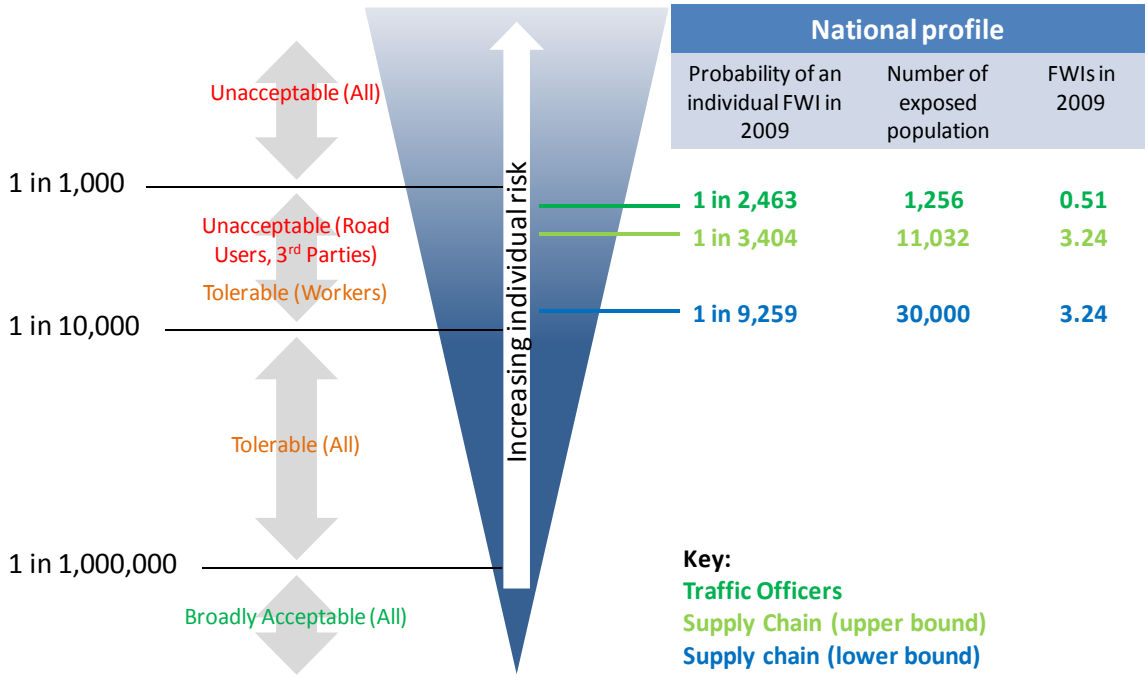


Figure 8.2a - Annual individual risk levels for workers (2009)

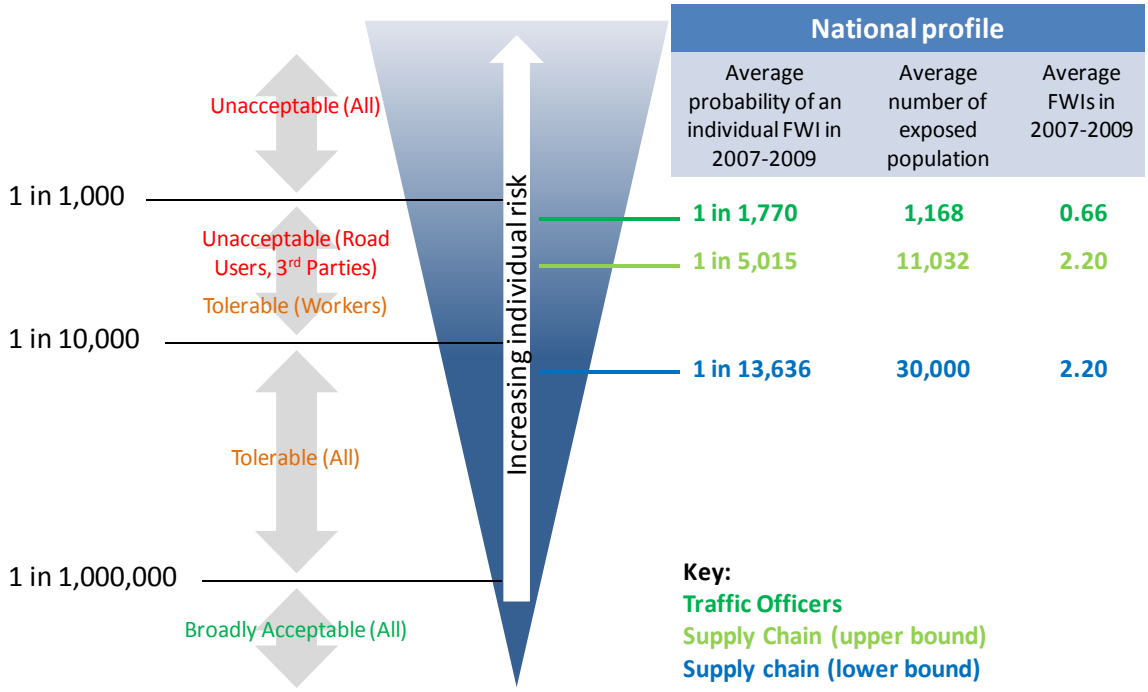


Figure 8.2b - Estimated average annual individual risk levels for workers (2007-2009)

Within Figure 8.2b, all values for Traffic Officers are based on actual data for the period 2007-2009. However, exposure data for supply chain for the period 2007 - 2009 is estimated as the data for 2009, multiplied by 3 (for the 3 years). This was used in the absence of any actual supply chain exposure data within the Agency for the 2007-2009 period.

Figures 8.2a and 8.2b show that risk for Traffic Officers decreased in 2009 compared with the period 2007-2009; however risks for supply chain (upper bound and lower bound) increased in 2009 compared with the period 2007-2009.

Road user and worker individual risk

Figures 8.3a and 8.3b show the individual risk profiles for all populations on the SRN for 2009 and the period 2007-2009, respectively.

Within Figure 8.3b, supply chain data is again hypothetical as it is based on estimates of worker exposure for 2007 and 2008.

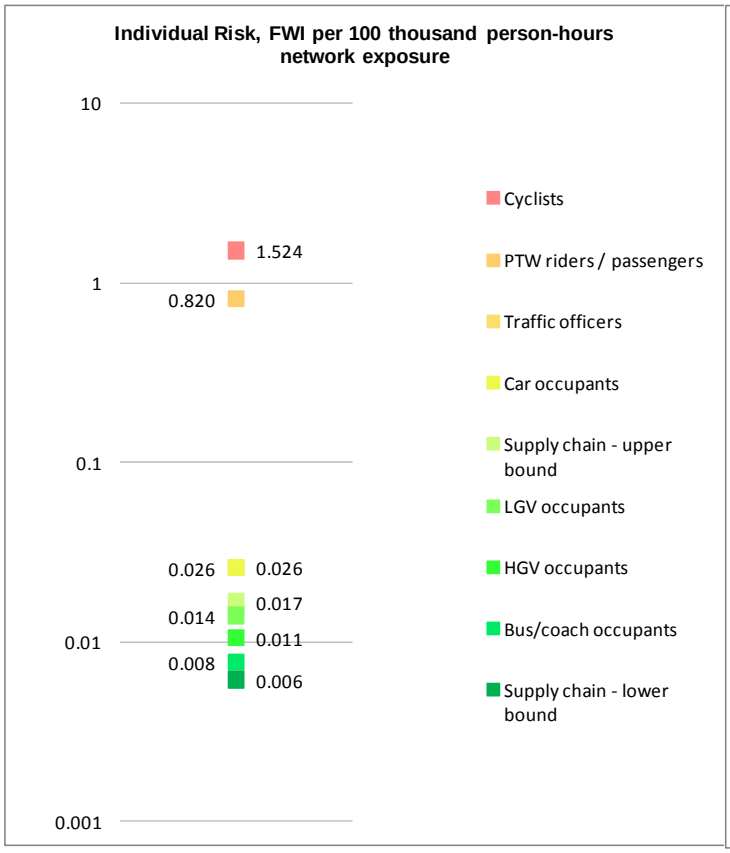


Figure 8.3a - Individual risk profile for all populations on the SRN (2009)

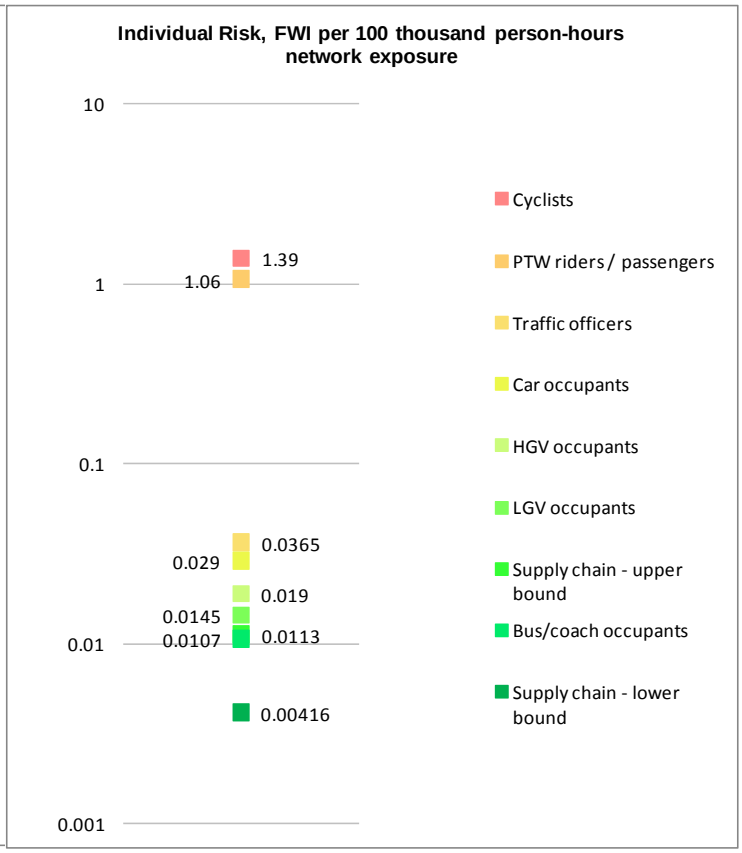


Figure 8.3a - Individual risk profile for all populations on the SRN (2007-2009)

The ordering of risk exposure for all populations on the SRN was slightly different in 2009 compared with the 2007-2009 3-year average. In 2009, Supply Chain (upper bound) were slightly higher than LGVs, which were slightly higher than HGVs. However, when considered over the 2007-2009 period, HGVs were subject to slightly higher risk than LGVs, who were then slightly higher than the Supply Chain (upper bound).

Overall, calculated individual risk levels in 2009 were generally lower in 2009 than for the 2007-2009 3-year period. The only exceptions to this were cyclists and the Supply Chain (upper bound and lower bound), for whom risk increased in 2009 compared with the 2007-2009 period.

Risk Profiles

Risk profiles for road users showed some minor changes, but no significant differences between the 3-year picture and the picture for 2009 described in this report.

For workers there are some differences between the 2007-2009 averages and the picture for 2009, but there is also evidence suggesting under-reporting in earlier years, so it is not possible to describe any observed differences as significant at this stage.

9. Comparison with Network Level Accident & Casualty Data

This section compares this report with the other main safety reports produced by the Agency:

- Reported Road Casualties on the HA Network
- Strategic State of the Network
- Operational State of the Network

The aim is to determine how far the results presented in this report can be compared with those presented elsewhere and, where comparisons can be made, how similar or different any conclusions are.

Comparison with 'Reported Road Casualties on the HA Network 2009'

'Reported Road Casualties on the HA Network 2009' (RRC09) reports on accidents on the HA 2006 Trunk Road Network, which is the network as it was in 2004, to allow for trend comparisons across all years from that point, unlike the current report which is based on the SRN of 2009. Casualties in RRC09 are reported in terms of fatal, serious, KSI (killed and seriously injured) and slight injuries, whereas this report focuses on FWIs, which weights serious and slight injuries together with fatalities. As such the figures are not directly comparable.

In RRC09 the road network is divided into Motorway and A road, but the A roads are in some cases split differently from this report (built-up and non-built up, as opposed to dual and single carriageway A road). Much of the RRC09 report is concerned with reporting trends – at present there is not enough data to produce useful trend data in terms of safety risks, although three years' worth of data is currently available within the SRM. RRC09 also reports on casualties by Area, which are not currently available within the SRM.

RRC09 measures risks to different customer groups in terms of total casualty rates (fatalities, serious and slight injuries, summed without weighting) and KSI rates, per hundred million vehicle miles; casualty rate data for individual customer groups is not disaggregated any further e.g. into separate fatal, serious or slight injury rates. Comparisons are provided for PTW, Car, LGV and HGV. Risks are shown as highest for PTW, then car occupants followed by LGV and HGV occupants. In these terms the risks for PTW are roughly ten times higher per vehicle mile than those for car occupants, which are in turn three times higher than LGV risk with HGV occupants exposed to the least risk.

In comparison, this report shows the FWI per billion vehicle miles by road type but.the risks in terms of FWI/bvm are slightly different. PTW is once again by far the highest risk group – in this case around a factor of 20 higher than car occupants. Car occupants are then approximately a factor of two higher risk than LGVs and HGVs remain the lowest risk group. Cyclists and bus/coach occupants are not discussed in the RRC09 in risk exposure terms so no comparison can be made.

Work is ongoing to fully understand the reasons for the differences in relative risk measures between this report and RRC09; however, it is assumed to result from the combination of different risk measures and network definitions.

RRC09 considers the impact of contributory factors on the seriousness of accidents in terms of the (approximately) 80 underlying contributory factors reported in STATS19. The SRM combines these factors into a series of higher level contributing factors (see Section 2 for further detail of these). Therefore findings relating to contributory (or contributing) factors across RRC09 and this report are not directly comparable. However the key message that the majority contribution to accidents is due to driver/ rider error, poor judgement or distraction rather than road or environmental conditions is compatible across both reports.

RRC09 also reports some results against different accident types (termed accident sequences in this report). As with the contributing factors, the categories of accident type/sequence are not directly comparable between the two reports; therefore results cannot be directly compared.

Comparison with 'Strategic State of the HA Network report 2010'

'Strategic State of the HA Network report 2010' (SSoN10) reports on trends and in particular on progress towards HA's target of casualty reductions against the 1994-98 average baseline. It therefore presents data on the basis of the 2006 Trunk Road Network – as the core network was in 2004 which allows for direct comparisons across years. This compares with the current report which presents risks as they currently are across the actual road network managed by the HA in 2009.

SSoN10 primarily presents data in terms of KSI, rather than the FWI measure used in this report. It focuses on total casualty figures, rather than using normalisation factors to show the risks associated with different road types, customer groups or regions. It breaks down the numbers by customer groups in a similar way to this report and overlaps somewhat with the RRC09, and as in that report the figures are not directly comparable with those presented here. It also presents regional breakdowns, which are not available (as yet) from the SRM. The focus is on trends.

Comparison with 'Operational State of the Network 2010 Draft'

'Operational State of the Network 2010' (OpSoN10) reports in some detail on regional trends, based against the 1994-98 average baseline and using the 2006 Trunk Road Network – the core network as it was in 2004. Regional performance is reported in terms of SPI – Safety Performance Indicators - which are different for each Area and Region, and take into account the baseline casualty rate, the make-up of the network in the region and the traffic growth in each Area and Region. Reporting of the overall picture is provided in terms of KSI, without weightings.

This report is not comparable with the data published in the OpSoN10 as the SRM does not currently produce results in terms of Areas or Regions, it is based on the 2009 SRN and findings are presented on a risk rather than a casualty basis.

10. Conclusions

This section describes the main conclusions from this first issue of the 'Safety Risk Profile of the HA Strategic Road Network'. For clarity, these are grouped under general headings.

Use of risk exposure data

The results presented clearly show that normalisation of safety data gives an extra perspective and important information which can provide additional insight to safety decision making when considered alongside simple counts of accidents or casualties.

Network level safety risks

Cyclists are currently subjected to collective risk levels approximately 200 times the national average for all road users; risk levels for PTW riders/passengers are approximately 20 times the national average.

Current collective risk levels for LGV and HGV occupants are approximately one-third of the national average.

Influence of road type

Motorways are currently the safest types of road for: HGVs (jointly with single carriageway A roads), cars and PTWs; they are not the riskiest type of road for any road user population.

Dual carriageway A roads are currently the safest types of road for: LGVs, buses and coaches; they are the riskiest types of road for HGVs and cyclists.

Single carriageway A roads are currently the safest types of road for HGVs (jointly with motorways) and cyclists; they are the riskiest types of roads for LGVs, cars, buses and coaches and PTWs.

Where the type of road is recorded, the majority of worker FWIs occur on motorways. However, there is a need for more detailed information about worker accidents and exposure in order to fully understand the risk associated with all aspects of working on the SRN.

Contributing factors & accident sequences

Road user factors are by far the biggest category of contributing factors for road user and worker risk. Within this, the main road user contributing factors are:

- Inattention-distraction-carelessness
- Judgement
- Speed-aggression

For workers, worker judgement is the most significant worker contributing factor of those recorded.

The causes of accidents and types of accidents that road users have on the HA network are specific to the particular road user type and road type; this suggests that there is not a generic solution for a particular type of road user or road type; both factors need to be taken into account within the design of any safety related intervention.

HA controls & influence

The HA can directly control only a relatively small proportion of the FWIs that happen on its network. Where it can control risk, the results presented in this report suggest that the main areas where HA can have most impact for road users are:

- road adhesion
- provision of safety barriers

For workers, the results suggest that HA can have some impact on safety risk, primarily through its procedures and requirements for:

- infrastructure design (including design for maintenance)
- roadworks design (including any constraints the Agency imposes on when and how roadworks can take place)
- worker training and behaviour
- Traffic Officer procedures

The area where there is most potential benefit (for road users and workers) though is through influencing road user behaviour.

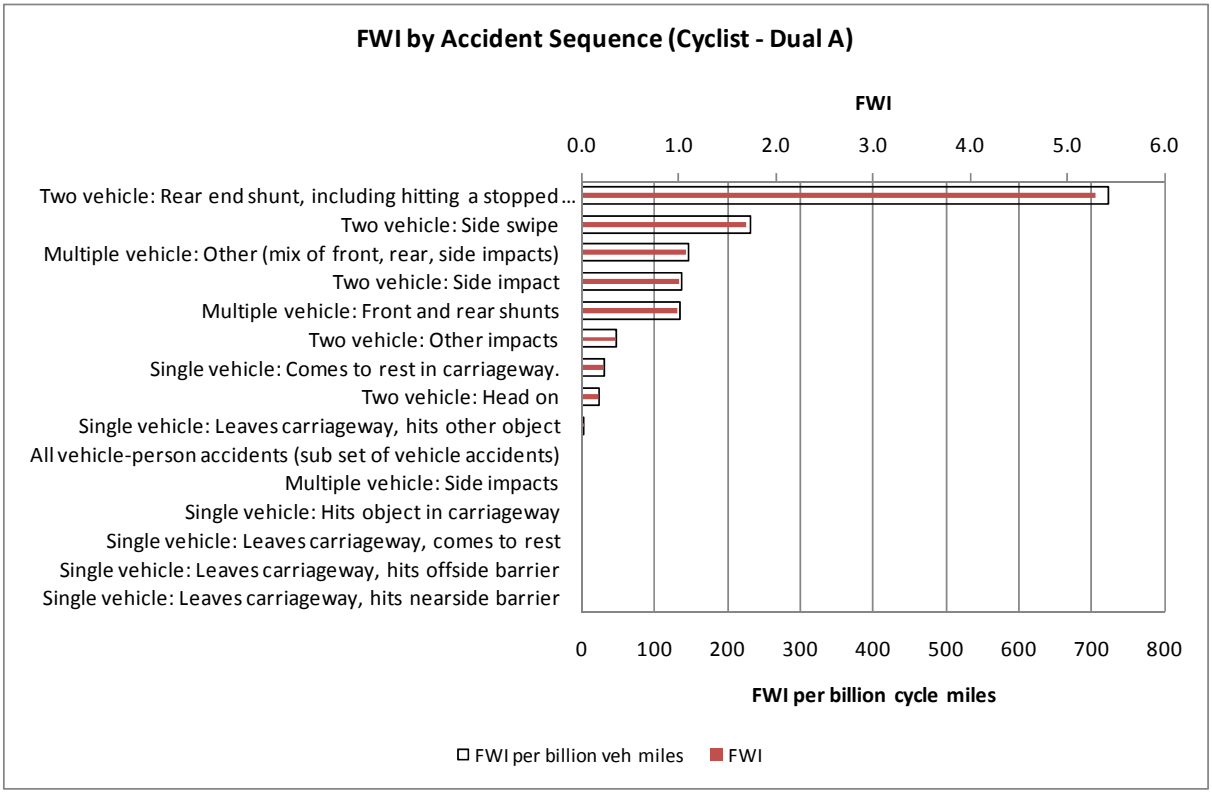
Trends

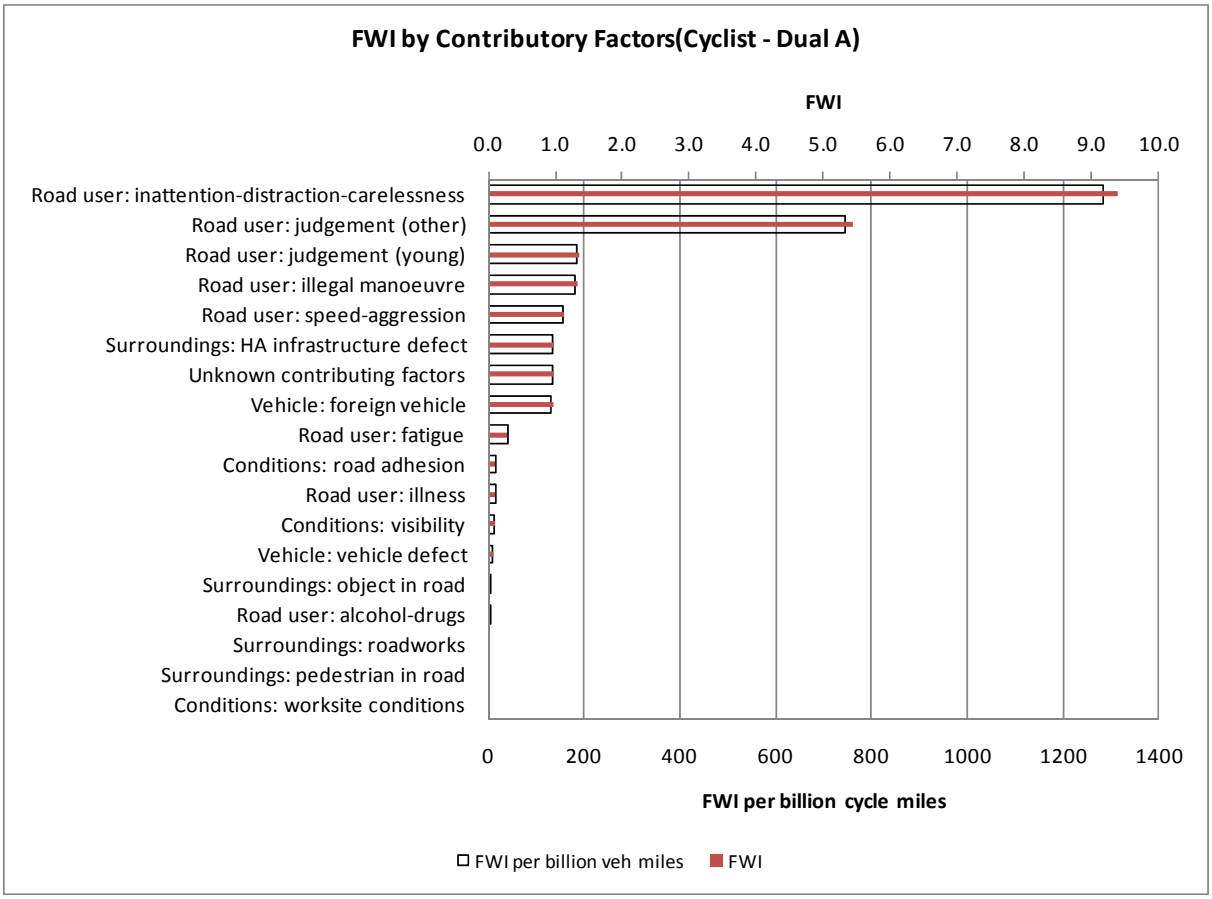
Comparison of the 2009 data with 3-year averages for the period 2007-2009 suggests a similar picture across both sets of results. There are some minor variations in risk values and ordering of risk profiles; the data also suggests that there has been a general improvement in 2009 relative to the period 2007 to 2009. However, care is needed in making this conclusion on the basis of one comparison over a relatively short time period.

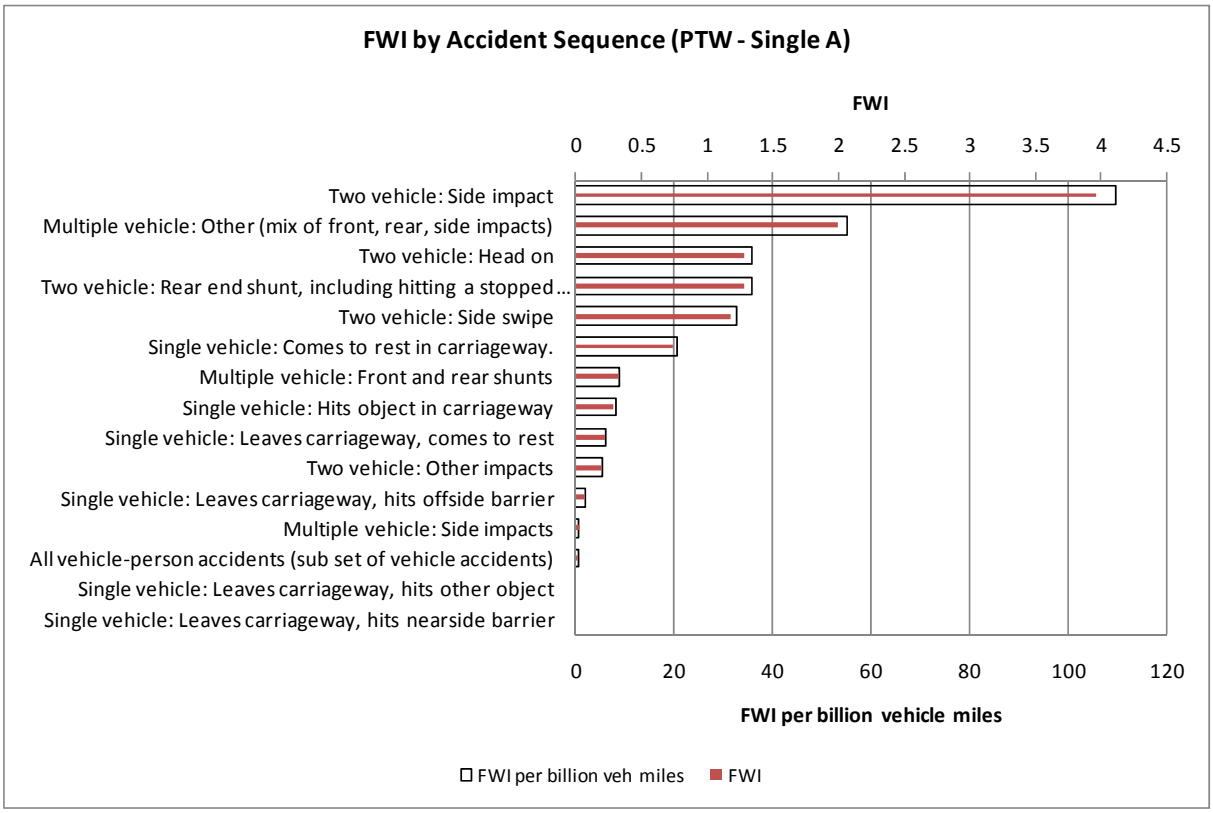
Comparison with other safety data

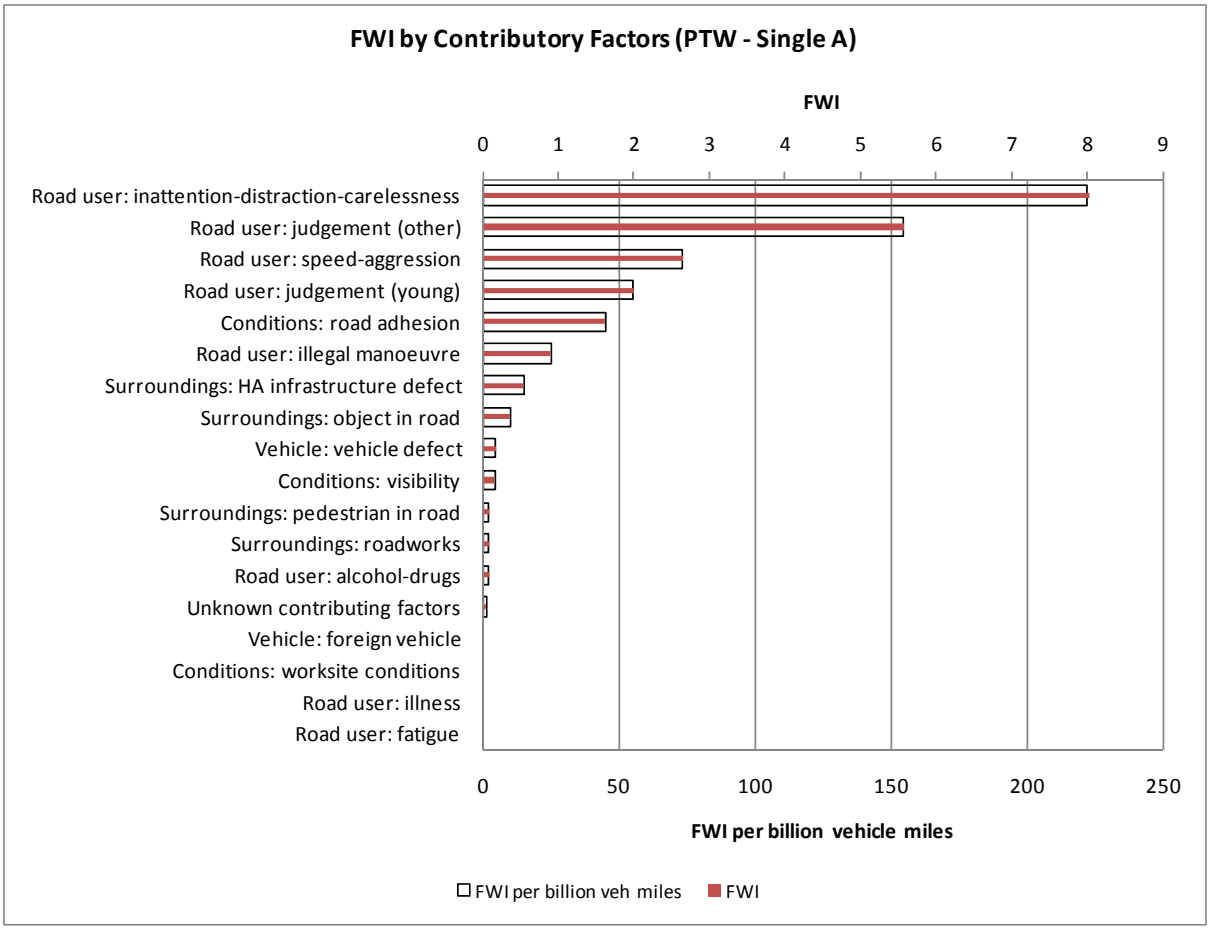
The results presented here are not comparable with results presented elsewhere. As such, they should be seen as stand-alone and used to provide additional information to inform safety decision making and strategy within the Agency.

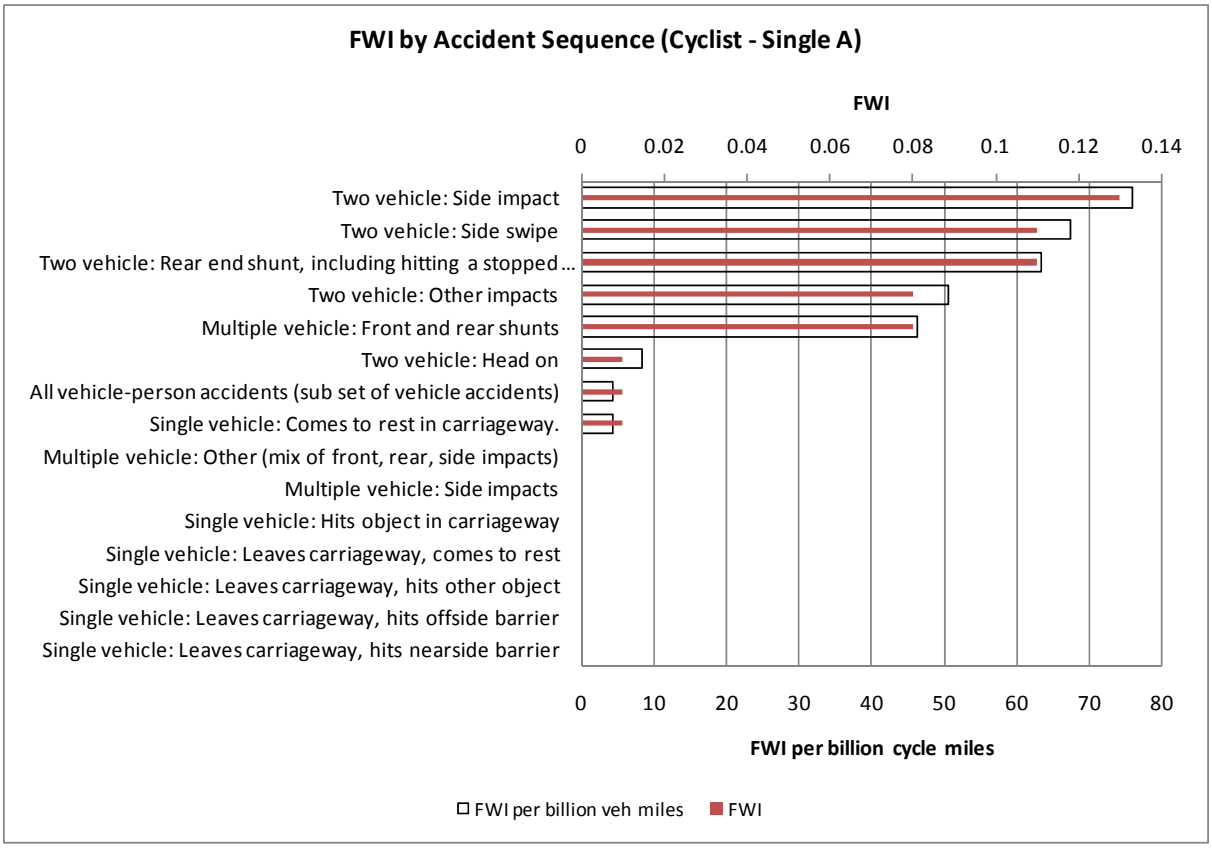
Appendix 1: Detailed Road User Risk Profiles

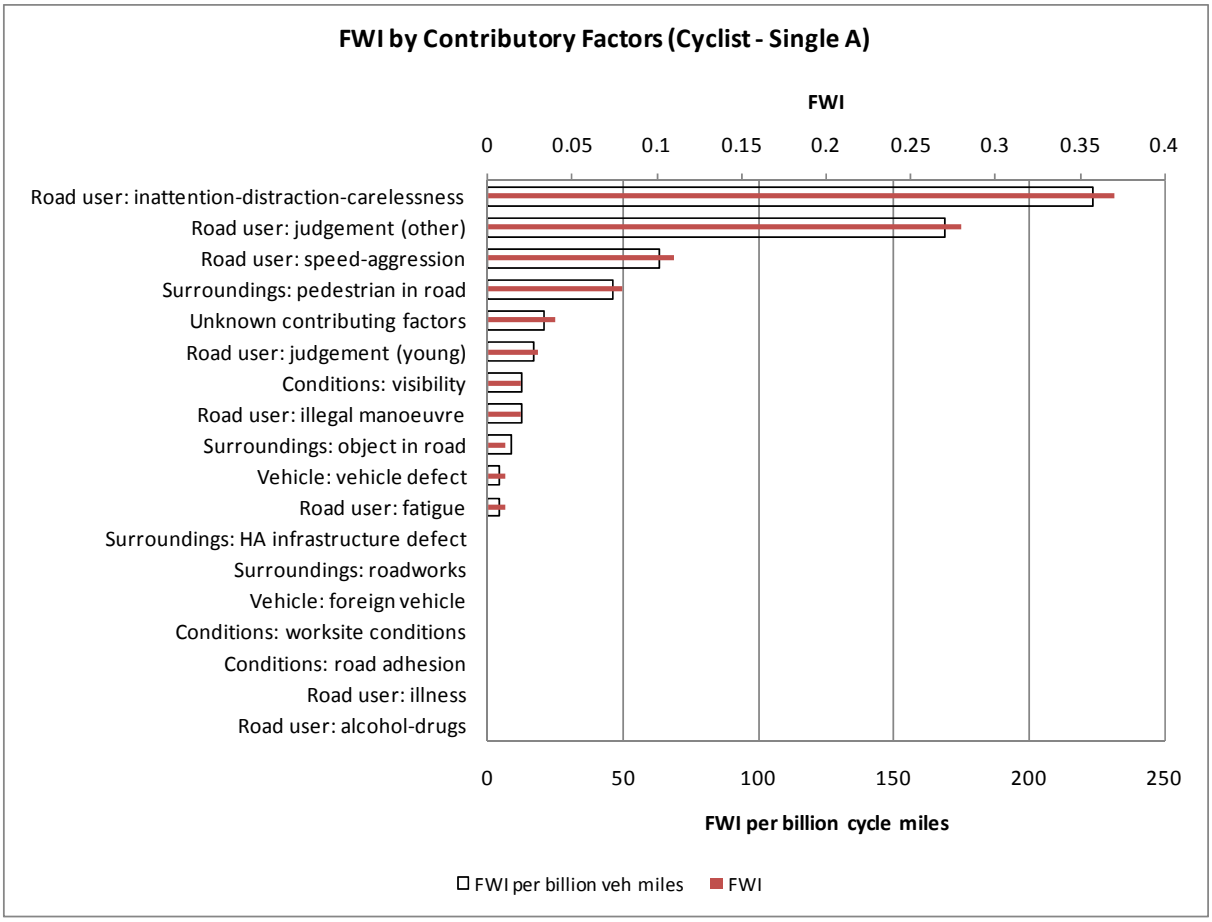


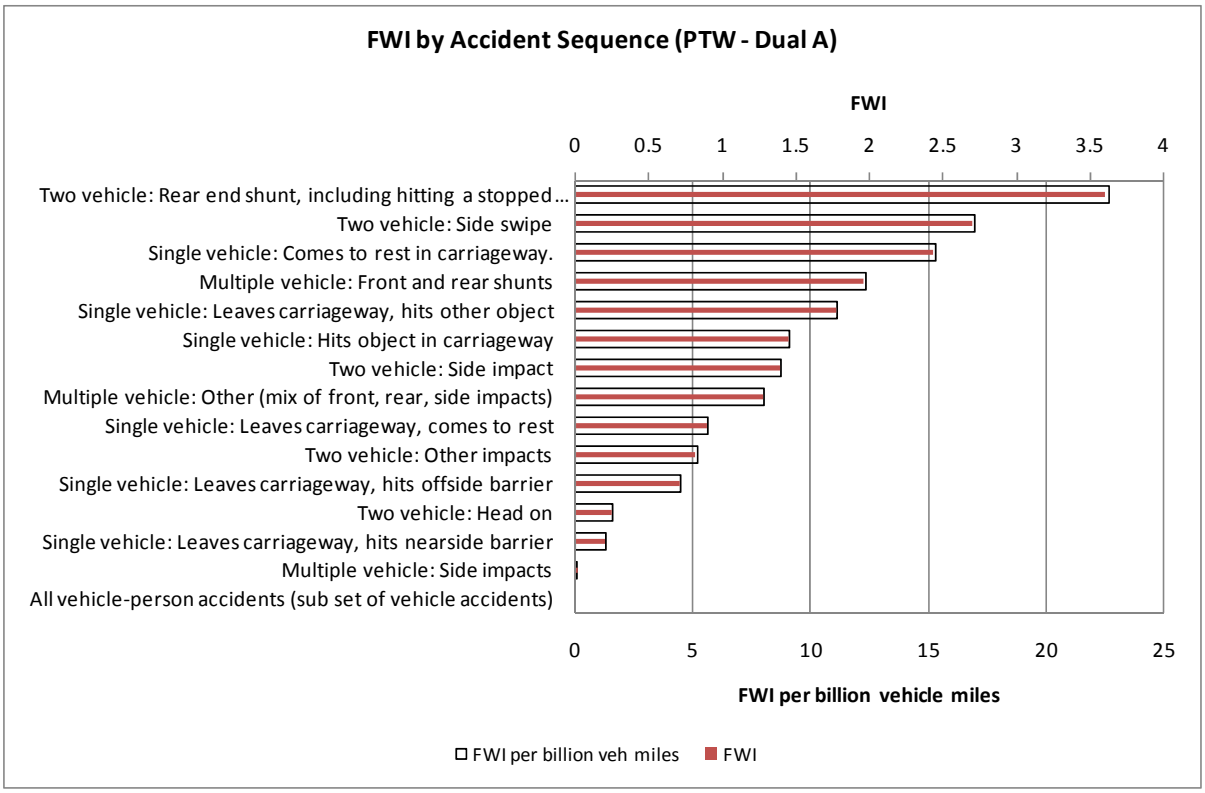

FWI by Contributory Factors(Cyclist - Dual A)
FWI
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0
Road user: inattention-distraction-carelessness
Road user: judgement (other)
Road user: judgement (young)
Road user: illegal manoeuvre
Road user: speed-aggression
Surroundings: HA infrastructure defect
Unknown contributing factors
Vehicle: foreign vehicle
Road user: fatigue
Conditions: road adhesion
Road user: illness
Conditions: visibility
Vehicle: vehicle defect
Surroundings: object in road
Road user: alcohol-drugs
Surroundings: roadworks
Surroundings: pedestrian in road
Conditions: worksite conditions
0 200 400 600 800 1000 1200 1400
FWI per billion cycle miles
FWI per billion veh miles
FWI

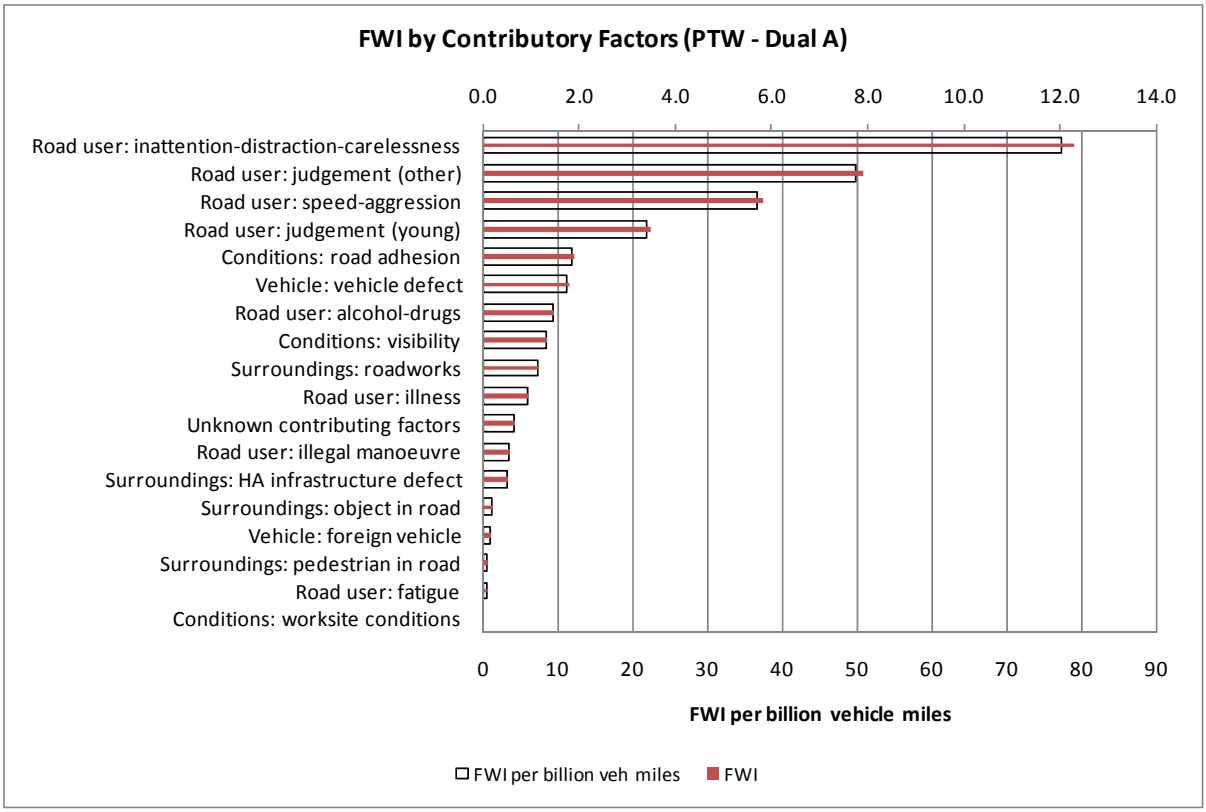

FWI by Accident Sequence (PTW - Single A)
FWI
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5
Two vehicle: Side impact
Multiple vehicle: Other (mix of front, rear, side impacts)
Two vehicle: Head on
Two vehicle: Rear end shunt, including hitting a stopped ...
Two vehicle: Side swipe
Single vehicle: Comes to rest in carriageway.
Multiple vehicle: Front and rear shunts
Single vehicle: Hits object in carriageway
Single vehicle: Leaves carriageway, comes to rest
Two vehicle: Other impacts
Single vehicle: Leaves carriageway, hits offside barrier
Multiple vehicle: Side impacts
All vehicle-person accidents (sub set of vehicle accidents)
Single vehicle: Leaves carriageway, hits other object
Single vehicle: Leaves carriageway, hits nearside barrier
0 20 40 60 80 100 120
FWI per billion vehicle miles
FWI per billion veh miles
FWI

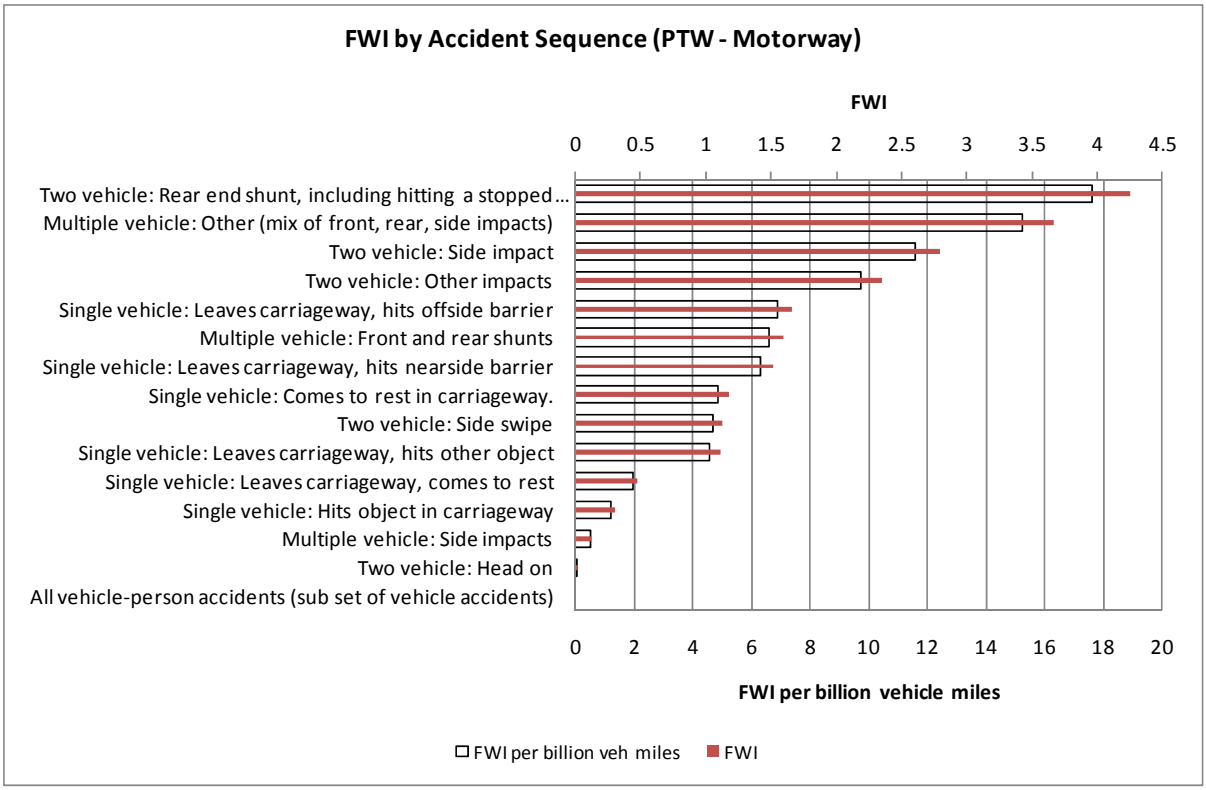

FWI by Contributory Factors (PTW - Single A)
FWI
0
1
2
3
4
5
6
7
8
9
Road user: inattention-distraction-carelessness
Road user: judgement (other)
Road user: speed-aggression
Road user: judgement (young)
Conditions: road adhesion
Road user: illegal manoeuvre
Surroundings: HA infrastructure defect
Surroundings: object in road
Vehicle: vehicle defect
Conditions: visibility
Surroundings: pedestrian in road
Surroundings: roadworks
Road user: alcohol-drugs
Unknown contributing factors
Vehicle: foreign vehicle
Conditions: worksite conditions
Road user: illness
Road user: fatigue
0
50
100
150
200
250
FWI per billion vehicle miles
FWI per billion veh miles
FWI

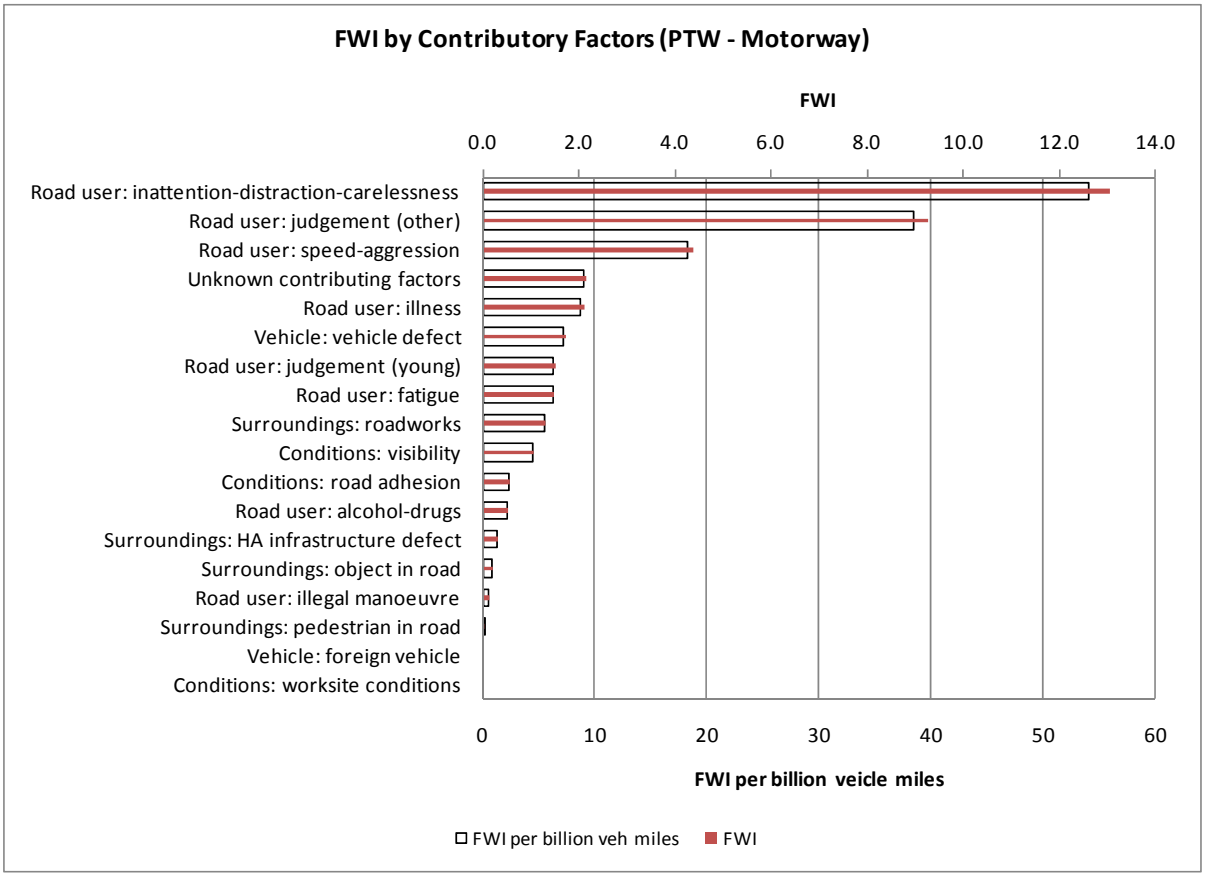

FWI by Accident Sequence (Cyclist - Single A)
FWI
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
Two vehicle: Side impact
Two vehicle: Side swipe
Two vehicle: Rear end shunt, including hitting a stopped ...
Two vehicle: Other impacts
Multiple vehicle: Front and rear shunts
Two vehicle: Head on
All vehicle-person accidents (sub set of vehicle accidents)
Single vehicle: Comes to rest in carriageway.
Multiple vehicle: Other (mix of front, rear, side impacts)
Multiple vehicle: Side impacts
Single vehicle: Hits object in carriageway
Single vehicle: Leaves carriageway, comes to rest
Single vehicle: Leaves carriageway, hits other object
Single vehicle: Leaves carriageway, hits offside barrier
Single vehicle: Leaves carriageway, hits nearside barrier
0
10
20
30
40
50
60
70
80
FWI per billion cycle miles
FWI per billion veh miles
FWI

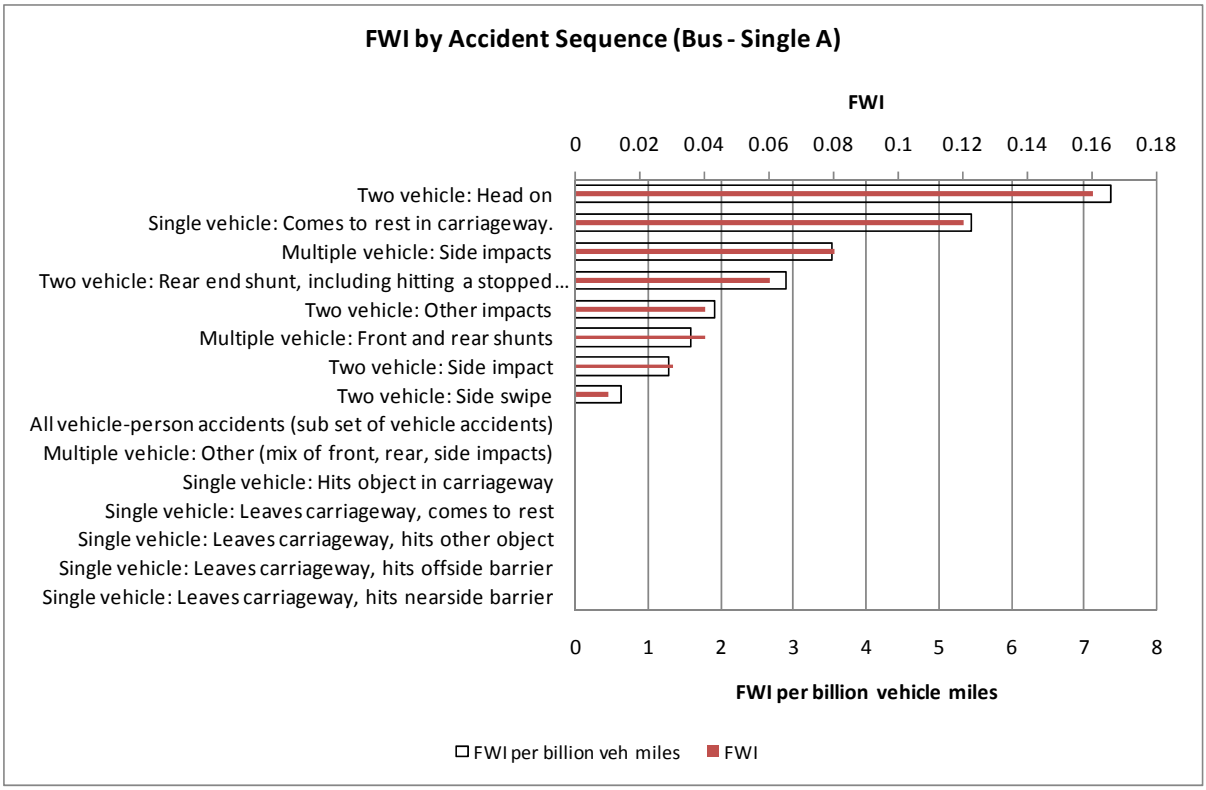

FWI by Contributory Factors (Cyclist - Single A)
FWI
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Road user: inattention-distraction-carelessness
Road user: judgement (other)
Road user: speed-aggression
Surroundings: pedestrian in road
Unknown contributing factors
Road user: judgement (young)
Conditions: visibility
Road user: illegal manoeuvre
Surroundings: object in road
Vehicle: vehicle defect
Road user: fatigue
Surroundings: HA infrastructure defect
Surroundings: roadworks
Vehicle: foreign vehicle
Conditions: worksite conditions
Conditions: road adhesion
Road user: illness
Road user: alcohol-drugs
0
50
100
150
200
250
FWI per billion cycle miles
FWI per billion veh miles
FWI

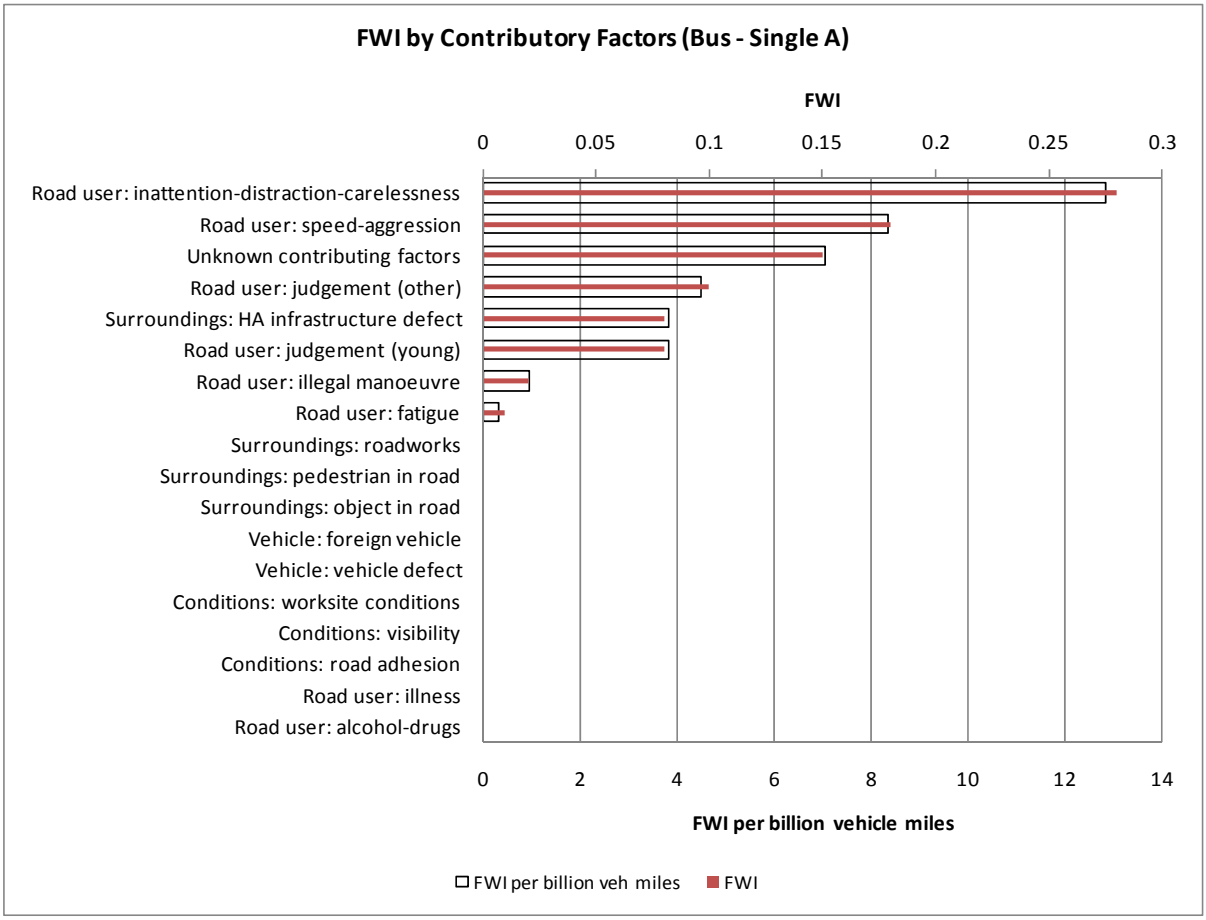

FWI by Accident Sequence (PTW - Dual A)
FWI
0
0.5
1
1.5
2
2.5
3
3.5
4
Two vehicle: Rear end shunt, including hitting a stopped ...
Two vehicle: Side swipe
Single vehicle: Comes to rest in carriageway.
Multiple vehicle: Front and rear shunts
Single vehicle: Leaves carriageway, hits other object
Single vehicle: Hits object in carriageway
Two vehicle: Side impact
Multiple vehicle: Other (mix of front, rear, side impacts)
Single vehicle: Leaves carriageway, comes to rest
Two vehicle: Other impacts
Single vehicle: Leaves carriageway, hits offside barrier
Two vehicle: Head on
Single vehicle: Leaves carriageway, hits nearside barrier
Multiple vehicle: Side impacts
All vehicle-person accidents (sub set of vehicle accidents)
0
5
10
15
20
25
FWI per billion vehicle miles
FWI per billion veh miles
FWI

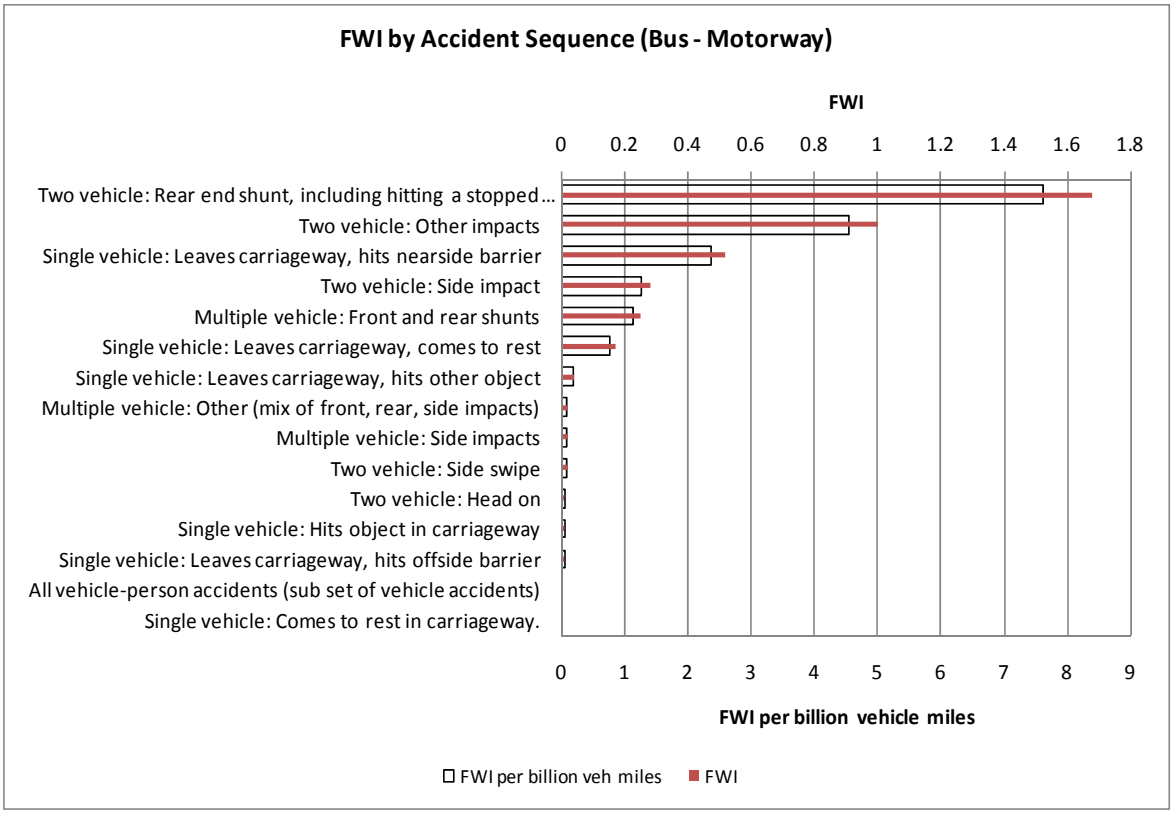

FWI by Contributory Factors (PTW - Dual A)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Road user: inattention-distraction-carelessness
Road user: judgement (other)
Road user: speed-aggression
Road user: judgement (young)
Conditions: road adhesion
Vehicle: vehicle defect
Road user: alcohol-drugs
Conditions: visibility
Surroundings: roadworks
Road user: illness
Unknown contributing factors
Road user: illegal manoeuvre
Surroundings: HA infrastructure defect
Surroundings: object in road
Vehicle: foreign vehicle
Surroundings: pedestrian in road
Road user: fatigue
Conditions: worksite conditions
0
10
20
30
40
50
60
70
80
90
FWI per billion vehicle miles
FWI per billion veh miles
FWI

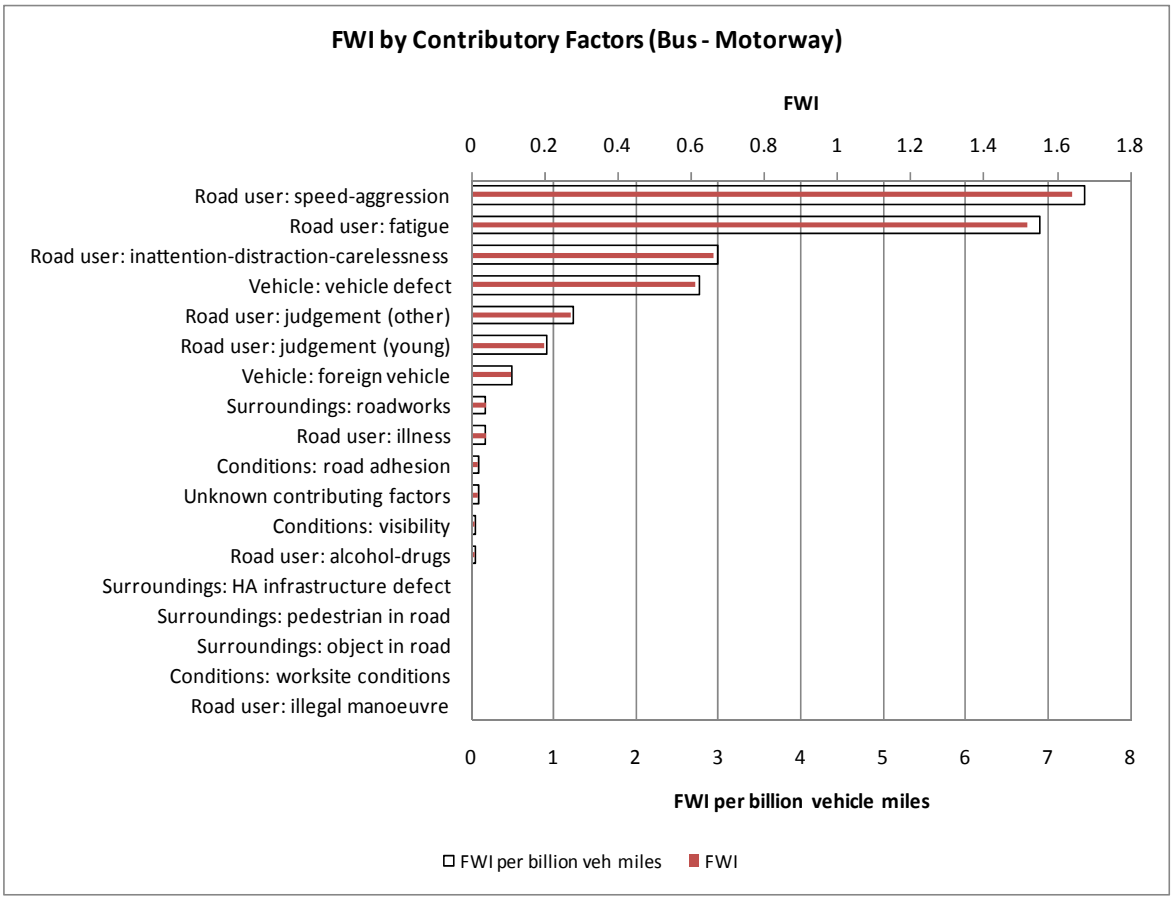

FWI by Accident Sequence (PTW - Motorway)
FWI
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Two vehicle: Rear end shunt, including hitting a stopped ...
Multiple vehicle: Other (mix of front, rear, side impacts)
Two vehicle: Side impact
Two vehicle: Other impacts
Single vehicle: Leaves carriageway, hits offside barrier
Multiple vehicle: Front and rear shunts
Single vehicle: Leaves carriageway, hits nearside barrier
Single vehicle: Comes to rest in carriageway.
Two vehicle: Side swipe
Single vehicle: Leaves carriageway, hits other object
Single vehicle: Leaves carriageway, comes to rest
Single vehicle: Hits object in carriageway
Multiple vehicle: Side impacts
Two vehicle: Head on
All vehicle-person accidents (sub set of vehicle accidents)
0
2
4
6
8
10
12
14
16
18
20
FWI per billion vehicle miles
FWI per billion veh miles
FWI

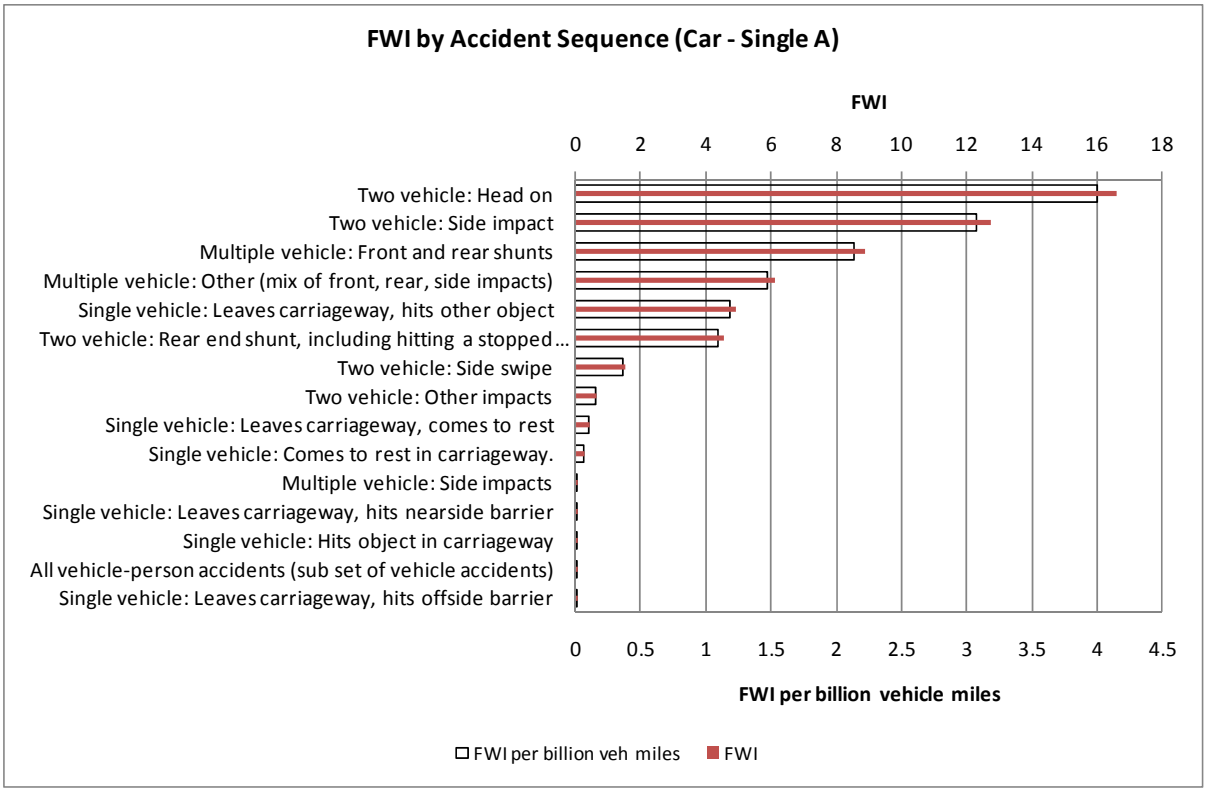

FWI by Contributory Factors (PTW - Motorway)
FWI
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Road user: inattention-distraction-carelessness
Road user: judgement (other)
Road user: speed-aggression
Unknown contributing factors
Road user: illness
Vehicle: vehicle defect
Road user: judgement (young)
Road user: fatigue
Surroundings: roadworks
Conditions: visibility
Conditions: road adhesion
Road user: alcohol-drugs
Surroundings: HA infrastructure defect
Surroundings: object in road
Road user: illegal manoeuvre
Surroundings: pedestrian in road
Vehicle: foreign vehicle
Conditions: worksite conditions
0
10
20
30
40
50
60
FWI per billion veicle miles
FWI per billion veh miles
FWI

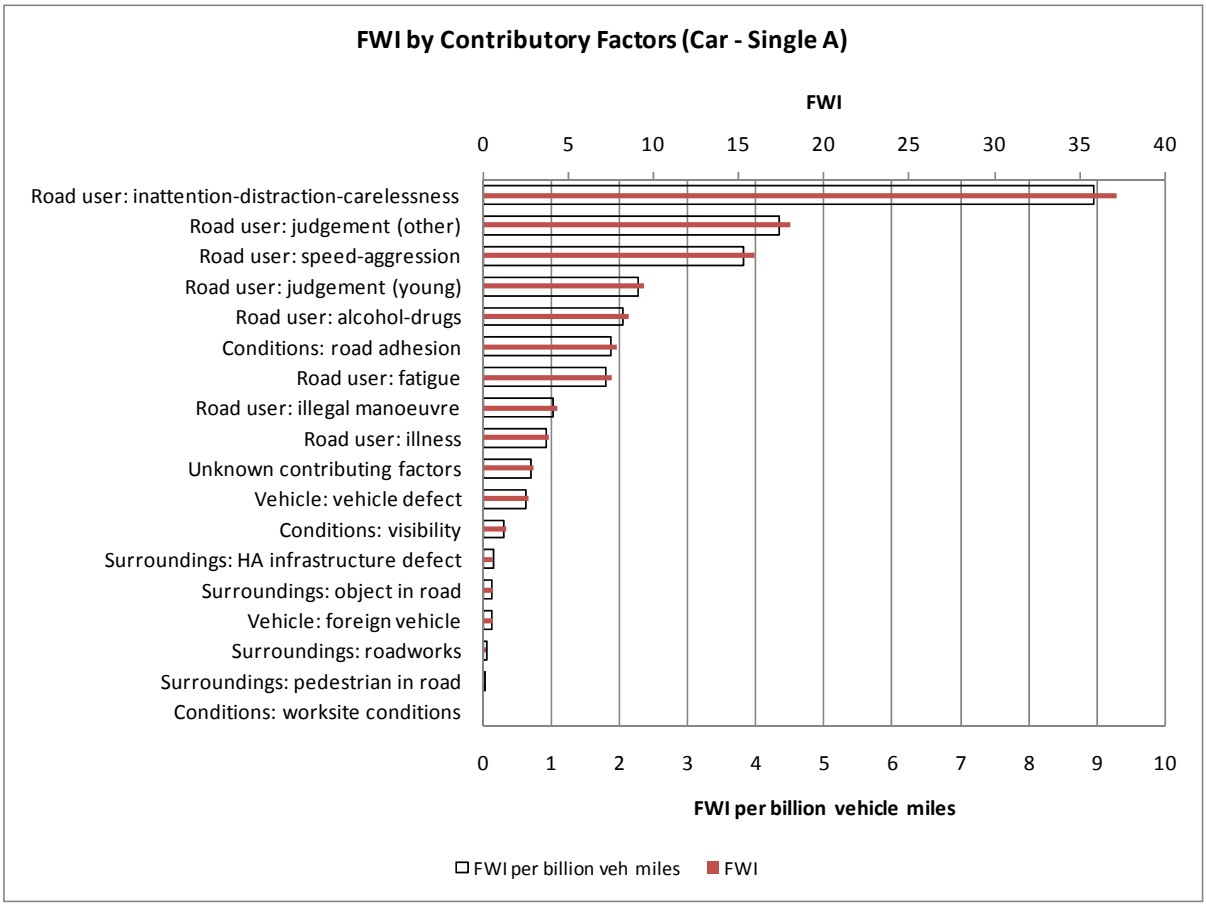

FWI by Accident Sequence (Bus - Single A)
FWI
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
Two vehicle: Head on
Single vehicle: Comes to rest in carriageway.
Multiple vehicle: Side impacts
Two vehicle: Rear end shunt, including hitting a stopped ...
Two vehicle: Other impacts
Multiple vehicle: Front and rear shunts
Two vehicle: Side impact
Two vehicle: Side swipe
All vehicle-person accidents (sub set of vehicle accidents)
Multiple vehicle: Other (mix of front, rear, side impacts)
Single vehicle: Hits object in carriageway
Single vehicle: Leaves carriageway, comes to rest
Single vehicle: Leaves carriageway, hits other object
Single vehicle: Leaves carriageway, hits offside barrier
Single vehicle: Leaves carriageway, hits nearside barrier
0
1
2
3
4
5
6
7
8
FWI per billion vehicle miles
FWI per billion veh miles
FWI

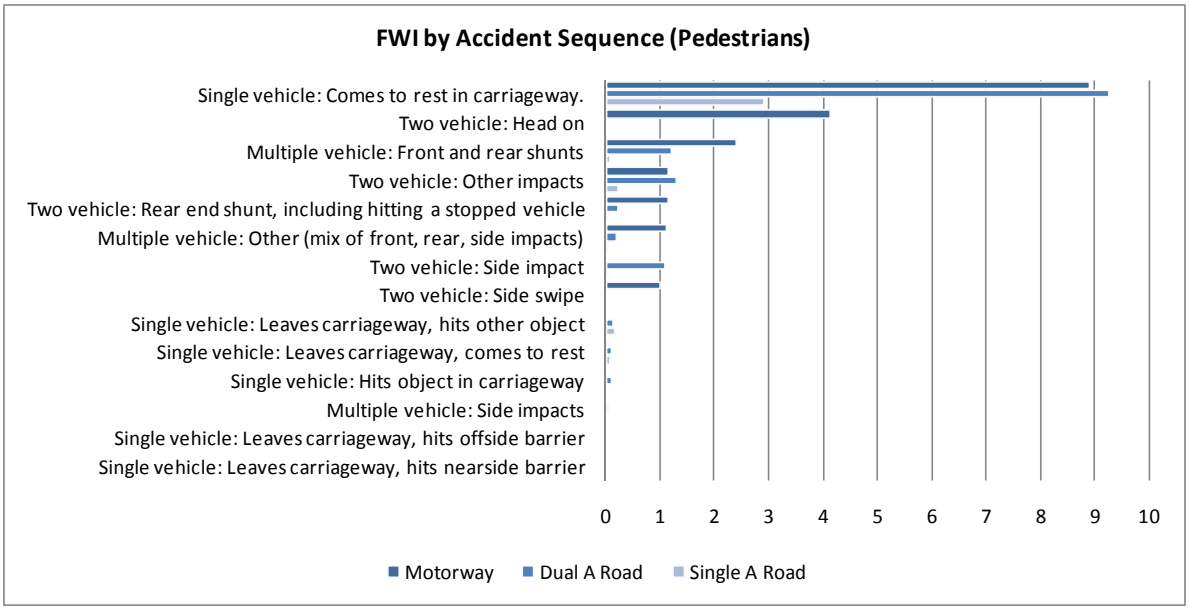

FWI by Contributory Factors (Bus - Single A)
FWI
0
0.05
0.1
0.15
0.2
0.25
0.3
Road user: inattention-distraction-carelessness
Road user: speed-aggression
Unknown contributing factors
Road user: judgement (other)
Surroundings: HA infrastructure defect
Road user: judgement (young)
Road user: illegal manoeuvre
Road user: fatigue
Surroundings: roadworks
Surroundings: pedestrian in road
Surroundings: object in road
Vehicle: foreign vehicle
Vehicle: vehicle defect
Conditions: worksite conditions
Conditions: visibility
Conditions: road adhesion
Road user: illness
Road user: alcohol-drugs
0
2
4
6
8
10
12
14
FWI per billion vehicle miles
FWI per billion veh miles
FWI

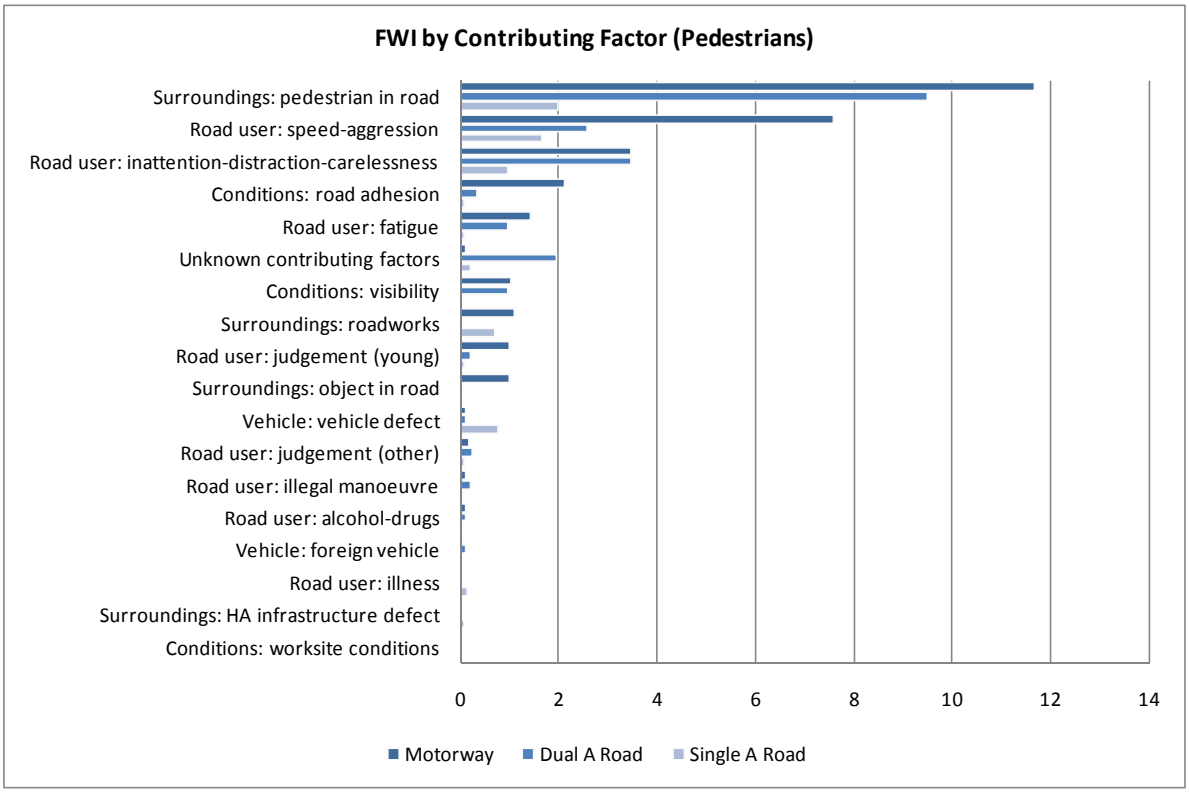

FWI by Accident Sequence (Bus - Motorway)
FWI
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Two vehicle: Rear end shunt, including hitting a stopped ...
Two vehicle: Other impacts
Single vehicle: Leaves carriageway, hits nearside barrier
Two vehicle: Side impact
Multiple vehicle: Front and rear shunts
Single vehicle: Leaves carriageway, comes to rest
Single vehicle: Leaves carriageway, hits other object
Multiple vehicle: Other (mix of front, rear, side impacts)
Multiple vehicle: Side impacts
Two vehicle: Side swipe
Two vehicle: Head on
Single vehicle: Hits object in carriageway
Single vehicle: Leaves carriageway, hits offside barrier
All vehicle-person accidents (sub set of vehicle accidents)
Single vehicle: Comes to rest in carriageway.
0
1
2
3
4
5
6
7
8
9
FWI per billion vehicle miles
FWI per billion veh miles
FWI


FWI by Contributory Factors (Bus - Motorway)
FWI
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Road user: speed-aggression
Road user: fatigue
Road user: inattention-distraction-carelessness
Vehicle: vehicle defect
Road user: judgement (other)
Road user: judgement (young)
Vehicle: foreign vehicle
Surroundings: roadworks
Road user: illness
Conditions: road adhesion
Unknown contributing factors
Conditions: visibility
Road user: alcohol-drugs
Surroundings: HA infrastructure defect
Surroundings: pedestrian in road
Surroundings: object in road
Conditions: worksite conditions
Road user: illegal manoeuvre
0
1
2
3
4
5
6
7
8
FWI per billion vehicle miles
FWI per billion veh miles
FWI


FWI by Accident Sequence (Car - Single A)
FWI
0 2 4 6 8 10 12 14 16 18
Two vehicle: Head on
Two vehicle: Side impact
Multiple vehicle: Front and rear shunts
Multiple vehicle: Other (mix of front, rear, side impacts)
Single vehicle: Leaves carriageway, hits other object
Two vehicle: Rear end shunt, including hitting a stopped ...
Two vehicle: Side swipe
Two vehicle: Other impacts
Single vehicle: Leaves carriageway, comes to rest
Single vehicle: Comes to rest in carriageway.
Multiple vehicle: Side impacts
Single vehicle: Leaves carriageway, hits nearside barrier
Single vehicle: Hits object in carriageway
All vehicle-person accidents (sub set of vehicle accidents)
Single vehicle: Leaves carriageway, hits offside barrier
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5
FWI per billion vehicle miles
FWI per billion veh miles
FWI


FWI by Contributory Factors (Car - Single A)
FWI
0 5 10 15 20 25 30 35 40
Road user: inattention-distraction-carelessness
Road user: judgement (other)
Road user: speed-aggression
Road user: judgement (young)
Road user: alcohol-drugs
Conditions: road adhesion
Road user: fatigue
Road user: illegal manoeuvre
Road user: illness
Unknown contributing factors
Vehicle: vehicle defect
Conditions: visibility
Surroundings: HA infrastructure defect
Surroundings: object in road
Vehicle: foreign vehicle
Surroundings: roadworks
Surroundings: pedestrian in road
Conditions: worksite conditions
0 1 2 3 4 5 6 7 8 9 10
FWI per billion vehicle miles
FWI per billion veh miles
FWI


FWI by Accident Sequence (Pedestrians)
Single vehicle: Comes to rest in carriageway.
Two vehicle: Head on
Multiple vehicle: Front and rear shunts
Two vehicle: Other impacts
Two vehicle: Rear end shunt, including hitting a stopped vehicle
Multiple vehicle: Other (mix of front, rear, side impacts)
Two vehicle: Side impact
Two vehicle: Side swipe
Single vehicle: Leaves carriageway, hits other object
Single vehicle: Leaves carriageway, comes to rest
Single vehicle: Hits object in carriageway
Multiple vehicle: Side impacts
Single vehicle: Leaves carriageway, hits offside barrier
Single vehicle: Leaves carriageway, hits nearside barrier
0 1 2 3 4 5 6 7 8 9 10
Motorway
Dual A Road
Single A Road


FWI by Contributing Factor (Pedestrians)
Surroundings: pedestrian in road
Road user: speed-aggression
Road user: inattention-distraction-carelessness
Conditions: road adhesion
Road user: fatigue
Unknown contributing factors
Conditions: visibility
Surroundings: roadworks
Road user: judgement (young)
Surroundings: object in road
Vehicle: vehicle defect
Road user: judgement (other)
Road user: illegal manoeuvre
Road user: alcohol-drugs
Vehicle: foreign vehicle
Road user: illness
Surroundings: HA infrastructure defect
Conditions: worksite conditions
0 2 4 6 8 10 12 14
Motorway
Dual A Road
Single A Road