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Safety Database Activity Report 2007

- Significant Accidents 2006

- Benchmarking and six-year Trends

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Foreword

This document provides UIC Infrastructure Forum members with information on the contents of the Safety Data Base (SDB). It is based on significant railway accidents in 2006(1) collected by the UIC. Railway safety experts will find an annual summary of railway accidents in Europe based on individual UIC member companies' results, as well as international benchmarking and trend analysis.

The analysis methodology, based on common safety indicators, enables targets to be identified and, by extension, indicates ways of maintaining and improving the overall level of safety across the UIC network. The methodology enables companies and accidents to be identified thereby indicating where actions should be concentrated. Safety experts should note that the proposed analysis methodology can easily be reproduced at national level by substituting UIC data for that of regions/departments or routes/corridors(2).

Readers used to accessing the SDB directly are advised that they should be aware that records in a live database are constantly updated and consequently the results can change slightly over time. The 2006 results presented here reflect the SDB updated as of 30 September 2007.

Section I of the document follows on from the executive summary; it gives a short explanation of the criteria adopted to enable analysis of railway companies' performances and presents global statistics. There are event types, causes, location of accidents, injured parties etc. represented collectively, and displayed in matrix format. The relationship between occurrences in accidents enables attention to be concentrated on "specific focus areas".

Section II shows indicators values and their normal distribution curves (S Curves(3)). The indicators reported are those introduced by the Safety Directive. They allow the railway companies in the sample to benchmark and enable other railway companies to evaluate their position in relation to the others examined.

Section III describes the analysis methodology; identifies both target values and railway companies where actions need to be concentrated to improve rail safety.

The Appendix gives the key accident definitions currently in force in Europe indicating their correlations.

UIC recommends that all members supply complete unambiguous declaration of the accidents and critical events to the database, as it is in their best interest as it will enhance the quality and accuracy of the UIC analysis. Moreover, the use of the SDB as a common source of information to generate UIC International Railway Statistics table A91, EUROSTAT tables H1 to H4 and to calculate a large part of the values of the CSI as required by the Safety Directive Annex I, would avoid discrepancies between the different publications produced in Europe.

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(1) In accordance with Commission Regulation (EC) N° 1192/2003 and notes from the European Office of Statistics (EUROSTAT). (See Appendix - Definitions on accidents currently in force in Europe)

(2) In this case it will be necessary to enlarge the data collection from significant accidents to incidents.

(3) S curves represent the distribution of the probability of obtaining at least the considered indicator value in the sample examined.

Executive Summary of significant accidents in 2006

In 2006 the Safety database collected accidents and critical events from the main railway companies in 20 European countries including Norway and Switzerland, plus EUROTUNNEL.

The total number of significant accidents reported in 2006 was 2372. 45 passenger and 34 staff fatalities were recorded, out of a total of 2430 victims (seriously injured + killed) for a total of around 4000 million km of train movements on the network.

The number of "serious accidents" (as defined by Directive 2004/49/EC) in the data collected is 210. For these accidents Member States shall ensure that an investigation is carried out by the investigating body and make the results of the investigations public (see Appendix: Accident definitions currently in force in Europe).

The accident data indicates a decrease in the number of passenger victims of accidents and confirms a higher number of third-party victims rather than passengers or staff. In the year 2006, the rate of victims per significant accident decreased to 1.02 (it was 1.22 in 2005). 2 passengers, 1 staff member and 51 third parties died per 100 significant accidents compared to 3.6 passengers, 2 staff members and 52 third parties registered in the previous year (see Charts 1 & 3).

The total rate of victims is 0.61 persons per million train kilometres. The value decreases to 0.01 persons per million train kilometres for passenger fatalities (see table 2).

Most of the accidents are individual accidents: 66.7% against 30.3% collective accidents. The breakdown of accidents by type is reported in table 1 below.

Accidents to persons caused by rolling stock in motion, with the exception of suicides, represent 58.7% and level crossing (LC) accidents 27.9% of total accidents. In 2006 these 2 types of accidents represented 35 of a total of 44 passenger fatalities, 23 of a total of 34 staff fatalities and 1168 of a total of 1206 third-party fatalities.

Collisions between trains (1.5%) and derailments (4.7%) make up 6.2% of the total. (They constituted 7% in 2005). The Safety Performance Group is developing a detailed analysis of derailments based on accidents registered in the SDB.

- Most victims in collisions between trains were staff (20 of a total of 41 victims of collisions between trains). 3 passengers died as consequence of this type of accident.
- The most serious derailment was on a switch where 7 passengers died and 14 were seriously injured.

Train collisions with an obstacle other than at level crossings represent 4.2% of the total of accidents.

- No passengers died as a consequence of this type of accident. This accident type resulted in 4 railway staff fatalities and 11 cases of serious injury to staff.

The remaining 3% are other types of accidents: electrocutions and fires in rolling stock. There were no passenger or staff deaths as a result of fires or electrocutions.

Regrettably, EUROTUNNEL recorded its first significant accident in 2006 since the creation of the SDB. At 1.30 p.m. on 21 August 2006, emergency procedures for fire alarms were implemented and passengers and staff were evacuated from the tunnel without human injury or fatalities.

Table 1 Breakdown and rate of types of significant accidents in 2006 according to different definitions.

Simplest type of accident definitions	Types of accidents as defined in UIC – SDB		Additional information from UIC -SDB		Types of accidents as defined in Safety Directive	
Collective accidents **30,3%**	**4,7%**	Derailments of trains	**4,7%**	Derailments of trains	**4,7%**	Derailments of trains
	1,5%	Train collision with another train	**1,5%**	Train collision with another train	**5,7%**	Collisions of trains, including collisions with obstacles within the clearance gauge
	24,1%	Train collision with an obstacle	**4,2%**	Train collision with an obstacle not at level crossing		
			19,9%	Train collision with an obstacle at level crossing	**27,9%**	Level-crossing accidents, including accidents involving pedestrians at level-crossings,
Individual accidents **66,7%**	**58,6%**	Individual hit by a train	**8,0%**	Individual hit by a train at level crossing		
			50,6%	Individual hit by a train not at level crossing	**58,7%**	Accidents to persons caused by rolling stock in motion, with the exception of suicides.
	8,1%	Individual falling from a train	**8,1%**	Individual falling from a train		
Other types of accidents **3,0%**	**1,6%**	Fire in rolling stock	**1,6%**	Fire in rolling stock	**1,6%**	Fire in rolling stock
	1,4%	Electrocution by overhead line or third rail	**1,4%**	Electrocution by overhead line or third rail	**1,4%**	Other types of accidents
100%	100%		100%		100%	

First level of cause analysis identifies that of a total of 2430 victims recorded in 2006, the actions of third parties resulted in 1968 victims and human factors were the cause of 425 victims. There were also accidents attributable to the Rolling Stock (7 victims), Operation and Traffic Management (9 victims), Infrastructure (3 victims) and Control-Command & Signalling (1 victim) sub-systems. Finally, climatic and environmental conditions caused 7 victims and the causes of accidents involving a further 10 victims are still not identified.

Cumulative data from a subset of 10 among the main railway companies from west Europe which were chosen on account of their homogeneous declaration of accidents in the years from 2001 to 2006, shows the trends of accidents and fatalities. The values are reported in table 2 below.

The accident data presented by these ten railways is based on a more consistent classification of accidents and is submitted more regularly than is the case on average for the other railways.

Table 2 Trend of accidents given as cumulative data from 10 railways and 2006 values for 20 railways companies. Source UIC Safety Database.

	10 railway companies						20 railway companies
Years:	2001	2002	2003	2004	2005	**2006**	**2006**
Number of serious injury accidents	878	986	823	732	757	808	2147
Rate of serious injury accidents per million km of train movements	0,32	0,35	0,30	0,26	0,25	**0,27**	**0.54**
Number of fatalities	468	470	486	459	466	500	1285
Rate of fatalities per million km of train movements	0,17	0,17	0,18	0,17	0,16	**0,17**	**0.32**
Number of significant accidents	1026	1124	948	815	853	1008	2372
Rate of significant accidents per million km of train movements	0,37	0,40	0,35	0,29	0,29	**0,34**	**0.59**
Number of victims	1022	921	950	1035	1119	919	2430
Rate of victims million km of train movements	0,37	0,33	0,35	0,37	0,38	**0,31**	**0.61**
Number km of million train movements:	2761,08	2793,126	2723,486	2780,54	2978,27	2988,5	3998.3

Data in the grey cells has been collected manually

Table 3 Number of accidents and victims in 2006. Data from 20 railway companies from UIC Safety Database.

			Fatalities			Serious injuries			Victims
		Number of accidents	Passengers	Staff	Other	Passengers	Staff	Other	All
At station	Collisions with an obstacle	36	0	1	7	6	5	9	28
	Collisions between trains	23	0	0	0	4	11	2	17
	LC accidents	89	1	0	47	0	1	51	100
	Derailments	45	7	1	0	15	0	0	23
	Hit by a train	465	12	9	263	29	27	142	482
	Falling from a train	156	13	1	3	97	8	37	159
	Other cases	36	0	0	12	13	0	14	39
	TOTAL at station:	**850**	**33**	**12**	**332**	**164**	**52**	**255**	**848**
In open line	Collisions with an obstacle	64	0	2	14	5	6	18	45
	Collisions between trains	11	3	4	2	10	4	0	23
	LC accidents	515	0	1	259	9	11	368	648
	Derailments	58	0	2	1	0	2	0	5
	Hit by a train	725	1	10	552	10	6	169	748
	Falling from a train	32	8	0	3	19	1	2	33
	Other cases	30	0	0	2	3	2	1	8
	TOTAL of victims in open line:	**1435**	**12**	**19**	**833**	**56**	**32**	**558**	**1510**
	In other locations:	**87**	**0**	**3**	**41**	**1**	**9**	**18**	**72**
	TOTAL:	**2372**	**45**	**34**	**1206**	**221**	**93**	**831**	**2430**

SECTION I

LEVEL 1 - DISCUSSION POINTS

The first level analysis based on significant accidents reported by 20 railway companies in 2006 confirms the previous year's result, where 97 % of total accidents are represented by 5 accident types.

THIRD PARTIES INVOLVED IN ACCIDENTS

Rail transport can be a greater source of danger for third parties who, irrespective of national laws and rail regulations, interact with the railways (i.e. level crossing users and trespassers) than for passengers and staff members.

Data analysis confirms that members of the public constitute a very large proportion of fatalities. The proportion is 93% others, 4% passengers and 3% employees (see Chart 2). The two main areas in which a significant proportion of third party fatalities occurred are level crossings (27.9% of total accidents) and persons struck by trains (50.6% of total accidents). These accidents represent the highest risk of incurring victims for railways in Europe. Level crossing accidents in particular cause significant numbers of fatalities and hours of traffic disruption.

LC ACCIDENTS

Concerning level crossing accidents, 1 passenger died as consequence of an accident at station and 9 were seriously injured. All these 9 cases of passenger injuries occurred at level crossings in open lines.

A better understanding of LC accidents should result from a separate investigation of cases of collisions with obstacles (mainly road vehicles) and cases of persons hit by trains occurring at level crossings. This is because the solutions to adopt for risk mitigation are different for the two accident types and depending on the location of the level crossing – on open line or in a station. The rate of pedestrian fatalities due to level crossings accidents increased in 2006.

Railway companies are committed to ensuring the safety of their customers as well as reducing the total number of accidents. Infrastructure managers have identified the removal of LCs and their replacement with footbridges, subways, etc. as a matter of priority.

The legacy of the railway system with a number of level crossings still presents problems in relation to railway accidents. Those level crossings (passive LCs, even equipped with road signs) that do not provide road users with additional warning or protection at the approach of a train are less and less suited to preventing accidents in a modern context where European road users have increasing assistance at their disposal on a daily basis. For these reasons, efforts to abolish passive LC(s) should be accelerated as a matter of urgency.

ERA should request member states to remove passive LC(s) and develop all possible synergies between social partners, administrators and road transport bodies responsible for improving the interfaces between the rail system and its environment in order to maintain safety.

Accidents at level crossings and persons hit by trains (mainly trespassers) represent 78.5% of total accidents, local risk analyses taking account of the severity of potential accidents at the level crossing interface (e.g. the number of people potentially hurt or killed in case of a collision and/or of a person being hit by a train) and the probability of the accident occurring enable an evaluation of acceptable risk levels and also enable priorities to be established in terms of technology modernisation or the adoption of new organisational solutions.

UIC recommends that the analysis and the solutions adopted be the result of a joint effort on the part of the railways and road sector managers but also with the involvement of civil servants in charge of the urban and rural planning and managment.

ACCIDENTS TO PERSONS CAUSED BY ROLLING STOCK IN MOTION AND ACCIDENTS AT STATIONS

A total of 1391 accidents to persons were caused by rolling stock in motion (with the exception of suicides, attempted suicides and level crossing accidents). They represent 58.7 % of total accidents. 50.6% of the accidents, as mentioned above, are persons struck by trains (mainly trespassers) and 8.1% are individuals falling from trains (see Charts 1 and 3). Accidents to persons caused by rolling stock in motion occur in stations in 45% of cases.

Stations are the interface contact points between trains and passengers, especially during the act of boarding/alighting. Passenger victims of accidents to persons involving moving trains in stations in Europe represent the majority of passenger fatalities (25 of a total of 45 for 20 railways in 2006) and a significant proportion of the passengers seriously injured (126 of a total of 221 for 20 railways in 2006).

With regard to particular types of accidents (e.g. fall from a moving train, person hit by a train) it could be useful to investigate the causes that expose passengers to the risk of accidents at stations and highlight the best solutions to successfully decrease this risk. Finally, closer attention should be paid to the behaviour of the public in the passenger area close to the train, and to preventing trespassers from accessing the trackside via the platforms.

In section III a method is proposed for setting acceptable risk values and assessing the effectiveness of the solution adopted in years to come.

LEARNING FROM EXPERIENCE AND PROMOTING EDUCATION PROGRAMMES

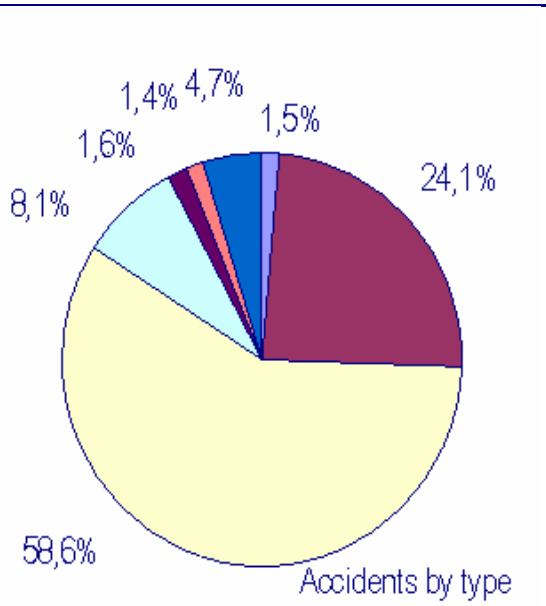
At the same time, in order to decrease the number of accidents it is important lo learn from experience. The SDB project team is available to extract information from the data collected and to provide the appropriate figures for the safety studies requested mainly by the Infrastructure Forum and by European bodies.

Finally it is extremely useful to promote wide-ranging education programmes sponsored by the Railway Association in co-operation with the European Safety Bodies, customer associations, railway companies, police, public institutions and community groups in order to reduce loss of life, injuries and damages caused by crossing collisions and train/pedestrian incidents. Such active, ongoing public education programmes, designed to increase general public awareness of the potential hazards of crossing railway lines and to urge caution by drivers and pedestrians when in their vicinity, have already been launched in Canada (see http://www.operationlifesaver.ca/).

LEVEL 1 - GENERAL REPORT ON SIGNIFICANT ACCIDENTS 2006

The total number of significant accidents registered in 2006 for 20 European UIC member railway companies is 2372. Global values (see Charts 1 to 3) are given in two different data aggregations directly from SDB.

Chart 1 UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Breakdown of accidents by type for all participant railways



	Victims / accident	Fatalities / accident	Serious injuries / accident
Passengers	0,11	0,02	0,09
Staff	0,05	0,01	0,04
Others	0,86	0,51	0,35
Total:	1,02	0,54	0,48

	Accidents		Victims	
Type of accidents	Number	[%]	Fatalities	Serious injuries
- Train collision with another train	36	1,5%	9	32
- Train collision with an obstacle (including at LC)	572	24,1%	237	443
- Individual hit by a train (including at LC)	1390	58,6%	986	450
- Individual falling from a train	191	8,1%	28	168
- Fire in rolling stock	38	1,6%	0	18
- Electrocution by overhead line or third rail	32	1,4%	14	17
- Derailment	113	4,7%	11	17
Total:	**2372**	**100%**	**1285**	**1145**

Key findings

- Comparison with 2005 results shows that the rate of victims per significant accident is decreasing for all categories of person involved.
- No passengers died as consequence of train collisions with an obstacle.
- No passengers or members of staff were killed as a result of fire in rolling stock or electrocution by overhead lines or third rails (see Chart 2).
- Almost all the passengers injured as a result of fire (13 of a total of 16) were involved in a single accident which occurred at Luxembourg station. On 14 July 2006 at 5:24 p.m. train n° 4717 stopped 500 m after departure following activation of the emergency brake by a passenger. The train driver

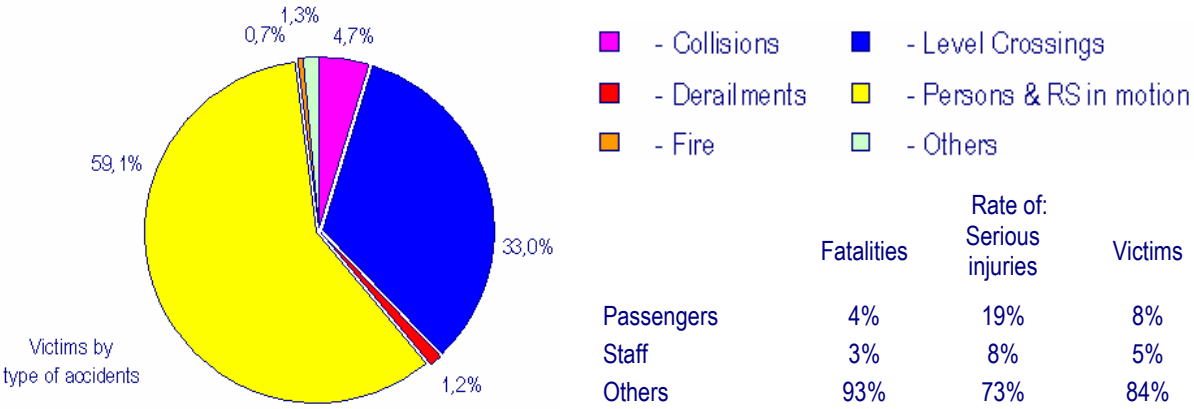
noted smoke emerging from the higher part of the third coach in the train. A passenger had set fire to the coach on purpose using newspapers and a very flammable liquid from a container

Chart 2 UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Fatalities and serious injuries

	Fatalities			Serious injuries		
Type of accidents	P	S	O	P	S	O
- Train collision with another train	3	4	2	14	16	2
- Train collision with an obstacle (including at LC)	0	7	230	20	21	402
- Individual hit by a train (including at LC)	14	19	953	39	39	372
- Individual falling from a train	21	1	6	117	12	39
- Fire in rolling stock	0	0	0	16	1	1
- Electrocution by overhead line or third rail	0	0	14	0	2	15
- Derailment	7	3	1	15	2	0
Total:	***45***	***34***	***1 206***	***221***	***93***	***831***

(1) P = passengers; S = staff; O = others

Chart 3 UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Breakdown of victims by type of accidents for all participant railways.



	Fatalities	Rate of: Serious injuries	Victims
Passengers	4%	19%	8%
Staff	3%	8%	5%
Others	93%	73%	84%

	Accidents		Victims	
Type of accidents	Number	[%]	Fatalities	Serious injuries
- Collisions	137	5,7%	34	81
- Level Crossings	661	27,9%	349	453
- Derailments	113	4,7%	11	17
- Persons & RS in motion (in this hit by train: 1200 or 50.6%)	1391	58,7%	877	559
- Fire	38	1,6%	0	18
- Others	32	1,4%	14	17
Total:	**2372**	**100%**	**1285**	**1145**

Key findings

- The most frequent type of accident is that of a person hit by a train (1391 accidents of which 190 were at level crossings). It also caused the most victims (1436).
- The total number of victims in the case of persons hit by trains (not at level crossings) was 1240 – i.e. more than 51% of the total number of victims in all railway accidents.

– As was the case in 2005, it can be observed that most passenger fatalities or serious injuries occur as a result of passengers falling from trains or being hit by trains.

– There were 661 level crossing accidents. They fell from 35.1% of total accidents in 2005 to 27.9% in 2006.

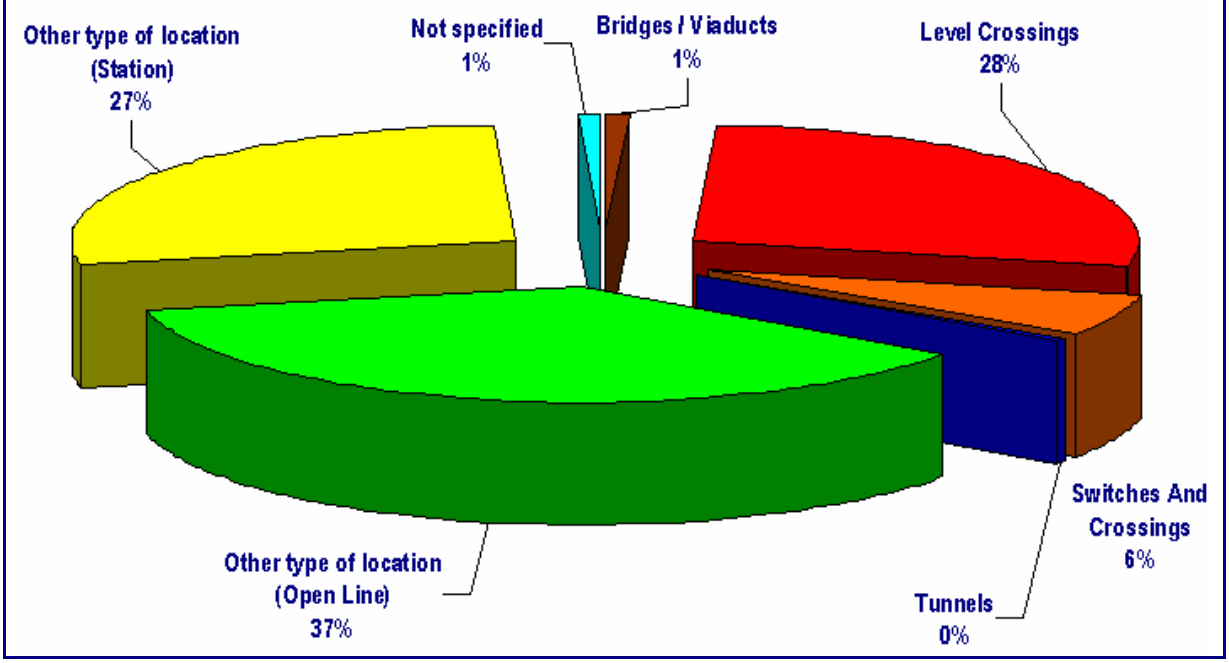
– Of a total of 802 victims involved in level crossing accidents, 193 were pedestrians hit by a train when crossing the track. Pedestrians killed in LC accidents represented almost 40% of the total fatalities recorded for this type of accident. They had represented 32.7% in 2005.

Chart 4 — UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Fatalities and serious injuries according to EUROSTAT form

	Type of accidents			Seriously injured		
	P	S	O	P	S	O
- Collisions	3	8	23	25	27	29
- Level Crossings	1	3	345	9	12	432
- Derailments	7	3	1	15	2	0
- Persons & RS in motion	34	20	823	156	49	354
- Dangerous goods Total	0	0	0	0	0	0
- Fire	0	0	0	16	1	1
- Others	0	0	14	0	2	15
Total:	***45***	***34***	***1 206***	***221***	***93***	***831***

(1) P = passengers; S = staff; O = others

Chart 5 — UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Breakdown of accidents for all participant railways by type of location



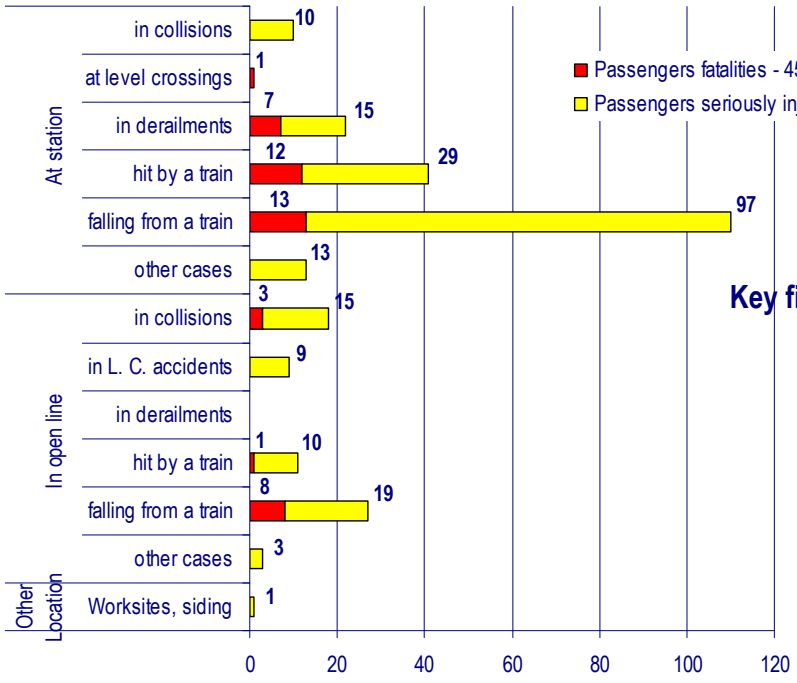
Key findings

– At least one accident per type occurred on switches and crossings. This is also the case of the train set on fire outside Luxembourg station on 14 July 2006.

– Of a total of 138 accidents which occurred on switches and crossings, 21 were collisions (of which 9 were collisions between trains), 33 were derailments, 80 were persons hit by trains, 1 case related to a person falling from a train, 2 were electrocutions and as mentioned above, 1 was a fire in rolling stock that resulted in 13 seriously injured passengers.

– The most serious derailment occurred when crossing a switch in Spain where on 21 August 2006 at 3:55 p.m. in Villada (line from Palencia to La Coruña) long distance train n° 280 derailed over the switch resulting in 7 passenger fatalities and 14 passengers seriously injured.

Chart 6 UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Total number of passengers who were victims of accidents by type of location



Key findings:

– Most of the passenger fatalities occurred in stations as a result of individual accidents (hit by a train or falling from a train). Cases of derailments refer almost exclusively to one very serious accident.

Key findings

– The number of passenger victims of accidents decreased from 2005 values.

– The number of passengers killed per 100 significant accidents reduced from 4 in 2005 to 2 in 2006.

– Of a total of 45 passengers killed and 221 seriously injured, 21 were killed and 117 seriously injured falling from trains and 14 were killed and 39 seriously injured being hit by trains.

– Falls from trains are responsible for almost 47 % of total passenger fatalities. This individual accident is the most severe for passengers. It is more severe than collective accidents.

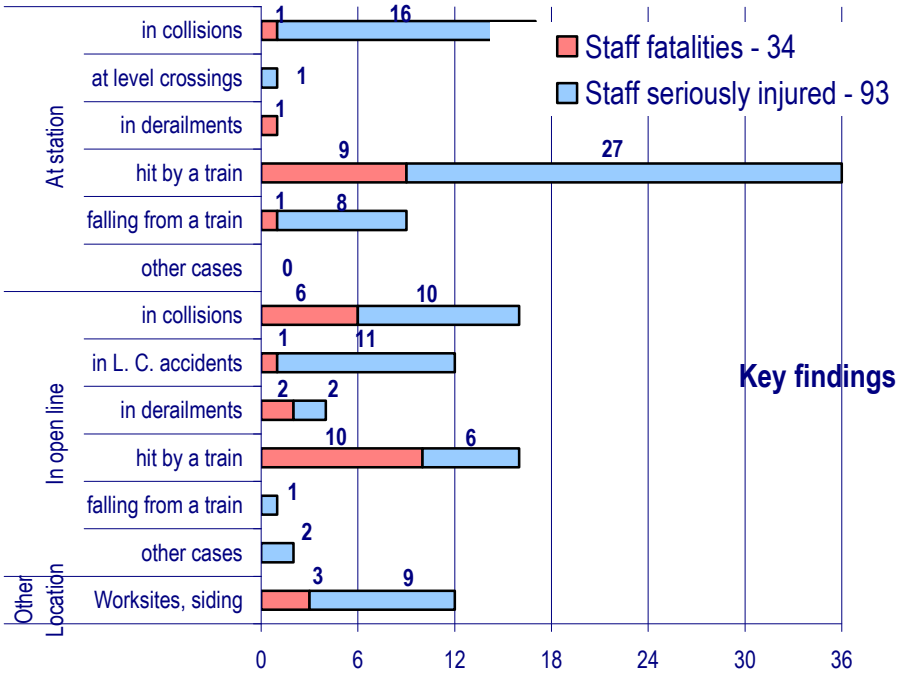
– The number of persons falling from trains, (mainly passengers) increased.

– Most of the passenger victims falling from trains occurred in stations - 13 fatalities and 97 seriously injured persons against 8 fatalities and 19 seriously injured persons on open line.

– Analysis of the second level causes indicates passengers' lack of attention more than poor communications between train crews and passengers as the cause of passengers falling from a running train.

– Around 10% of fall accidents involved trespassers sleeping in wagons and coaches.

Chart 7 — UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Total number of staff who were victims of accidents by type of location



Key findings: – Most cases of staff member victims were as a result of individual accident.

Key findings

- The number of staff who were the victims of accidents decreased in relation to the 2005 values. 2006 results indicate 1 staff member killed per 100 significant accidents compared to 2 staff members in 2005.
- Most staff fatalities and serious injuries continue to be as a result of being hit by a train
- Most staff member deaths occurred in open line accidents, whereas most serious injuries to staff members were incurred in accidents in stations.

– Most staff victims were injured or killed in accidents in stations.

– First level analysis also indicates that a very high number of fatalities and staff injuries occurred at switches and crossings.

– There were 2 cases of staff members seriously injured due to falls from trains for which the cause has been identified as linked to “Rolling Stock”.

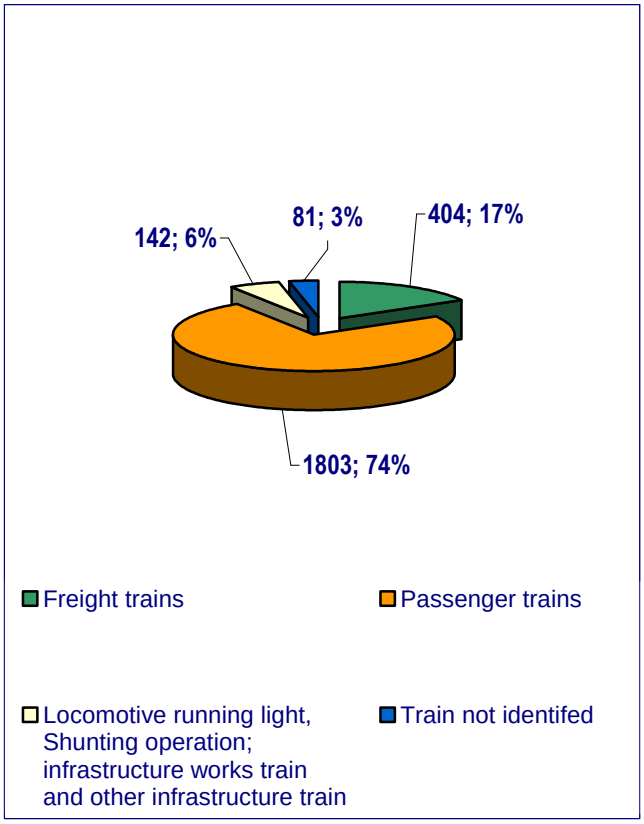
LEVEL 1 - CAUSES OF ACCIDENTS

Table 4 (ex 5)	UIC – SBD: First level analysis from UIC Safety Database – 2006 data Causes of accidents.			
Simplest type of cause definition	Basic cause definition from UIC-SDB	More detailed information from UIC-SDB second level causes	Number of significant accidents	
INTERNAL CAUSES **20,6%**	RAILWAY SUB-SYSTEMS **4,4%**	Infrastructure (track & structures)	1,39%	33
		Energy system	0,04%	1
		Control-command signalling	0,08%	2
		Operations & traffic management	0,34%	8
		Rolling stock	**2,57%**	**61**
	HUMAN FACTORS **16,2%**	Track and track contractors staff	0,76%	18
		Control-command, traffic operating and switching staff	1,22%	29
		Train driver and train crew	1,10%	26
		Other human factor in RU(s)	0,08%	2
		Passengers and freight company customers	**5,02%**	**119**
		Other users	1,85%	44
		Not specified	**6,20%**	**147**
EXTERNAL CAUSES **78,4%**	WEATHER & ENVIRONMENT **1,3%**	Weather	0,46%	11
		Environment	0,76%	18
		Not specified	0,04%	1
	THIRD PARTIES **77,1%**	Non-compliance with national laws & regulations	**18,30%**	**434**
		Parallel or crossing infrastructure	0,00%	0
		Objects on the gauge	0,34%	8
		Trespass (intrusion)	**30,02%**	**712**
		Other or vandalism	**2,95%**	**70**
		Not specified	**25,55%**	**606**
1% CAUSES NOT IDENTIFIED				22
100%	100%		Total:	**2372**

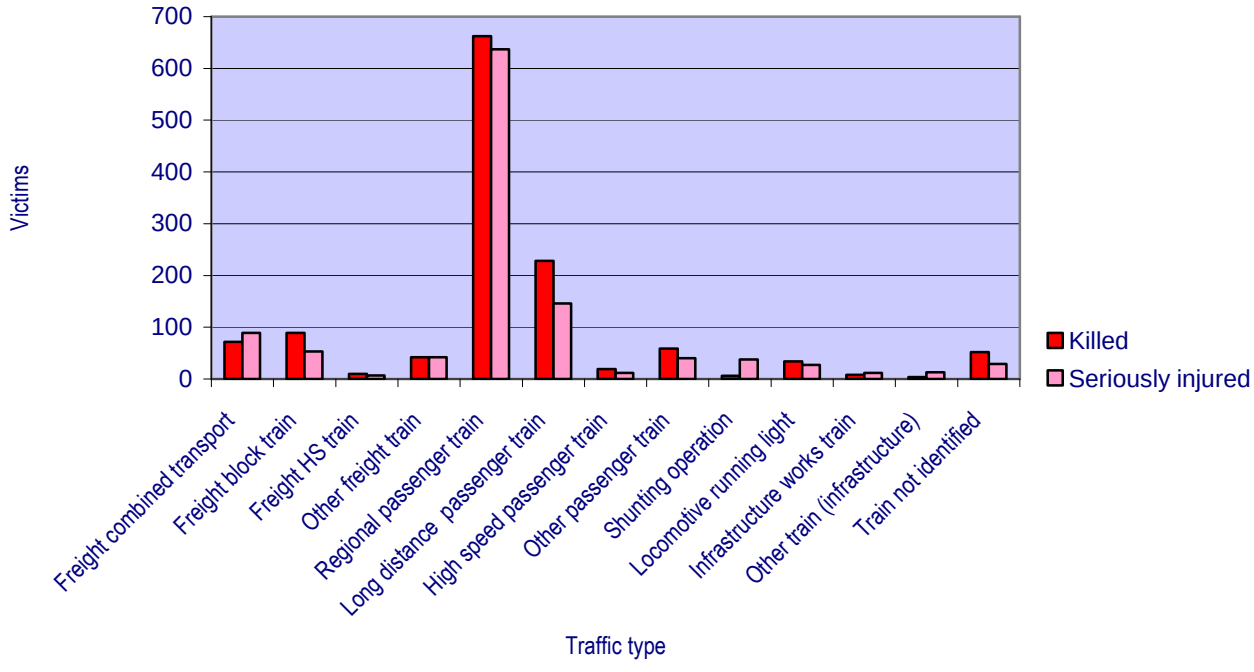
Key findings

- 78.4% of the accidents were caused by external factors and 20.6% of the accidents were related to internal causes.
- Human factors represent 78.6% of the causes of all accidents related to the railway system itself.
- At least 30% of accidents were caused by trespassers.
- At least 18% of accidents were due to the non-respect of national laws/regulations. 297 of these 434 accidents were due to car drivers who did not observe the Highway Code.
- At least 5% of accidents were caused by railway customers.

Chart 8 — UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Breakdown of victims by type of traffic involved



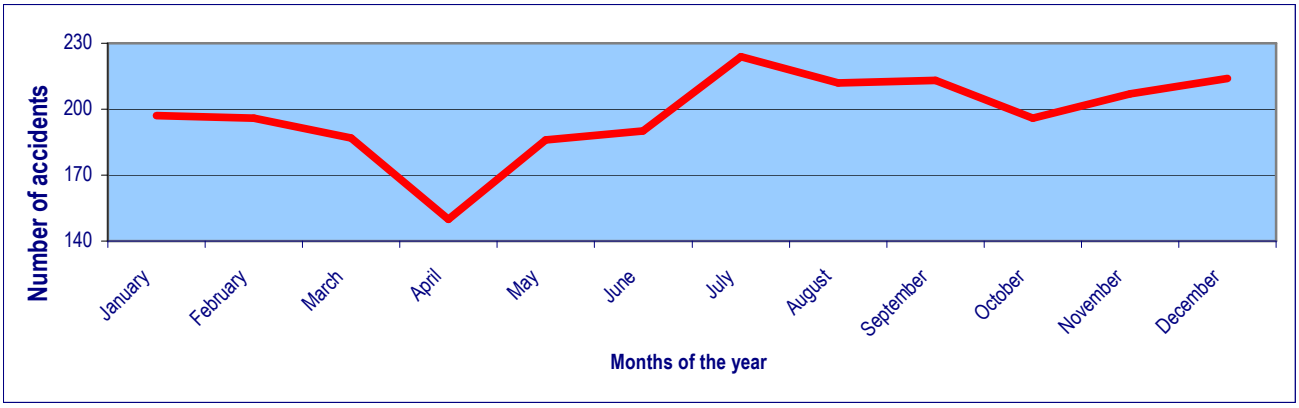
Type of accident	*Number of Victims*			
	Freight trains	Passenger trains	Light running locomotives, Shunting operation, infrastructure works train and other infrastructure train	Train not identified
Collision	31	65	18	1
Derailment	2	23	3	0
Level-crossing accidents	134	614	47	7
Accidents to persons caused by rolling stock in motion	225	1080	71	60
Fires in rolling stock	1	17	0	0
Other accidents	11	4	3	13
TOTAL victims:	**404**	**1803**	**142**	**81**

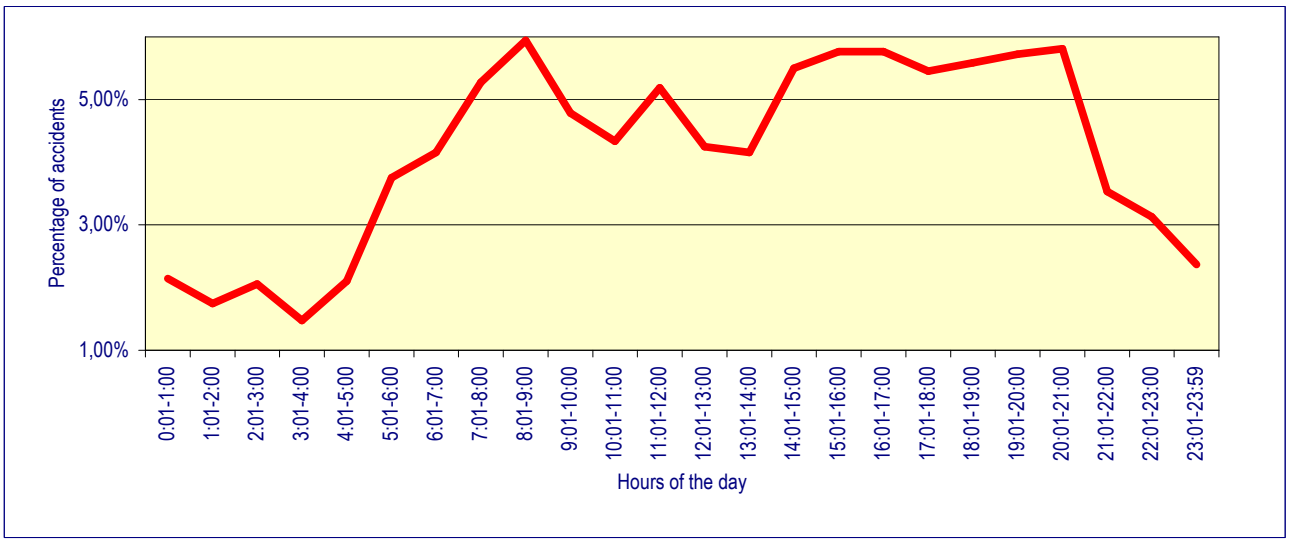


Key findings

– The 2005 results are confirmed. Most of the victims were linked to regional passenger traffic. Further work needs to be carried out to verify if the high number of victims in regional passenger traffic is proportional to the higher percentage of trains or if differences in regulations and or in rolling stock are at cause.

Chart 9 UIC - SBD Report on significant accidents from 2006-01-01 to 2006-12-31
Monthly and daily accident distribution





Key findings

– The annual variation in the number of incidents shows some differences from month to month. Low points are reached in April (they occurred between February and March in 2005) and peaks in July (they occurred between September and November in 2005).

– The lowest number of monthly incidents was recorded in April (It was recorded in February in 2005).

– The daily variation confirms the 2005 results, peaks at 08.30 and between 20.00 and 21.00.

– The period with the lowest accident rate is from 23.00 to 05.00.

SECTION II

LEVEL 2 - TRENDS

Plus and minus signs correspond to higher and lower value of 2006 figure in relation to the previous five years average.

Chart 10 Trend of the number of accidents and trend of the number of victims for individual IM in the period 2001 – 2006.

Number of accidents per type / Railway Company	OO	BB Rail	SS NET	AA Net	TT	LL	CC Main lines	GG RAIL	UU	NN Infra	TOTAL
Collisions	-		+	-	-		+	-	+	+	-
Derailments	-	-	+	+	+		+	-	+	+	+
Level crossing	-			+	+		-		-	-	+
To persons	+	+	-	-	-			+	+	+	-
Fires			+	+	-			-	+		+
Trend of the number of railway accidents (10 IM) in 6 years. TOTAL:											+

trend diminishing

trend constant

trend increasing

Value of signs for number of accidents and number of victims in 2006

Number of victims per type of accident	OO	BB Rail	SS NET	AA Net	TT	LL	CC Main lines	GG RAIL	UU	NN Infra	TOTAL
Collisions	-	-	+	-	-			-	-		-
Derailments					-					-	-
Level crossing	-	+	-	-	+		-	+	-	-	-
To persons	+	+	-	+		+		+	+	+	+
Fires			-			+					+
Trend of the number of victims of railway accidents (10 IM) in 6 years. TOTAL:											-

- lower than the average for 2001-2005

almost equal to the average for 2001-2005

+ higher than the average for 2001-2005

(Source UIC Safety Database)

Key findings

- Trend of accident from 2001 to 2006 is diminishing;
- Total number of accidents on 2006 was greater than the average value of the past 5 years.
- Trend of victims of accident from 2001 to 2006 is constant.
- Total number of victims in 2006 was less the average value of the past 5 years.

LEVEL 2 - BENCHMARKING

The benchmarking proposed here is based on the combined significant accidents recorded in the SDB from 2004 - 2006. Each railway company in the sample can evaluate the trend of their 2006 performances compared to the combined results of the last 3 years. Other railway companies should enter their indicator in the abscissas axis and evaluate their position in relation to the other railways considered in the sample.

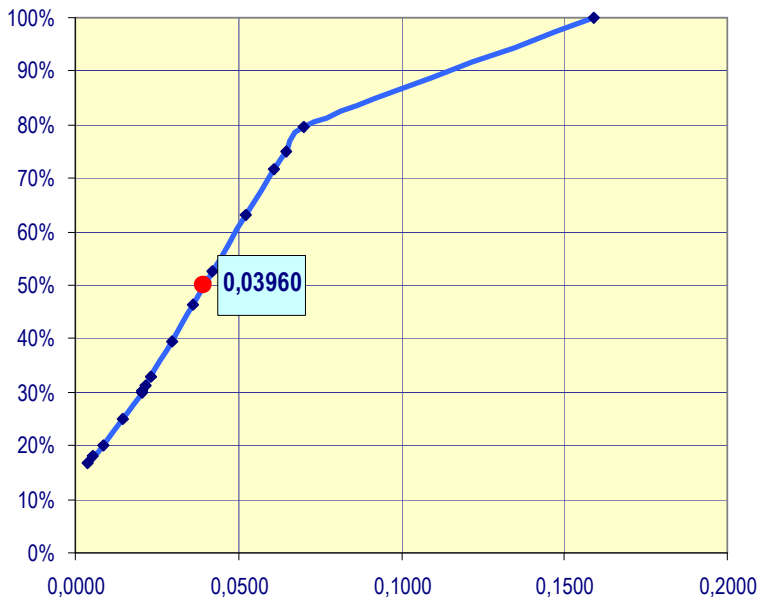
In diagrams Chart 11 to Chart 15, the 'x' axis represents the values of the indicator (number of accidents of the same type divided by million km of train movements) and the 'y' axis (corresponding point on S-curve) represents the probability of the community of railways not exceeding the specific value of the indicator. Given the heterogeneous nature of the set, a position between 20% and 80% could be considered as representative of the community of railways.

Based on the 3-year average indicator values for each of the 20 railways, the S curve (normal distribution function) has been drawn by calculating the mean value and standard deviation of the sample.

For the purpose of examining the distribution of the indicators, it is assumed that a spread of below 1 is most representative of homogenous samples.

Chart 11	Indicator 1, 1, 1 - Significant accidents - Number of collisions of trains, including collisions with obstacle within the clearance gauge relating to combined total number of million km of train movements in the period 2004 2006.

Railway	
PP	
NN Infra	
FF NET	
TT	
HHH	
SS NET	
DD	
GG RAIL	
AA Net	
BB Rail	
QQ Manager	
OO	
UU	
ZZ	
CC Main lines	
RR Regional	
VV Corridor	
Mean value	0,03960
Standard deviation	0,03702
Spread	0,9350



Key findings

- The sample is quite homogenous. It seems to represent reality and may be used for benchmarking.
- Two more useful indicators should be obtained by splitting 'collisions' into 'train collision with another train' and 'train collision with an obstacle. The set of indicator values for collisions between trains is the most accurate. It seems that infrastructure managers handle this type of accident with a very homogenous approach (see Chart 12).

Chart 12	Indicator 1,1,1a - Number of collisions between trains relating to combined total number of million km of train movements in the period 2004 - 2006.

Railway

NN Infra
TT
SS NET
GG RAIL
AA Net
MM
BB Rail
DD
HHH
CC Main lines
QQ Manager
RR Regional
UU
OO

Mean value	0,01544
Standard deviation	0,01001
Spread	0,64795

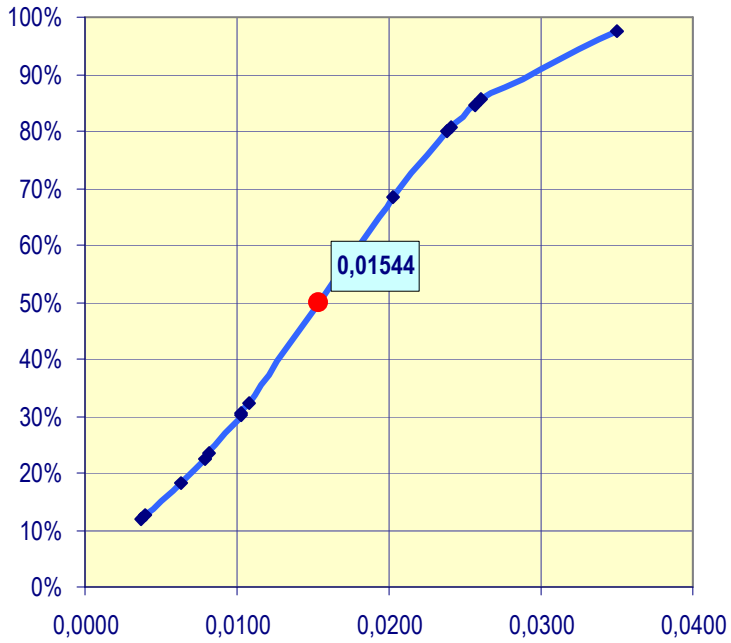


Chart 13	Indicator 1,1,1a - Number of collisions between trains and 1,1,1b - Number of trains collisions with an obstacle within the clearance gauge relating to combined total number of million km of train movements in the period 2004 - 2006.

Railway

NN Infra
PP
FF NET
TT
SS NET
QQ Manager
GG RAIL
OO
AA Net
UU
DD
BB Rail
CC Main lines
ZZ

Mean value	0,0343
Standard deviation	0,0382
Spread	1,1144

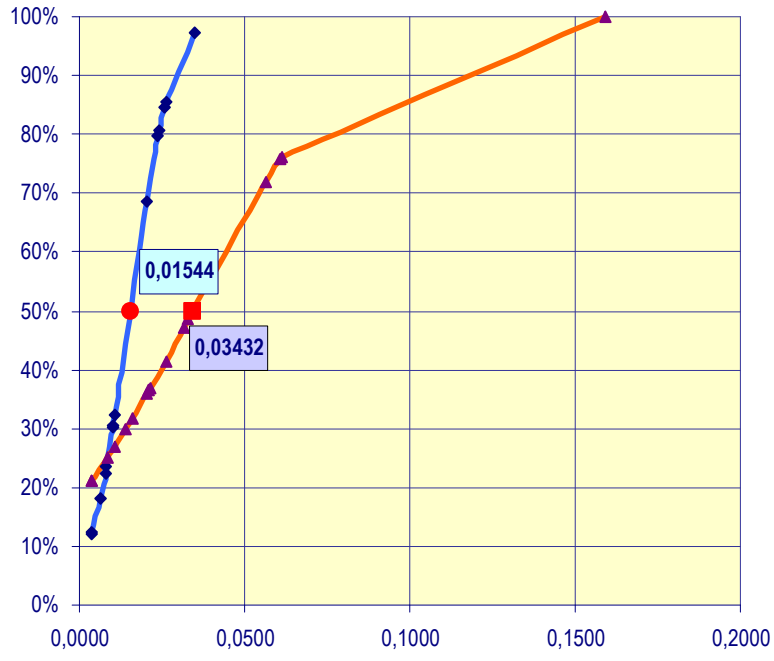
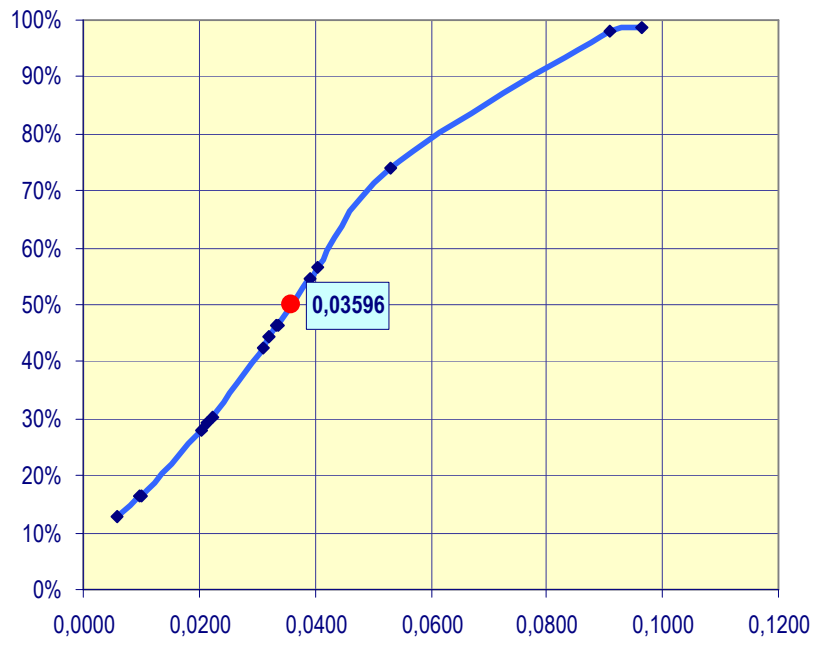


Chart 14	Indicator 1,1,2 - Significant accidents - Number of derailments of train relating to combined total number of million km of train movements in the period 2004 - 2006.

Railway

FF NET
BB Rail
AA Net
HHH
NN Infra
SS NET
PP
QQ Manager
TT
GG RAIL
UU
CC Main lines
VV Corridor
OO
RR Regional

Mean value	0,03596
Standard deviation	0,02668
Spread	0,74173



Key findings

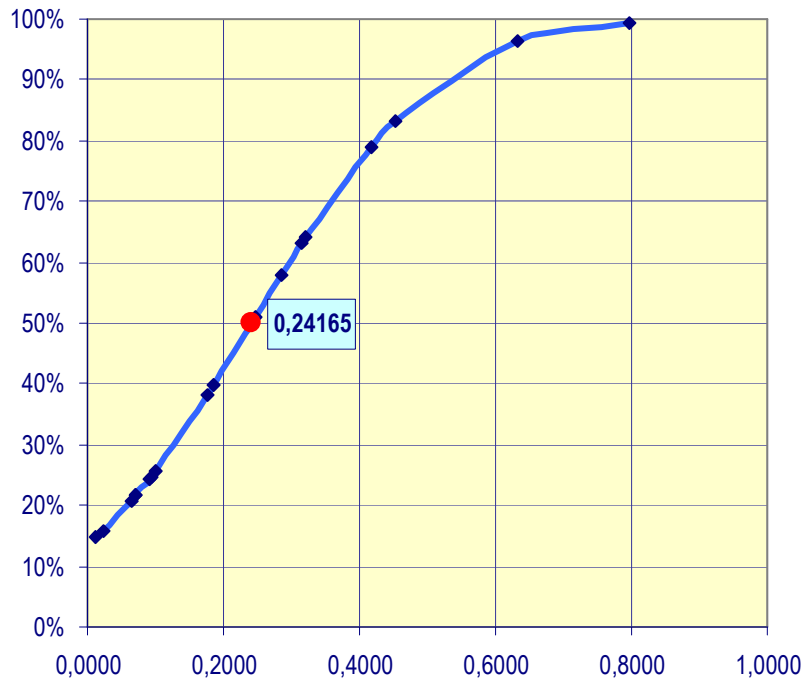
- The sample is homogenous, as already mentioned spreads of below 1 are the most representative of homogenous samples. S curves proposed for collisions between trains and derailments of trains may be profitably used for benchmarking.
- Collisions between trains and train derailments are very rare in Europe. Railway performances indicate in 0.035 collisions between trains and in 0.1 derailments, per million of train movements, the upper limit of the probability that these types of accidents happen.

Chart 15	Indicator 1, 1, 3 - Significant accidents - Number of level crossing accidents, including accidents involving pedestrians at level crossing relating to combined total number of million km of train movements in the period 2004 - 2006.

Railway

UU
NN Infra
CC Main lines
GG RAIL
TT
AA Net
FF NET
SS NET
QQ Manager
BB Rail
OO
ZZ
DD
LL
PP
HHH
RR Regional
VV Corridor

Mean value	0,24165
Standard deviation	0,21832
Spread	0,90347



Key findings

- The sample in Chart 15 has homogeneous results and may be used for benchmarking.
- It should be verified whether new indicators relating to level crossing density and to the road traffic would be more appropriate. The SDB project team receives information on the number of level crossings in service at the end of each year from the railway correspondents and consequently new indicators will be calculated.

Readers can note that dividing the railway companies of the sample into two families in accordance with the magnitude of the obtained performances, the homogeneity of the samples increase. Further investigations should highlight differences in the installed technologies or/and in the operational rules between the railway companies considered in the two set of values but also different behaviours of the level crossings users and different regimes of road traffic at the origin of the different performance results.

LEVEL 2 - DISCUSSION POINTS

The quality of benchmarking could be improved by paying the same degree of attention to the declaration of significant accidents as already accorded to the declaration of accidents causing serious injuries. In other words, it is necessary to pay more attention to the costs of accidents, whilst adopting homogeneous procedures and methods to evaluate those costs.

SECTION III

THREE LEVELS OF ANALYSIS OF UIC DATABASE

The evidence of accidents recorded in the UIC Safety Database indicates that the interaction of the rail system with its external environment (i.e. adjoining land use, road interfaces and social behaviour) results in more accidents to passengers, staff and third parties than the failure of the internal safety management of the rail system itself. As mentioned above, level crossing accidents and cases of persons being hit by trains represent 78.5% of the total of accidents and 84% of the total of victims of rail accidents. In this respect there is a need for wider community responsibility to be taken in the development of solutions to combat such types of accidents.

The analysis of the frequency of occurrence of all accidents, both in comparison between networks and in terms of overall trend, can assist in monitoring the safety level of the rail system. Before approaching this subject it is worthwhile stressing two points:

- UIC accident data cannot solely be taken as evidence of a good or bad safety management system being applied in any particular organisation. Each railway organisation manages a portfolio of risk and its safety management system is tailored to meet its own circumstances.
- The starting point from which to compare relative safety levels is different for each organisation. This is mainly due to the configuration of the network, social behaviour and patterns, available budgetary resources and the community's perception and acceptance of risk.

Accordingly, it may be said that benchmarking and the sharing of experience is helpful, if applied and interpreted in its proper context. It is also clear that attempting to find a common target for rail safety may be elusive, though this should not diminish the aspiration to improve safety even further.

At present there is no common answer in the railway community to the question: "What is the maximum acceptable risk value?" A conservative approach may consider that the existing level of safety is accepted by citizens and that targets can be based on current values. A cost/benefit approach may conclude that a risk is acceptable when the cost of reducing it is not acceptable. A further approach may rule out the possibility of establishing any other target than zero accidents. A target other than zero accidents would imply acceptance of a number of accident and a resultant number of victims.

By carrying of a **Level 1** analysis of the UIC data it is possible to establish the main types of accidents which occur together with associated aspects, such as location, number of victims, interfaces and primary and secondary causal relationships. This information has been demonstrated in the earlier sections of this report. This helps to focus attention the frequency of certain types of accidents and their severity. The underlying trend for the last number of years is evident and shows that over 97 % of all incidents can be categorised under five general classes of accident.

A second level analysis (**Level 2**) permits the plotting of S curves for a number of these accident parameters (indicators) which indicate the ability of the current community of railways to achieve certain levels of compliance. In interpreting such curves, one determines that the whole community can come under the threshold of the poorest performer and that few of the community will be able to achieve the lowest value of the best performer. The shape of the S curve, and its trend over time, can give an indication of how closely the community is clustered around any given indicator. The S curves thus provide a general overview of the community's exposure to risk (perhaps best represented by the mean value) and the range of that risk. The word 'risk' is used appropriately, as the UIC database can provide some historical evidence of the consequences of particular accidents in terms of numbers of victims.

Individual railways can plot their respective positions on the S curves and decide upon appropriate actions. It must always be remembered that attention paid to addressing one risk may, or may not, draw resources from other parts of the organisation and so it is necessary to consider the overall consequences for safety management when looking at any one single indicator. Consequently, addressing many type of existing system deficiencies may necessitate additional resources (financial and human) rather than a just a reallocation of current resources.

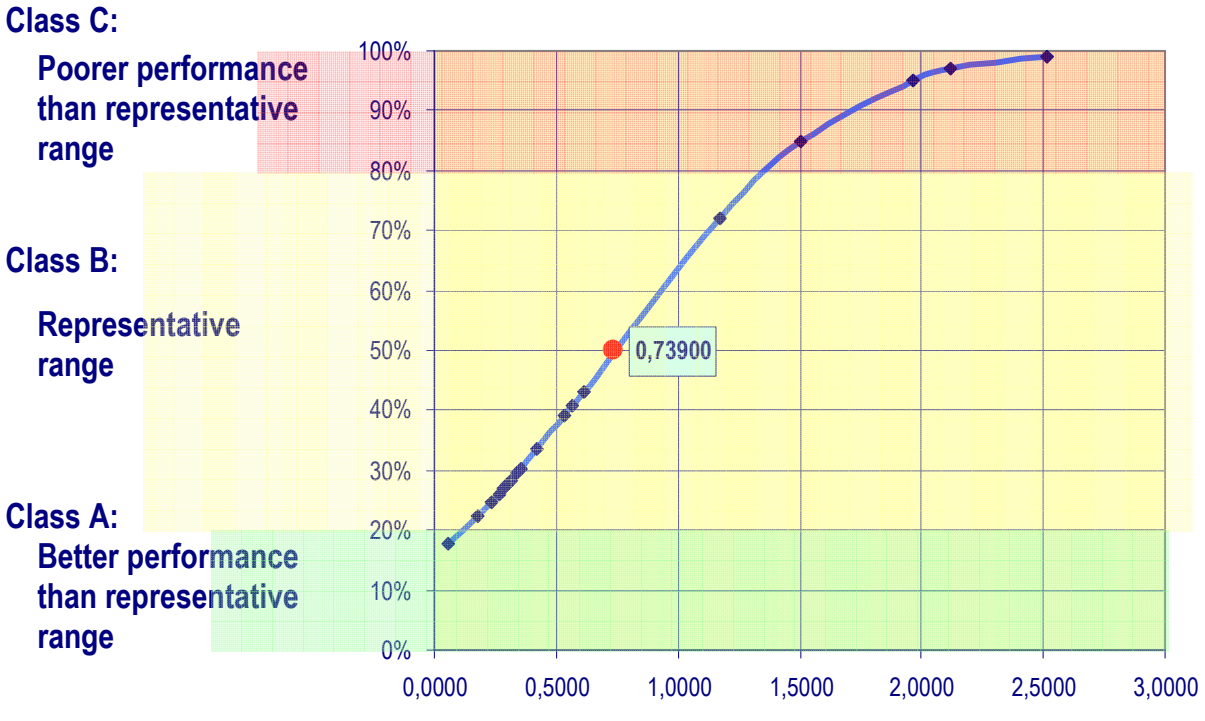
Moving on from an individual analysis and assessment of a single company's position on one S curve, a methodology has been devised to compare the overall performance of a company in a number of accident categories with other railways' performance. **Level 3** analysis proposes to assess the performance of each company in the context of the distribution of community performance rather than to define a fixed value as a target or benchmark for railway. A future threshold for each indicator can also be defined for the community.

LEVEL 3 - ANALYSIS

The following example sets out the approach using the indicator of 'total of all significant accident categories' compared with 'millions of train –kilometres' runs on each network.

Fig 1 (normal distribution of the accident indicators), represents the results obtained based on a sample of IMs from European countries. Readers can observe that all the railways achieve an accident ratio below 25 significant accidents per ten million train kilometres whereas only a small proportion of the community can achieve an accident rate at or below 2 significant accidents per ten million train kilometres

Fig 1	Normal distribution of the indicators on significant accidents per million km of train movements in the period from 2004 to 2006 for the network of European UIC members



The difficulty in setting a single target for the railway community as a whole is evident. It is apparent that the lowest value (around 2 per 10 million train-km in this example) will be difficult to obtain while the

highest (around 20 per 10 million train km in this example) would result in establishing a weaker target that a large proportion of the community already achieve. Given the variable 'starting points' on each railway it may be more sensible to define a general objective that all railways should not worsen their current performance and that the 80% threshold level should be at least a reference for those railways that currently exceed it. Via an iterative process focused on local risk reduction it will be possible to increase the overall safety of the community.

Developing this approach, we can broadly define three ranges of performance for each indication: Class C (Red Zone: above 80%), Class B (Orange zone: 20%-80%) and Class A (Green Zone: below 20%). It should be made clear that these classes do not indicate a new set of formal or informal targets.

To avoid erratic change in the S curves, from year to year resulting from the possibility of an exceptional accident and to observe the trend over time, UIC propose to construct the S curves, each year, based on a five-year rolling average of accident history. Once data becomes available for more than five years, UIC will utilise the most recent five year period, when updating the curves. This will permit a stable incremental review.

Appendix

ACCIDENT DEFINITIONS CURRENTLY IN FORCE IN EUROPE

At present there are at least four definitions of "railway accidents" which have legal force in Europe:

2 definitions from Directive 2004/49/EC of 29 April 2004 (Railway Safety Directive):

(1) **"accident"** means an unwanted or unintended sudden event or a specific chain of such events which have harmful consequences; accidents are divided into the following categories: collisions, derailments, level-crossing accidents, accidents to persons caused by rolling stock in motion, fires and others;

(5) **"serious accident"** means any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety; "extensive damage" means damage that can immediately be assessed by the investigating body to cost at least EUR 2 million in total.

2 definitions from Commission Regulation (EC) N° 1192/2003:

(3) **"Significant accident"** means any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person, or in significant damage to stock, track, other installations or environment, or extensive disruptions to traffic. Accidents in workshops, warehouses and depots are excluded. **Notes from the European Office of Statistics (EUROSTAT) specify the following factors:** significant damage over €150K and extensive disruptions to traffic with tracks blocked for more than 6 hours.

(4) **"Serious injury accident"** means any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person. Accidents in workshops, warehouses and depots are excluded.*(Where "person killed" means any person killed immediately or dying within 30 days as a result of an accident, excluding suicides; and "person seriously injured" means any person injured who was hospitalised for more than 24 hours as a result of an accident, excluding attempted suicides)*.

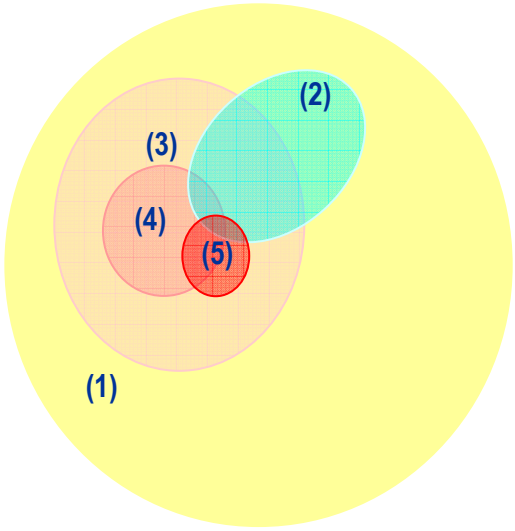
Fig 2 comprises a diagram showing the field of application of and intersection between the four accident definitions.

The UIC Safety Database collates information on railway accidents, critical events, suicides and attempted suicides. UIC SDB accepts declarations based on all the above accident definitions. However, **declaration of "Significant Accidents"** in accordance with the definition given by the Commission Regulation (EC) N° 1192/2003 and the notes from European Office of Statistics **is mandatory.**

Moreover, SDB offers specific reports and analysis for the community or for a single railway based on filtering the data collection according the definitions in force. So, for its own information, a SDB member can declare accidents to the database other than significant accidents without prejudice to its relative position in the international benchmarking where only significant accidents are automatically taken into account for declarations in accordance with Commission Regulation.

The UIC International Railway Statistic – Table A91 collates the total of Significant Accidents in 5 categories and the number of passenger, staff and third parties victims as a result of the accidents.

Fig 2 Domains of the different definitions of accidents



(1) Accidents as defined in the European Railway Safety Directive.
It is not used for any mandatory data collection.

(2) Dangerous goods accidents as in RID/ADR section 1.8.5.
It contains the accidents to take into account to complete EUROSTAT table H2

(3) Significant Accidents as in EC Regulation N° 1192/2003.
It contains the accidents to take into account to complete EUROSTAT table H1 and to calculate the Safety Indicators as defined in the Safety Directive Annex 1.

(4) Serious Injury Accidents in EC Regulation N° 1192/2003
It is used to complete the optional part of EUROSTAT table H1 and tables H2 and H3.

(5) Serious Accidents domain as defined in the European Railway Safety Directive.
It contains those accidents for which Member States shall ensure that an investigation is carried out by the investigating body and the results of the investigations made known to the public.

Finally, SDB must contain at least all the significant accidents and all the dangerous goods accidents declared (one by one or automatically transferred) by the SDB Correspondents plus the number of critical events, suicides and attempted suicides in a defined period.

Table A91 of the UIC International Railway Statistics must contain, for each UIC member, the total number of accidents by type (5 types) and the number of passenger fatalities and injuries for each type of accident, calculated as a total of all significant accidents experienced by each UIC member.

Every year at the end of September, the values necessary to compile Table A91 are extracted by the SDB and transferred to the UIC Committee for International Statistics. Those responsible for statistics within UIC railway member companies can confirm or correct the totals that will be published thereafter in the official statistics Table A91: “Railway Accidents”.

FUTURE DEVELOPMENT OF ACCIDENT DEFINITIONS. DEVELOPMENT OF THE UIC SDB

The railway community considers the definition of "Significant accident" a good reference point for compiling international statistics and benchmarking; there is some uncertainty with regard to the breakdown into the different types of accidents considered in the domain and on the utility of separating accidents involving moving trains from other rolling stock in motion. (Engines running when traffic is interrupted, shunting operations)

Those in charge of the UIC SDB have decided not to change the SDB definitions before the collection of 2007 data is completed. This is in order to constitute the most homogeneous collection of data possible, and, on the basis of that experience, to contribute to amending Annex 1 of the Safety Directive by proposing the appropriate changes to the ERA.

From 2008 SDB should consider significant accidents involving railways vehicle in motion, potentially in two different groups:

- Accidents involving at least one train
- Accidents involving other moving railway vehicles, excluding trains.

The first group could be adopted to calculate the CSI that are defined in the SD as number of accidents in relation to train kilometres and not in relation to rolling stock movements.

Finally, indicators from the first group highlight the level of service offered to customers both for passengers and freight and enable a benchmark of rail safety in comparison with other transport modes *(road,* naval and aviation). The second group of accidents (collisions and derailments involving maintenance vehicles or rolling stock during shunting operations or vehicle runaways on sidings, etc.) demonstrates the efficiency of the organisation of work and the safety performance of maintenance services.

Moreover, different solutions adopted for level crossing protection (road protection) could result in different levels of accident risk reduction. The European SELCAT project and ERA WG 7.1 are addressing the topic. The collection of information on the types of level crossing should prove useful in evaluating the different levels of safety offered by the different technologies.

In the meantime, in case of an accident at level crossing it seems useful to record in the SDB whether the accident occurs at a passive or active level crossing. "Active Level Crossing" means a level crossing where crossing users are protected from or warned of the approaching train by the activation of devices when it is unsafe for them to cross. "Passive crossing" means a level crossing without any form of warning system and/or protection activated when it is unsafe for the user to cross.

CAUSE ANALYSIS

Infrastructure managers are used to measuring the performance of systems, monitoring trends and analysing the causes of accidents. Possible causes of accidents are taken into account in a risk analysis model. Removal of accident causes, applied to the whole network, is a potential, realistic way of preventing accidents and increasing safety levels.

SDB collates causes of accidents with the information broken down into three declaration levels.

The first declaration level seeks to determine whether the cause of the accident is internal or external by indicating the sub-system involved.

The second declaration level seeks to distinguish, within the sub-system involved in the accident, if the accident was caused by human error or a technical problem. It does this by indicating the component or the particular category of person involved (permanent track staff, traffic operating staff, train driver, etc.)

The third declaration level enables the cause of the component malfunction to be identified (design/dimension, construction/manufacture, incorrect installation, maintenance, material, etc.) or, in case of human error, to distinguish cases of inatttention and the influence of alcohol or drugs from bad organisation or lacking / ineffective regulations

Last year the safety database correspondents agreed on the utility of recording second and even third level causes. Second and third levels causes have already been declared for 2006 accidents in almost 70% of cases. The Infrastructure Forum is requested to support second and third level cause declaration as a mandatory requirement on SDB Members, starting from the collection of data relating to accidents in 2007.

The project team would like to thank the Safety Database Correspondents: Mrs C. Herrero, Mrs C.-L. Lasbareilles, Mrs J. van Strijland-Zweers and Messrs: C. Basting; L. Bourreau; E. Caporaletti; A. Carabineanu; A. Collinet; S. F. Erichsen; G. Fejös; A. Fondatori; J. Fouquet; J. C. Freitas; M. Hari; H. Jürgen; M. Lannoy; D. Lenart; T. Merz; J. Molko; J. Neustifter; L. Nilsson; Z. Novotny; S. Sabariego; P. Sizer; Z. Specjalski; Z. Zawadzki. They have participated in the work over the last year.