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Case report

Fatalities in value chains—an attempt to classify road traffic crashes in accordance with the United Nations General Assembly resolution 74/299

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Abstract: Large corporations are today expected or obliged to report on accidental deaths and serious injuries to employed or contracted employed as a part of reporting on sustainability and workplace safety. Data about road crashes are part of such events and are therefore, but not separately, collected and presented. In Europe, 40% to 60% of all work-related accidents resulting in death has been reported to be road traffic accidents. In 2020, the Stockholm Declaration urged all corporations to report on their safety footprint including their entire value chain. The aims of the present study were to use a new definition of safety footprint and to quantify those killed as employed and at work, and those killed in a crash where the other part was at work, as so called third parties, to transports for duty with employed drivers. The Swedish Transport Administration (STA) in-depth database of fatal crashes was used, that covers all fatalities classified as road traffic related and consists of information from the police, medical journals, autopsy reports, accident analyses performed by STA, and witness statements. All fatalities excluding suicides or those caused by sickness occurring during year 2019 were investigated (n = 214). 11% (23/214) of the fatalities occurred when the killed person was at work and 16 while commuting. 37% of the fatal accidents occurred when the killed road user or the other part was at work. In total, almost half of the fatalities in the road transport system were related to work in some way when including both the fatally injured and their collision partners. A larger proportion of non-privately owned and procured vehicles was found for the vehicles of the collision partners compared to the vehicles of the fatally injured. In approximately one third of the fatal accidents a procurement of a transport service was involved. The Swedish Work Environment Authority (SWEA) identified 10 of the 23 fatalities at work investigated and none of these accidents was found to be investigated by the police as a crime related to the work environment. In conclusion, almost half of the fatalities in the road transport system in 2019 were related to work in some way, either the fatally injured or their collision partners were at work or while commuting. When including the third-party casualties, the problem becomes much bigger and more complex. In Sweden fatalities related to work are under reported, as the SWEA does not receive basic data. Efforts are needed to improve reporting of work-related road

fatalities. It was found that the police did not investigate road traffic fatalities as death at workplace. It is crucial that the police start to follow the intention of regulations linked to workplace safety. If not, the possibility to collect relevant data for organizations to report on their safety footprint is limited. It is complicated to collect, classify and analyse value chain fatal crash information, mainly due to that the police do not investigate fatal road crashes as possibly work-related events. It is recommended that organizations manage their own data collection if they wish to report on their safety footprint data.

Keywords: fatal accident, fatal collision, fatal crash, safety footprint, value chain, work-related

1 Introduction

Following the Stockholm Declaration on road safety (Stockholm_Declaration, 2020), the United Nations General Assembly in September 2020 decided on the resolution 74/299 (UN, 2020). In this resolution it is stated:

'*The General Assembly ... 19. Calls upon businesses and industries of all sizes and sectors to contribute to the attainment of the road safety-related Sustainable Development Goals, including by applying safe system principles to their entire value chain, as appropriate and in line with national laws*'.

The Stockholm Declaration also suggests that large corporations should report on the road safety and its performance within their entire value chains in their sustainability reporting. In essence this a pledge for collecting and presenting road crash statistics, in particular serious consequences, i.e. deaths and serious injuries. In popular terms this is called the safety footprint in congruence with the expression carbon footprint that relates to the CO_2 output within an organization's or jurisdiction's value chain.

Already today, large corporations are expected, and in some jurisdictions on a mandatory basis, to report on deaths and serious injuries to employed or contracted employed as a part of reporting on sustainability and workplace safety. Data about road crashes are part of such events and are therefore, but not separately, collected and presented. The challenge to collect and report on death and serious injuries to employed in road crashes is therefore limited. In Europe 40% to 60% of all work-related accidents resulting in death has been reported to be road traffic accidents (EUROGIP, 2009; ORSA, 2023). The figures are similar in Australia (Rowland et al., 2008). In Sweden the Swedish Work Environment Authority (SWEA) has the responsibility for reporting all fatalities during work within the road transport system. During 2019 they identified 10 traffic related fatal accidents (SWEA, 2019). To date only accidents during work are investigated, not those occurring during commuting to or home from work. The Swedish police authority has the responsibility to investigate fatal accidents that could be judged as a work environment crime. It is of interest to evaluate how many of the work-related fatal crashes that are identified and reported by SWEA and the Swedish police authority.

The pledge expressed in the UN declaration should though be understood to also include those killed in a crash with another part at work, so called third parties, as well as customers or clients to products or services related to a corporation. The expression 'entire value chain' would include all activities from sourcing raw materials to the end use of a consumer and it should not only include employee or contracted but instead include all victims in road crashes from the activities of the corporation related to road use (Trafikverket, 2019).

The expansion of earlier reporting to include the entire value chain, and not only limited to employed, offers a much larger challenge to any organization, in particular as there is no general definition of statistical data that can be used to classify road crashes in relation to value chains.

A further question is how far a value chain can reach in relation to road crashes. A value chain, including an organization's supply chain as well as its products, should include all activities involved to create the intended value. As road crashes in a supply chain would involve logistics, it would be the inbound and outbound transports along the supply chain. The question is how many tiers, or layers, that should be included.

With help of identified value chains in an organization it is possible to identify the safety footprint of their activities. There is a preliminary definition of traffic safety footprint stated by Federation Internationale de l'Automobile (FIA) Road Safety Index (FIA, 2022): '*The number of fatalities and seriously injured persons as a result of road crashes occurring within*

an organization's entire value chain. All casualties resulting from relevant and significant activities, services and products should be included in the calculation.'

The overall objective of this study was to classify road traffic fatalities from a value chain perspective.

More specifically, the aims were to:

- quantify those killed as employed and at work, and those killed as third parties to transports for duty with employed drivers;
- classify and quantify fatalities in value chains;
- compare the findings of this study with the official statistics of the Swedish Work Environment Authority;
- study to what extent the police investigate relevant crashes as deaths at the workplace.

2 Material och method

The Swedish Transport Administration (STA) in-depth database of fatal crashes was used. The database covers all fatalities classified as road traffic related and consists of information from the police, medical journals, autopsy reports, accident analyses performed by STA, and witness statements. All fatal accidents occurring during year 2019 were investigated (n = 272). Fatalities classified as suicide or caused by sickness were excluded (n = 58), so 214 fatalities remained to be analysed.

Based on the documents available, several parameters were noted regarding the accident circumstances, the killed victim and the other parts involved (see Table 1).

Information about the first purchaser of each vehicle was retrieved from the Swedish national road traffic vehicle registry (Transportstyrelsen, 2020).

The distribution of combinations of road users for the fatalities and their collision partners was studied. The next step was to identify the number and proportions of the fatal accidents that were related to work. The data were divided into categories based on whether each accident involved a road user that was traveling during leisure time, at work or while commuting and if their collision partner was traveling during leisure time, at work or while commuting. The total proportion of the fatalities that were related to work (either the fatally injured and/or the collision partner were at work or commuting) was also evaluated.

In the next step the numbers and proportions of the vehicles of both the killed and the collision partners that were procured by a private person or by a non-private person were analysed. Furthermore, the proportions of an involved procurement of a transport service for both the killed and their collision partners were analysed.

It was also checked how many of the fatal accidents included that were identified and investigated by SWEA and if there were signs that any of the accidents were investigated by the police as a work environmental crime.

3 Results

Most of the fatalities were males (78%). The average age was 51.5 years, see Appendix A. Road users in the age groups 20–29 and 30–39 were most common in total and for males separately. Fatally injured females were older than males. For females the age groups 70–79 and 80–89 were most common. In total there were seven fatally injured children (0–17 years age). And there was only one fatality in the age group 0–9 years (a five-year old male car occupant).

Among the fatally injured road users 59% were car occupants and 18% were pedestrians and bicyclists, see Appendix B. In total, 53% of the fatalities involving a collision partner were struck by passenger cars and 38% by HGVs. One third of the fatalities occurred in single accidents and one fourth in head on collisions. Fourteen per cent were pedestrians and bicyclists hit by motor vehicles.

3.1 Fatalities related to work

Twenty-three (11%) of the fatalities were killed while working and 7 % while commuting (see Table 3). Of those 23 fatal accidents, SWEA identified 10 traffic related fatal accidents occurring during 2019 (see Table 3). In six of those accidents the collision partners were also at work. In 62% (57% + 5%) of the crashes involving another vehicle, the road user was killed in a collision with another part at work or while commuting (64% including those that probably were working or commuting).

In total 37% of the fatalities occurred when the killed road user or the other part was at work (see Table 4). In 10% of the cases the killed road user or the other part was commuting. This means that 47% of the deaths were classified as work related, in which the killed road user or the other part either was working or commuting.

Table 1 Parameters noted for the analysis

Area	Parameter
General	Type of accident
	Road authority
	Speed limit
	Status of road maintenance prior to the crash
	If the fatal accident was investigated by the Swedish Work Environment Authority
	If there were indications that the police made an investigation of work environmental crime
Fatally injured road user	Sex and age of the victim
	Type of road user
	If the journey was during leisure time, at work or while commuting
	Vehicle manufacturer, make and model
	Owner at the time of the crash and first purchaser of the vehicle
	Procurement of transport service
Collision partner	Type of road user
	If the journey was during leisure time, at work or while commuting
	Vehicle manufacturer, make and model
	Owner at the time of the crash and first purchaser of the vehicle
	Procurement of transport service

Table 2 Distribution of road user for the fatalities and for the other parts involved in a crash

	In collision with…								
Fatally injured road user	Passenger car	HGV	Bus or coach	Motorcycle	Pedestrian or bicyclist	Other road users	No other vehicle involved	Total	
Car occupants	35	40	4			4	44	127	59%
HGV occupants	1						3	4	2%
Motorcyclists	9	3				1	14	27	13%
Pedestrians	16	6			1	1		24	11%
Bicyclist	5	2			2		6	15	7%
Moped riders	2						3	5	2%
Other road users	4						8	12	6%
Total	72	51	4	0	3	6	78	214	
	53%	38%	3%	0%	2%	4%	-		100%

3.2 Results related to value chains addressing the fatal accidents

The Swedish Transport Administration was the responsible road authority in 76% of the fatal accidents. In 16% various municipalities were responsible road holders. In 7% it was a privately owned road. In two cases the road authority was unknown.

Twenty to twenty-four per cent of the vehicles the fatally injured were using, were first-hand bought by non-private purchasers, and between 56% and 62% were bought by private persons (see Table 5). Regarding the collision partner 69% were bought by non-private purchasers, and only 22% by private persons (see Table 5).

Regarding vehicle ownership, 84% of the vehicles the fatally injured were using were owned by private persons, while the corresponding proportion for their collision partners was 38% (see Table 6). The proportion of non-privately owned vehicles was much higher among the collision partners, 62% vs. 15%.

Table 3 Numbers and distribution of work and leisure time related fatal accident for the fatalities and their collision partners. The numbers of fatal accidents during work included in the investigations by the Swedish Work Environment Authority (SWEA) are noted in parenthesis.

	Collision partner during leisure time, at work or while commuting								
Fatality during leisure time, at work or while commuting	During leisure time	Probably during leisure time	At work	Probably at work	While commuting	Probably while commuting	Unknown	Not relevant	Total
During leisure time	35	5	51	1	6		3	69	170 (79%)
At work	3 (1)		13 (6)	1			1	5 (3)	23 (11%)
While commuting	1		9		1			5	16 (7%)
Unknown			4			1			5 (2%)
TOTAL	39 (29%)	5 (4%)	77 (57%)	2 (1%)	7 (5%)	1 (1%)	4 (3%)	79* (-)	214

*The figure 79 represent 78 crashes with no other vehicle involved and one bicyclist to pedestrian accident.

Table 5 Vehicle procurement for the vehicles of the fatally injured and their collision partners

Vehicle procurement	Fatality		Other part	
	n	proportion	n	proportion
Non-private	36	20%	92	69%
Probably non-private	8	4%	0	0%
Privat person	101	56%	29	22%
Probably privat person	10	6%	1	1%
Unknown	25	14%	12	9%
Not applicable/unregistered vehicles (bicyclists, pedestrians, one wheelchair and one racing car)	34	-		
TOTAL	214	100%	134	100%

Table 6 Vehicle owner of the vehicles of the fatally injured and their collision partners

Vehicle owner	Fatality		Other part	
	n	proportion	n	proportion
Private person	151	84%	51	38%
Probably private person	1	0.5%		
Non-private	27	15%	83	62%
Unknown	1	.5%		
Not applicable/unregistered vehicles (bicyclists, pedestrians, one wheelchair and one racing car)	34	-		
TOTAL	214	100%	134	100%

Table 4 Number and proportion of the fatally injured and their other parts related to work

Work related fatal accidents	n	Proportion
Killed at work	23	11%
Killed while commuting	16	7%
Killed by other part at work	55	26%
Killed by other part commuting	6	3%
Non-work-related fatality	109	51%
Unknown*	5	2%
TOTAL	214	100**%**

*The group unknown contains those regarded as 'probably' in Table 3 and not possible to categorize in the other groups.

Furthermore, for 52% of the 23 fatally injured who were at work, a procurement of a transport service was involved. The corresponding proportion for the 79 collision partners who were at work was 84% (see Table 7).

It was found that 59% (126 of 214) of the fatal accidents were in the so-called sphere of influence an organization, meaning that they have the possibility to influence the outcome with specific policies for vehicle procurement, vehicle ownership, or procurement of transport services.

None of the investigated accidents occurring during 2019 was found to be investigated by the police as a crime related to the work environment.

4 Discussion

A work-related journey is both a road safety and occupational safety issue and thereby a shared responsibility. In the 'Global plan—decade of action for road safety 2021–2030 it is highlighted that the private sector has a tremendous influence on the road transport system (WHO, 2020). To improve work-related road safety, it requires a systematic approach and that the private sector integrate leadership and management policies to their entire value chain. Reporting safety performance will be crucial to drive it in the right direction.

Road traffic crashes can be classified in many ways. On an aggregated level, using jurisdictions is the dominating way to classify, analyse and monitor progress. A good example is the Global Plan and the associated global reports on road safety (WHO, 2020), where each country has collected and reported its safety

Table 7 Procurement of transport service for the fatalities and the collision partners who were at work

Procurement of transport service	Fatality		Other part	
	n	proportion	n	proportion
Yes	12	52%	66	84%
No	9	39%	8	45%
Unknown	2	9%	2	2%
TOTAL	23	100%	79	100%

footprint and some safety performance factors. Deaths at the workplace are also published country by country, but for many years also by large organizations in their sustainability reports. Road traffic crashes as origins of workplace deaths are often the dominating cause at work but are normally not separated in work accident statistics (Newnam et al., 2022; Newnam & Watson, 2011)). With the introduction and expectation of sustainability reports including traffic safety and safety footprints of large organizations (Trafikverket, 2019; Stockholm_Declaration, 2020) new challenges to collect and to analyse safety related data will arise. Some of these challenges have been found in this study.

First of all, even when using in depth crash data, the collection of relevant information to classify a crash according to value chain analysis is often lacking. Even basic information about travel type and travel reason is not a mandatory piece of information that the police record, and as a consequence it is often a missed piece of information in in-depth investigations. The fact that none of the fatal crashes used in this study were investigated by the police as a workplace fatality is therefore not only serious but also leads to a very limited possibility to conduct studies of fatal crashes related to work. Furthermore, the occupational health and safety authority does not receive basic data, leading to serious underreporting. It seems therefore crucial that prosecutors and the police start to follow the intention of regulations linked to workplace safety and investigate relevant crashes at work related. If not, the possibility to collect relevant data for organizations of different kinds is very limited, if not impossible. Furthermore, the importance of road use fatalities at work is underestimated. In this study, only 40 % of the fatalities were reported by the Swedish Work Environment Authority, and even this figure might be overestimated as some cases were not possible to classify. The findings clearly demonstrate the challenge to collect and report on work-related death in road crashes. In Sweden each employer is responsible to report fatal accidents of their employees at work. It is obvious that in many cases fatal accidents in the road transport systems are not reported.

ETSC (2017) studied the phenomena of underreporting across the EU and found similar problems of how data are collected across all EU members states. They estimated that 40% of all road crashes are work related. In the current study, 45% of the fatalities studied were work related, including commuting to work. The results are also in line with another previous study (DaCoTA, 2012). Furthermore, ETSC (2017) pointed at the role of the police to collect data and found that less than 50% of the EU member states even had a data point for purpose of travel associated with the crash. They recommended that the EU should direct all member states to introduce such information for police reported data.

The lack of systematic collection of relevant data reveals an even more serious problem with work related fatal crashes. The problem itself, that road crashes are often work related and should be exposed to the rules and regulations associated with the workplace, continue to be unnoticed by the community, including the legal system. As a consequence, incorrect laws are applied for many fatal road crashes, where individuals are prosecuted for causing crashes and deaths while in reality such events should have been exposed to other laws. But as none of the fatal work-related crashes were investigated in this study, prosecutors never brought any of the employers to court. It can therefore be hypothesized that the legal system is seriously biased towards a road user-oriented approach while at least in Sweden, the safe system principles where the professional users of the road transport system together with the infrastructure and vehicle provides are ultimately responsible for its safety is not applied.

One of the consequences is that the employers are probably not applying the systematic approach to the use of the road transport system as they would with other working locations. In reality, the norm of the

legal system and in particular the police, to find the guilty road user of a fatal crash leave the employer outside the legal process. The preventative obligations that is the main substance of occupational health and safety regulation is lost. While this is a finding and conclusion outside the scope of this study, it is nevertheless an important issue that can explain why organizations seldom deal with traffic safety in value chains. Australia might be the best example of legislation going beyond common occupational health and safety regulation, stipulating that there is a 'chain of responsibility' that must be mapped and used by all parties involved in a transport (Rowland et al., 2008). The legislation also urges that the transport activities by an organization does to pose a risk to the society. These expressions are close to the content of 'the entire supply chain' as used in sustainability definitions (FIA, 2022).

Third-party victims, those killed in crashes where at least one of the drivers was working, are even more complicated to identify. In some cases, where a typical commercial vehicle was involved, it is obvious that the crash involved a third-party victim to work. But there are other crashes where this was not obvious and sometimes impossible to judge. The police should be more active in searching for this kind of information to make it possible to estimate the number of killed third party victims. In the present study, with some cases not possible to identify, the number of third-party victims were three times more common than those employed or contracted killed. To what extent this result can be generalized to other jurisdictions is not possible to judge, but ETSC (2020) found that the relation between driver deaths and partner deaths (deaths in other vehicles, unprotected road users etc.) for heavy goods vehicles in the EU was 1:10 while for light commercial vehicles the relation was 1:3. The finding from the present study does therefore not seem surprising.

With the extension to the entire value chain, we also include products and services. In doing so, all crashes occur within someone's value chain. It is always at least two, as road traffic crashes must take place on a road with at least one vehicle moving. Therefore, both an infrastructure provider and a vehicle manufacturer must be involved and include any crash in their value chain. In this study, there were more stakeholders identified. The one who bought the vehicle first-hand is an interesting agent, often being an organization. As the choice of vehicle and its specifications have a large impact on the safety level, decisions taken by organizations play a vital role. Two thirds of the partner vehicles in the crashes of this study were owned or bought initially by an organization. Actions aimed to influence vehicle procurement and ownership within companies, such as procurement policies, see for example (Ydenius & Kullgren, 2019), are thereby important. It is also important to influence procurement of transport services. Regarding the collision partners at work the proportion of accident involving a procurement of transport service was 84% and among the fatally injured at work the corresponding figure was 52%.

With almost half of the total number of fatalities in Sweden 2019 related to work, the question of what employers and other stakeholders in a value chain can do to prevent fatalities in road crashes is apparent. The vehicles play an important role, but also the way transports are managed and carried out are important. Speed, the use of personal gear, fitness to drive and even route planning are all system components that contribute to safe traffic (Stigson et al., 2008). These components are all possible to influence by an organization responsible for generating transport. Transport management, policies, monitoring and technical support are examples of ways to control and improve safety (FIA, 2022).

In summary, it is complicated to collect, classify and analyse value chain data in fatal crashes, mainly because the police do not investigate fatal road crashes as possible work-related events. It is recommended that organizations manage their own data collection if they wish to report on their safety footprint data.

5 Limitations

Value chains related to the road authority, such as road maintenance and road infrastructure were not included in this study. The data available relating to the road authority were not of necessary quality to include it in the analysis. Furthermore, an analysis of the influence of the road environment was not included.

Furthermore, it should be stressed that STA's in-depth studies are not originally designed to investigate value chains in fatal crashes. Several parameters such as whether a transport was procured or not, may not always be explicitly coded in the database. In these cases, such information was rather coded by the research team using other data included in the in-depth studies, for instance police pictures, witness statements

and alike. This implies that the level of accuracy of such coding may depend on the data provided by the police to STA crash investigators.

6 Conclusion

11% (23/214) of the fatalities occurred when the killed person was at work. However, almost half of the fatalities in the road transport system were related to work in some way, either the fatally injured or their collision partners were at work or while commuting. When including the third-party casualties, the problem becomes much bigger and more complex.

In Sweden fatalities occurring during work in the road transport system are underreported, as the Swedish work environment authority does not receive basic data. Further efforts are needed to improve reporting of work-related road fatalities.

It was found that the police did not investigate road traffic fatalities as death at workplace. It is crucial that the police start to follow the intention of regulations linked to workplace safety. If not, the possibility to collect relevant data for organizations of different kind is limited.

It is complicated to collect, classify and to analyse value chain fatal crash information, mainly due to that the police do not investigate fatal road crashes as possible work-related events. It is recommended that organizations manage their own data collection if they wish to report on their safety footprint data.

CRediT contribution statement

Anders Kullgren: Conceptualization, Methodology, Writing—original draft, Writing—review & editing. **Helena Stigson:** Conceptualization, Methodology, Writing—original draft, Writing—review & editing. **Matteo Rizzi:** Writing—review & editing. **Claes Tingvall:** Conceptualization, Methodology, Writing—original draft, Writing—review & editing.

Declaration of competing interests

The authors have no competing interests.

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About the authors

Anders Kullgren has been working as a traffic safety researcher at Folksam since 1988 and since 1995 as head of the research department. Since 2011 he also has a position as an adjunct professor at Chalmers University of Technology. The research is primarily based on real-world crash data, including crashworthiness analyses of cars and effectiveness studies of various safety technologies.

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A Appendix. Distribution of fatalities regarding gender and age groups

Age group	Female	Male	Total
0–9	-	1	1
10–17	1	5	6
18–29	7	34	41
30–39	7	26	33
40–49	4	20	24
50–59	4	22	26
60–69	3	20	23
70–79	12	15	27
80–100	10	23	33
TOTAL	48	166	214

B Appendix. Distribution of accident types for the fatalities

Accident type	n	Proportion
Single	70	33 %
Head on	55	26 %
Crossing traffic	31	14 %
Pedestrians and bicyclist hit by motor vehicles	25	12 %
Rear end	14	6 %
Large animal	8	4 %
Turn off	5	2 %
Unprotected hits unprotected	3	1 %
Overrun by own car	2	0,9 %
Backing	1	0,5 %
TOTAL	214	100 **%**