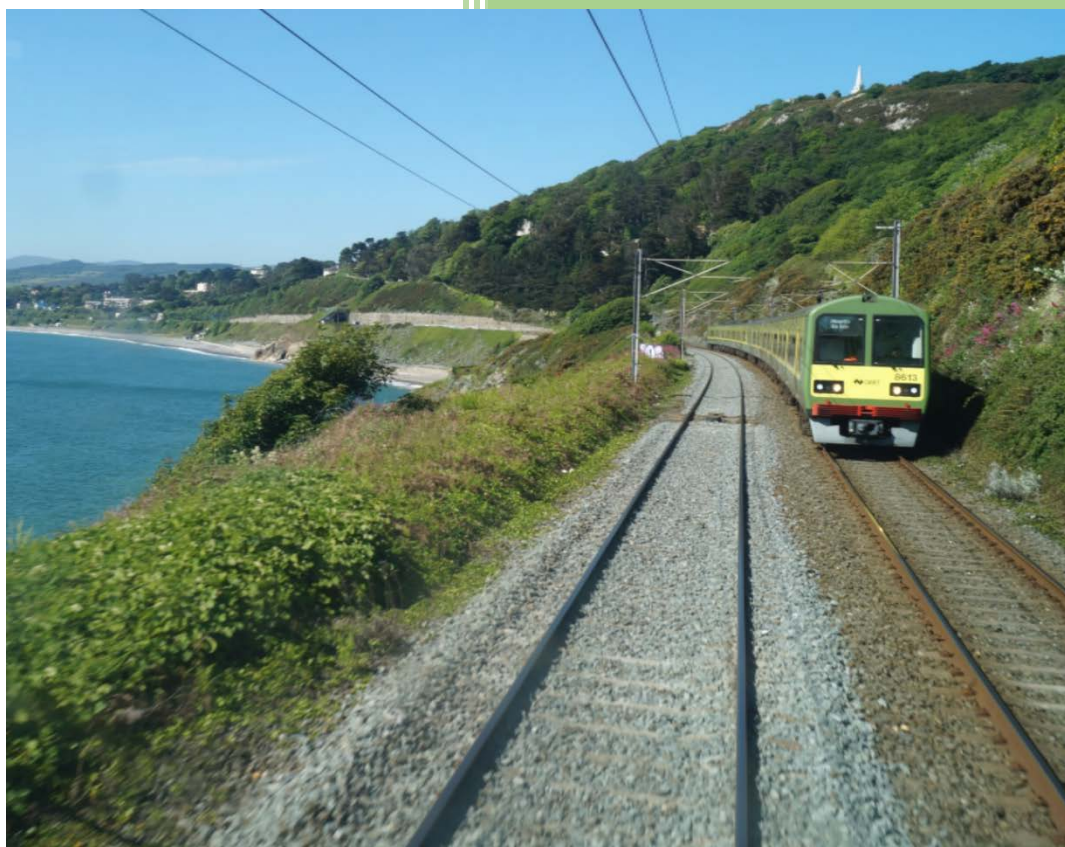


Railway Safety Performance in Ireland



Commission for Railway Regulation

16/12/2016

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Foreword

The safety performance of our principal railway operators in 2015 was, on the whole, positive with many key performance indicators seeing improvements on 2014. Passenger numbers on both the Iarnród Éireann rail network and on the LUAS continue to recover to the highs of 2007/08.

There were no passenger fatalities in 2015, however, sadly there were 2 fatalities on our railways, both as a result of apparent self-harm.

2015 saw an increase in incidents in depots and sidings which while pose less of a safety risk to the general public suggest internal monitoring by railway organisations might be in need of improvement.


The number of signals passed at danger (SPAD) occurrences, an indicator of particular interest to the Commission for Railway Regulation (CRR) given their potential for a serious accident, increased slightly in 2015 and will therefore continue to be a focus of our attention.

Over speed occurrences have also seen an increase as new speed detection methods are used to monitor adherence. Such occurrences have the potential to be catastrophic as was the case in Santiago de Compostela in 2013 and more recently in Eckwersheim, Eastern France, in November 2015.

In terms of the LUAS operation infrastructure failures are now on the increase possibly as a result of the aging assets. Vigilant inspection and monitoring and planned renewal activity will be required over the coming years to ensure the system remains safe.

In conclusion, the CRR will continue to focus on its mission “to advancing railway safety, ensuring fair access to the Iarnród Éireann infrastructure, and monitoring the sustainability of rail transport in Ireland.

I hope that you will find this report informative and interesting.



Anthony Byrne

Principal Inspector – Supervision & Enforcement

Executive Summary

This is the seventh separately published annual safety performance report of the Commission for Railway Regulation (CRR). It has been prepared for the general public in line with Section 10 of the Railway Safety Act 2005 (the Act), which requires that the CRR operates in an open, non-discriminatory and transparent manner. This report provides background statistics to a number of safety performance indicators with discussion when appropriate.

The CRR is the independent railway safety regulator in the Republic of Ireland and is responsible for overseeing the safety of all railway organisations, including Iarnród Éireann, Transdev (Luas Operator), Balfour Beatty Rail Ireland (BBRI), Bord Na Móna where their railway interfaces with public roads, the Railway Preservation Society of Ireland and a number of smaller heritage railways and the authorisation of projects undertaken by the Transport Infrastructure Ireland (TII) formally the Railway Procurement Agency (RPA).

The safety performance of Iarnród Éireann, BBRI and Transdev is, in the main, positive and broadly in line with previous years. However, concerns remain for both the rail and tram networks, with the operational environment continuing to remain demanding. Imported risk, from third parties interfacing with the railway continues to be an issue.

There were no passenger fatalities or serious injuries in 2015. However, 2 people lost their lives due to unauthorised entry onto the railway. There were no reports of level crossing deaths this year.

Passenger injuries were consistent with 2014 data, with no discernible trend detected. Employee injuries have also fallen, even as the number of passengers carried has continued to increase. The number of train collisions has also continued a downward trend, with the exception of collisions with large animals. There is no obvious cause of this, but the dataset is characteristically erratic.

Signals Passed At Danger (SPADs) has unfortunately reverted to a downward trend since the low of 2011. The trend is being monitored as part of specific supervision activities by the CRR. Iarnród Éireann is also developing a unique hybrid train protection system that seeks to overlay, and eventually replace, the current train control system and enhance safety through increased supervision of train movement.

LUAS safety performance in 2015 was broadly consistent with previous years, all the safety indicators are trending in a positive direction with the exception of Emergency Brake (EB) Applications. These are not actual accidents, but where the tram driver has braked sharply. They have been on a steady rise since 2013, and maybe reflective of increased road and pedestrian traffic, as the economy recovers. Transdev are monitoring EB applications and are devising initiatives to reverse this trend. In other initiatives, Transdev have worked with An Gardaí Síochana to introduce a Red Light camera, to detect car drivers who run red lights, at

the junction of Benburb Street/Blackhall Place, previously the location of a high number of RTAs.

Further insight is given to Ireland's rail safety performance within a European Context. It is demonstrated in the report that Ireland continues its satisfactory trend of recent times relative to other European Railways. Additional analysis is presented showing the installation of train protection systems in Europe, where it was noted Ireland's network has had no increase in percentage of track covered by ATP. Notable international railway incidents are also discussed.

In 2015 the RAIU published two reports into accidents and incidents that were formally investigated. These produced a total of 4 new safety recommendations, which are detailed in Chapter 5.

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1 Introduction



1.1 Introduction

This is the seventh Annual Safety Performance report of the Commission for Railway Regulation (CRR), prepared for the general public in line with Section 10 of the Railway Safety Act 2005 which requires that the CRR operates in an open, non-discriminatory and transparent manner. This report provides background statistics and comment to a number of important safety performance indicators. Performance indicators are guided by the Common Safety Indicators (CSI), as specified in Directive 2004/49/EC and amended by Directive 149/2009/EC. Further indicators are included in this report to reflect unique aspects and risks particular to Irish Railways.

1.2 Overview of Report

In Chapter 2, a brief overview of the public representations received by the CRR is presented. Safety trends in Ireland are presented and discussed in Chapter 3. All categories of train incidents are included. In Chapter 4, a high level comparison with other European railways shows where Iarnród Éireann (IÉ) are positioned in terms of railway safety. This includes a brief overview of significant accidents that have occurred in other countries in 2015. Chapter 5 concerns the Railway Accident Investigation Unit (RAIU) and recommendations made arising out of their investigations. The status of each recommendation is explained together with details of actions taken to date.

1.3 The Commission for Railway Regulation

The CRR (then the Railway Safety Commission) was established on 1st January 2006 under provision of the Railway Safety Act 2005, with responsibility for railway safety regulation. It is a small, professional organisation with a flat reporting structure. Its mission is to “advance the safety of railways in Ireland through diligent supervision and enforcement”

The CRR as the NSA has responsibility for conformity assessment and issuing of safety certificates and safety authorisations for safety management systems, new rolling stock and infrastructure, and monitoring the industry to ensure it manages its safety risk effectively. The CRR also co-ordinates and encourages railway safety initiatives between the industry and external stakeholders. Further details may be found on the CRR website www.CRR.ie.

1.4 Statistical Qualification

The CRR produces this report to enhance public access to information about safety performance of the various Irish railway organisations. The CRR’s goal is to keep this information timely and accurate. If errors are brought to the CRR’s attention, every effort will be made to correct them.

This information is:

Anthony Byrne

- of a general nature only
- not professional or legal advice

It is important to note that the figures used in this report are intended to illustrate broad trends and are not meant to be read as exact calculations. Rounding has been used and this could affect the overall data.

It is the CRR's goal to minimise any inconvenience caused by technical errors. However, some data or information in this report may have been created or structured in files or formats that are not error-free. The CRR accepts no responsibility with regard to such problems incurred as a result of using data from this report

2 Public Representations



2.1 Introduction

The CRR encourages the public, passengers, railway staff and others to bring any railway safety concerns to its attention. Facilities are available to communicate with the CRR by phone, post or via the CRR website (www.crr.ie) and a confidential recipient programme. The CRR also monitors media coverage of incidents related to railway safety. The input of all stakeholders in the railway, such as employees, passengers and the general public is valuable in the CRR's work to improve railway safety. Where these issues relate to service rather than safety, the CRR directs the representation to the appropriate entity. Where the matter involves railway safety the CRR endeavours, wherever possible, to deal with the matter directly. If necessary the CRR will seek information from the appropriate railway company for further clarification.

2.2 2015 Data and Commentary

In 2015, the CRR received 60 direct or indirect representations relating to a range of heavy and light rail infrastructural and operational matters, a decrease in 13 on 2014 (73), but in line with the 5 year average of 59. Of these, 51 are related to Iarnród Éireann operations or infrastructure (69 in 2014), 8 pertained to the LUAS (Dublin Light Rail) system (3 in 2014) and 1 for the RPSI.

A number of the representations did give cause for concern and the CRR acted promptly to ensure that corrective action was taken by the relevant Railway Organisation. In some instances the Railway Organisation was required to take immediate action. It is CRR policy that all safety related concerns are investigated. Representations are continually tracked for re-occurrence and detection of trends. If either are observed, monitoring activities are increased to determine and address underlying causes.

The variation in public representations from 2014 to 2015 is downward, but as mentioned above, in line with the 5 year average of 59 per annum. The increase in 2013 was attributed to passenger safety concerns of overcrowding of services on the Iarnród Éireann network. Passengers continued to contact the CRR on this concern, but it is reduced by about 50% from 2013, and only two representations relating to overcrowding on IÉ and one on Luas in 2015. Figure 2 contains further data describing a more detailed breakdown.

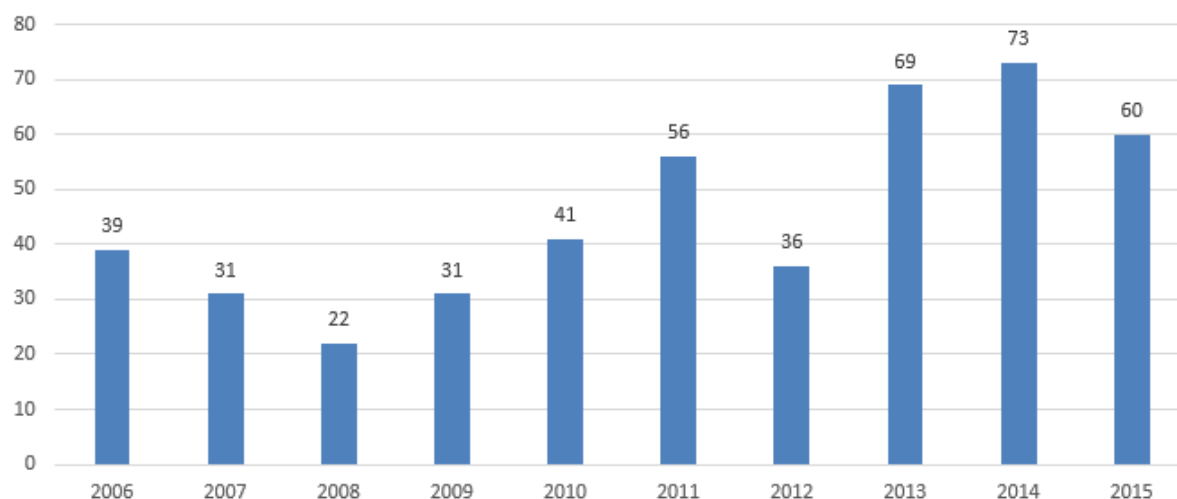


Figure 1- Public Representations to the CRR by year

Representations from 2015 were further analysed and broken down in to the following categories:

- Safety at Stations: Queries relating to incidents or concerns at stations
- Safety of Infrastructure: Queries relating to Railway Infrastructure such as bridges, level crossings or fencing
- Safety of Rolling Stock: Queries relating to Vehicles such as grab rail security or door operation
- Safety of Train Operation: Queries relating to operations such as train loading, excess train speed or shared running of trams
- Safety of Railway Working: Queries relating to operational activities on the railway such as network regulation or management control.

The distribution of the categories is shown in Figure 2. The distribution has changed somewhat compared to 2014, with Safety of railway working reports reverted to a similar proportion in the years before 2014. It is not possible to ascribe changes in reporting to one particular reason, but the CRR will continue to monitor as to if the trend continues.

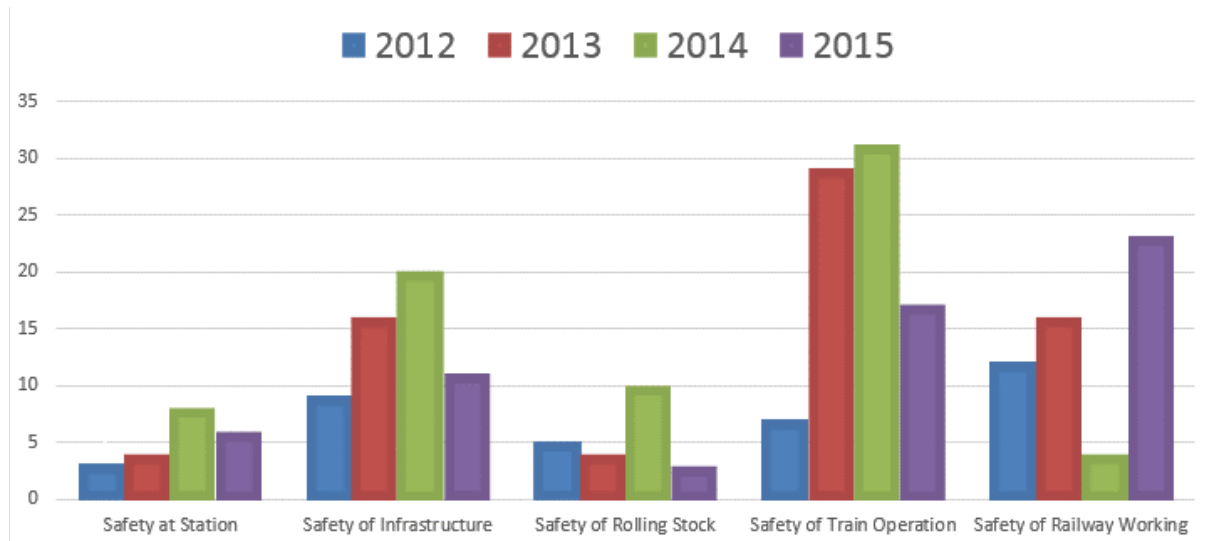


Figure 2 - CRR Public Representation by category

3 Railway Safety Trends in Ireland



3.1 Introduction

The safety performance of the Railway Organisations in the Republic of Ireland is considered for the four principal railway sub-sectors that the CRR regulates, namely heavy rail, light rail, public highway interfaces with industrial rail systems, and heritage railways. Each Railway Organisation is mandated by law to report statistical data on railway operations and incidents to the CRR. This data is then used for assessing Railway Organisation safety performance and management of risk.

3.2 Iarnród Éireann

3.2.1 Operational Statistics

At year end, the IÉ operational network was 1683 route-kilometres, the same as in 2014. There were no significant changes to the network or to the operational pattern of trains.

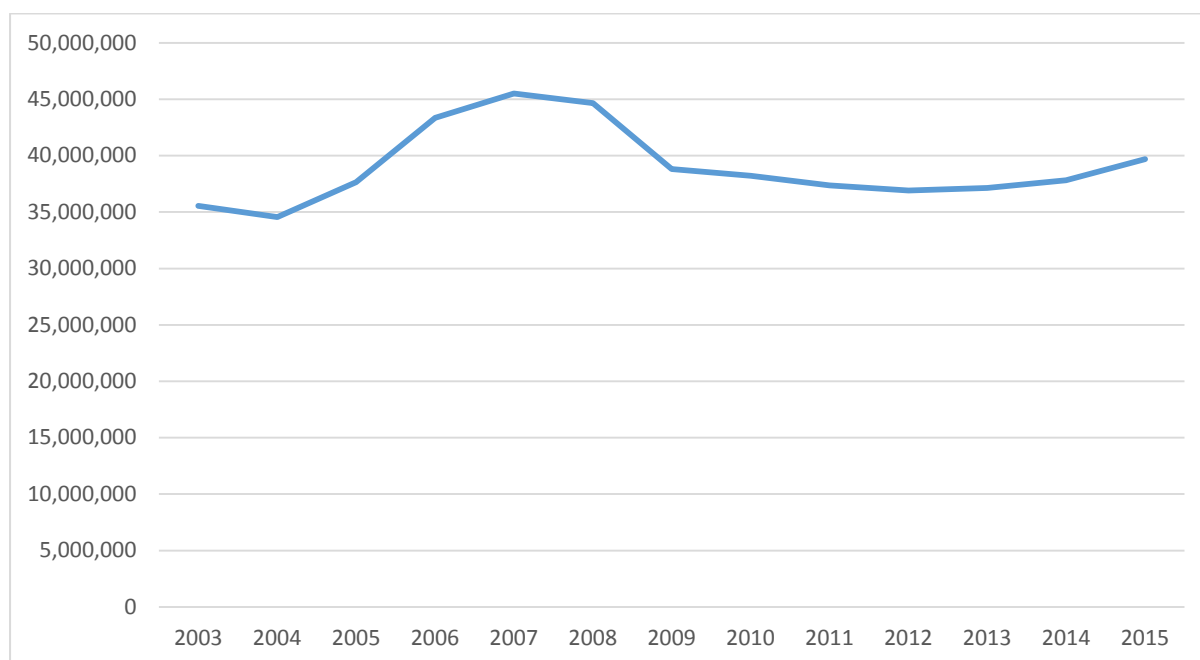


Figure 3 - IÉ Passenger Journeys 2003-2015

Passenger Journeys are up 5.5% on the 2014 figure to 39.7 million reflecting the recovery in the economy and exceeding the figures seen in 2005, although not yet at those seen in 2006-2007 of ~ 45,000,000. The trend, noted in 2014, has now been established which demonstrates an increase in passenger journeys for the last four years. There is scope for this pattern to continue with several public transport projects such as Cork Kent Station Development, Phoenix Park Tunnel Passenger Services, and Luas Cross City in various stages of progress.

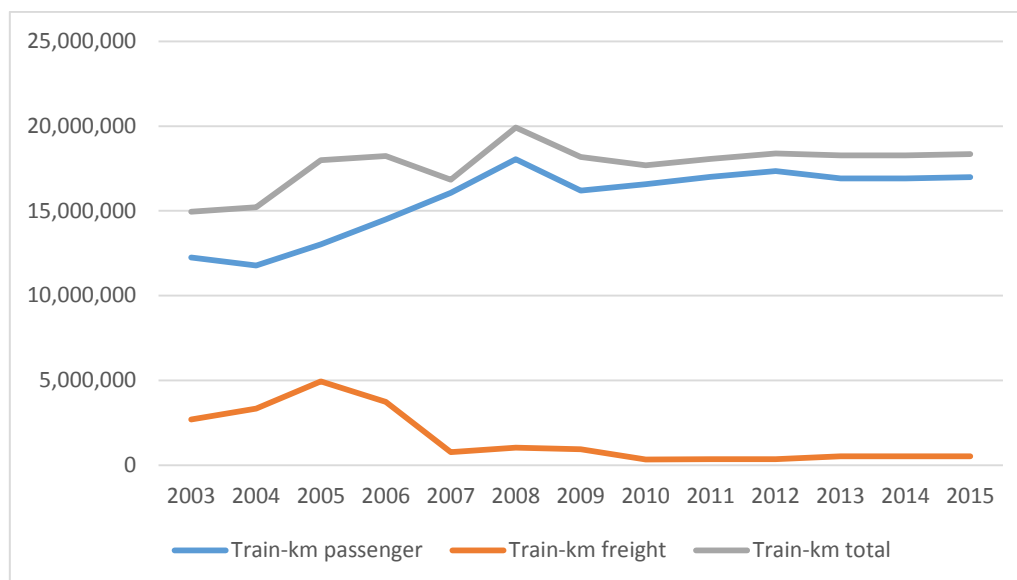


Figure 4 - Train-km on the IÉ Network 2003-2015

The long term trend for reduced freight movements is quite evident in Figure 4. A peak of about 5,000,000 freight train-km was reached in 2005 but this declined rapidly afterwards following strategic operational decisions which reduced freight traffic. At about this time, passenger-km soared and peaked in 2008. Iarnród Éireann is currently endeavouring to expand freight services following the plateauing of freight from 2010, with a decline of 3.4% in 2015, compared to 2014, to 96.4m freight tonne kilometres.

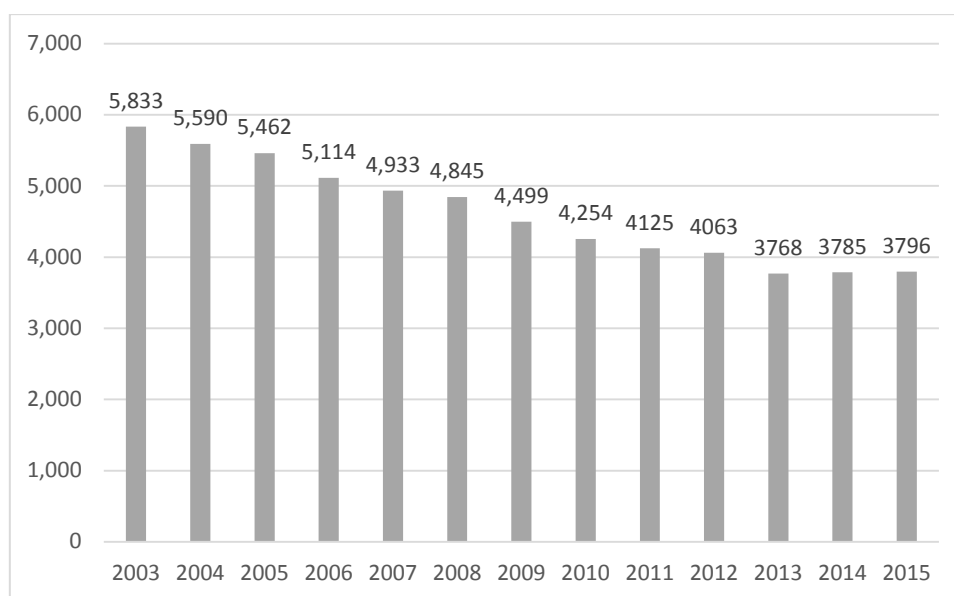


Figure 5 - Personnel engaged in full time employment with IÉ

Since 2008, Iarnród Éireann had decreased employee numbers significantly. This trend has been arrested in the last 3 years, with consistent staff numbers since 2013. As the volume of both passenger and freight traffic starts to increase again, having a critical mass of competent staff is vitally important to maintaining operational and infrastructure safety.

3.2.2 Iarnród Éireann Fatality and Injury Statistics

Figure 6 illustrates the fatalities and lost-time injuries reported for employees and fatalities and injuries to third parties on the national railway network for the years 2006 to 2015.

Category	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend
Railway operations: passenger fatal injuries											
Fatal injury to passenger due to a train accident, not at level crossing	0	0	0	0	0	0	0	0	0	0	
Fatal injury to passenger due to a train accident at level crossing	0	0	0	0	0	0	0	0	0	0	
Fatal injury to passenger travelling on a train, other than in train accident	0	0	0	0	0	0	0	0	0	0	
Fatal injury to passenger attempting to board or alight from train	0	0	0	0	0	0	0	0	0	0	
Railway infrastructure: third party fatal injuries											
Fatal injury to third party at a level crossing involving a train	0	1	1	0	2	0	0	0	0	0	
Fatal injury to third party at a level crossing not involving a train	0	0	0	0	0	0	0	0	0	0	
Railway operations: employee fatal injuries										0	
Fatal injury to employee at a level crossing due to train in motion	0	0	0	0	0	0	0	0	0	0	
Fatal injury to employee due to train in motion (other than at a level crossing)	0	0	0	0	0	0	0	0	0	0	
Fatal injury to employee not due to train in motion	0	0	0	0	0	0	0	0	0	0	
Railway infrastructure: employee fatal injuries											
Fatal injury to employee at a level crossing due to train in motion	0	0	0	0	0	0	0	0	0	0	
Fatal injury to employee due to train in motion (other than at a level crossing)	0	0	0	0	0	0	0	0	0	0	
Fatal injury to employee not due to train in motion	0	0	0	0	0	0	0	0	0	0	
Railway operations: fatal injuries to other persons											
Fatal injury due to train in motion not at level crossing	0	1	0	0	0	0	0	0	0	0	
Fatal injury to customer or visitor, no train involved	0	1	0	0	0	0	0	0	0	0	
Fatal injury involving train in motion on railway or level crossing where trespass or suspicious death was indicated	7	5	8	3	8	7	5	4	6	2	
Railway operations: non fatal injuries to passengers											
Injury to passenger travelling on train due to a railway accident not at level crossing	0	0	0	2	0	0	0	0	0	0	
Injury to passenger travelling on train due to railway accident at level crossing	0	0	0	0	0	0	0	0	0	0	
Injury to passenger attempting to board or alight from train	55	50	43	17	64	46	41	39	45	48	
Injury to passenger travelling on train, other than due to a railway accident	41	35	22	40	28	10	27	43	18	15	
Railway infrastructure: third party non fatal injuries											
Third party at level crossing injury involving a train	0	1	0	0	0	1	2	0	0	0	
Level crossing user injury not involving a train	0	1	1	1	0	2	5	1	0	0	
Railway infrastructure: non fatal injuries to other persons											
Injury to customer or visitor to premises	72	70	54	56	85	113	116	193	205	146	
Injuries to other persons including unauthorised persons	0	1	0	0	0	0	5	3	0	1	
Railway operations: non fatal employee injuries											
Employee lost time injury involving train movement or train accident	15	7	8	13	11	7	13	5	21	3	
Employee lost time injury while working on railway not due to train in motion	38	36	37	31	27	22	32	39	43	22	
Railway infrastructure: non fatal employee injuries											
Employee lost time injury involving train movement or train accident	0	1	1	0	1	2	1	0	0	0	
Employee lost time injury while working on railway not due to train in motion	31	42	42	34	30	23	32	41	25	6	
Employee lost time injury while working at level crossing not due to train in motion	2	4	0	0	0	0	1	1	2	0	
Entity in charge of maintenance and maintenance workshops: non fatal employee injuries											
Employee lost time injury involving train movement or train accident	0	0	0	1	0	0	0	0	0	0	
Employee lost time injury while working on railway not due to train in motion	30	36	27	21	10	18	10	14	18	13	

Figure 6 - IÉ Operational fatality and Injury Statistics by year

3.2.2.1 Fatal Injuries

In 2015 there were 2 fatal injuries on the railway, which is a decrease from 6 in 2014. Both these fatalities were categorised as trespasser fatalities. The CRR refers to a coroner's verdict, when available, to assist in classifying the circumstances surrounding a fatality.

3.2.2.2 Passenger Injuries

The data indicates that the largest proportion of incidents occur to passengers during time spent at stations as opposed to time spent on trains. This is common across many railways due to the sedentary nature of passengers when on board a train.

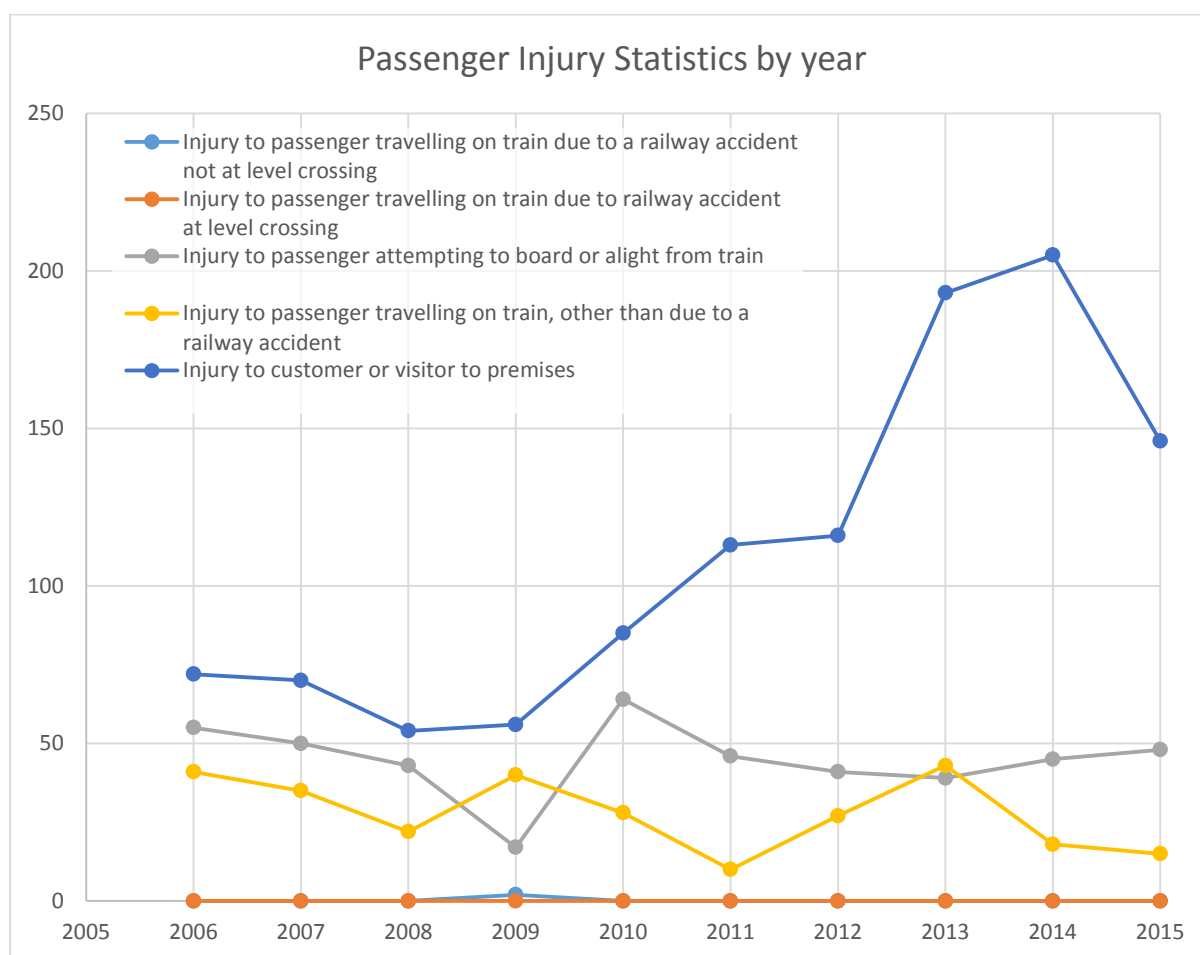


Figure 7 - Passenger Injury Statistics by year

Similar to other years, injuries to customers or visitors to premises remain at the largest single group with slips, trips and falls being the dominant cause of these injuries. It is notable that there has been a sharp reduction in these incidents in 2015 well below the 2014 and 2013 peak values. These incidents tend to be of a minor nature and are usually treated by first aid at the station. IÉ continue report usage of mobile phones has been a factor in many incidents,

where customer/visitor's attention is divided and therefore more prone to injury at stations, due to a slip, trip or fall.

Injuries to passengers attempting to board or alight from trains has seen a small increase and remains a cause for concern owing to the high risk of significant injury from this type of incident. It should be noted though that with the exception of 2009, these injuries trend in line with passenger numbers.

3.2.2.3 Employee Injuries

As in last year's report, employee injuries are categorised in the first instance by the sector of the railway system in which they work; Railway Operations, Infrastructure, and Entity in Charge of Maintenance (ECM)*.

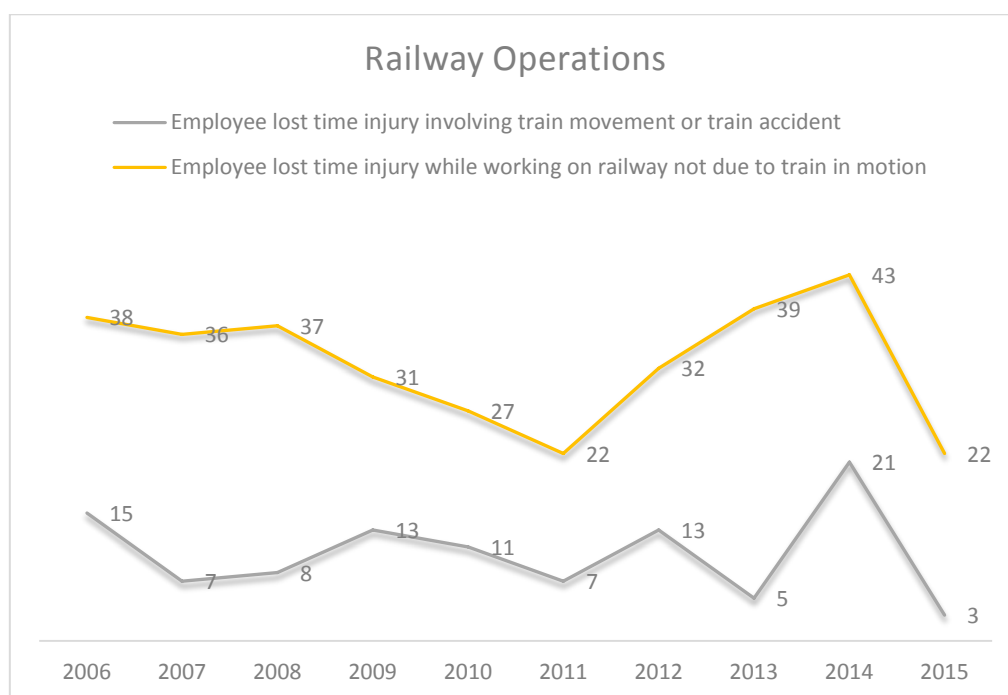


Figure 8 - Employee Injury statistics by year (Railway Operations)

The significant rise in Lost Time Incidents involving train movements in 2014 has been reversed. IÉ has rolled out a number of initiatives such as “Accident Free Depends on Me” and “Close Call” reporting. These are ongoing initiatives across all IÉ business units, and have been suggested as the cause of the decrease in Lost Time incidents for the IM (Infrastructure Managers) and ECM graphs too.

* Note ECMs are organisations which through a system of maintenance is responsible vehicles are safe to run.

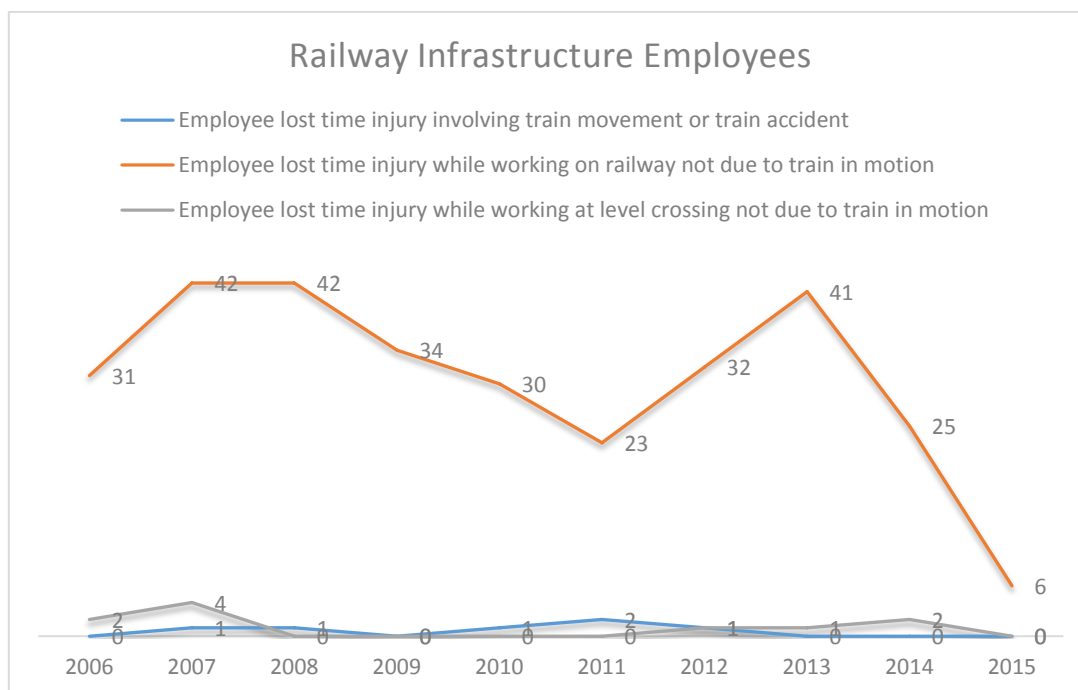


Figure 9 - Employee Injury statistics by year (Railway Infrastructure)

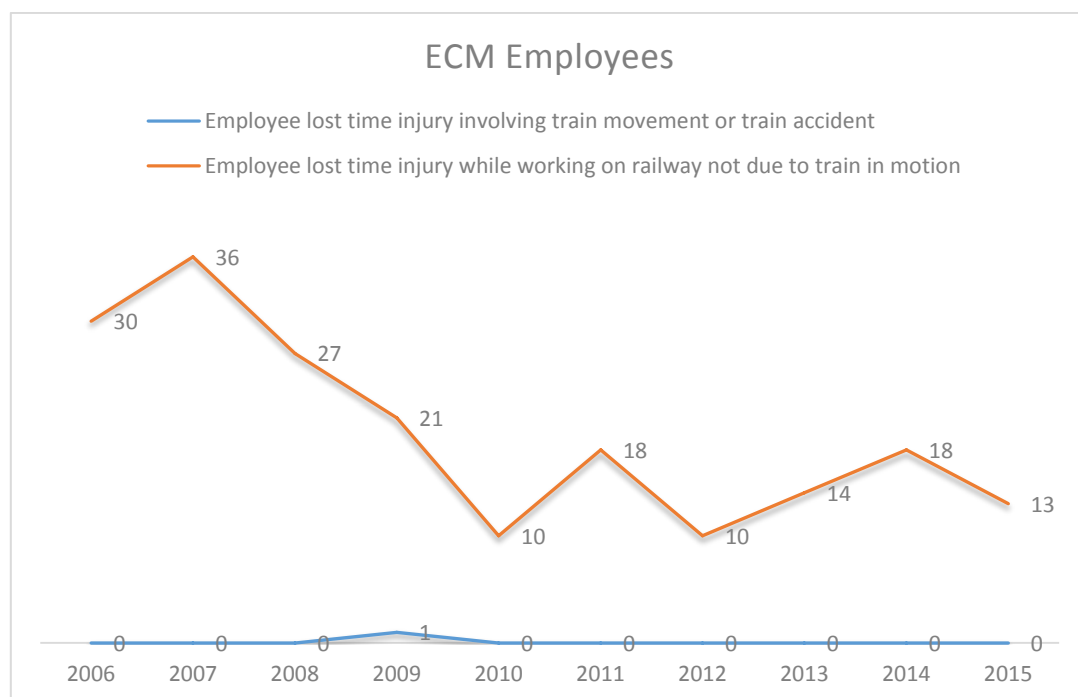


Figure 10 - Employee Injury statistics by year (Railway ECM)

In response to an increasing trend for the ECM in 2014, an Accident Reduction Strategy was established that has sought to reduce accidents by enhanced analysis of accident causes and review of safety management procedures.

3.2.3 Iarnród Éireann Operational Incident Statistics

3.2.3.1 Train Collisions

Train collisions can pose a significant risk to passengers, train crew and third parties. They have the potential to cause significant human and environmental harm. Figure 11 illustrates the trend for collisions since 2003. Figure 11 has been further split into parts, seen in Figure 12 & Figure 13 to aid understanding of the data. Two categories, ‘Total Collisions with Obstacles on the line’ and ‘Train Collisions with animals (large)’, have been separated to enhance visibility of the data.

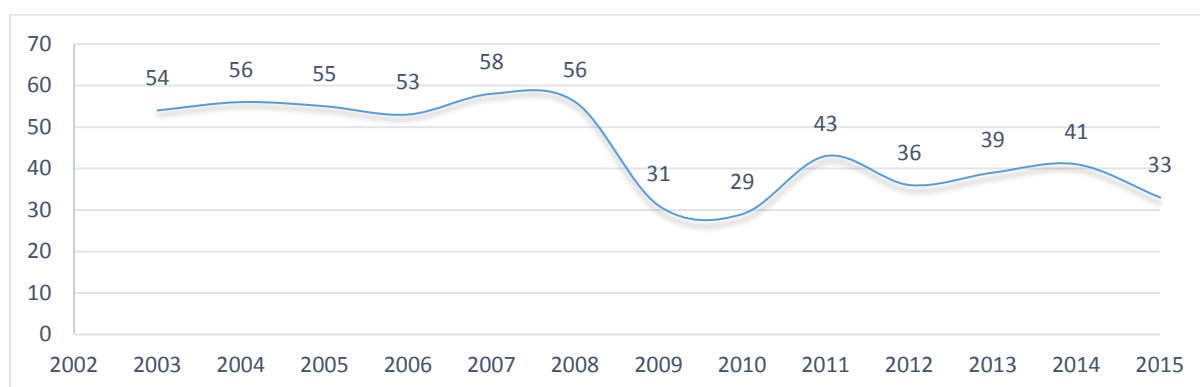


Figure 11 - Total Collisions by year

Category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Trend
Train collision with passenger or goods train on running line	0	0	0	1	0	0	0	0	0	0	0	0	0	
Train/railway vehicle collision in station or possession movement	2	0	1	1	0	1	1	0	0	1	1	1	1	
Train collision with a motor vehicle at a level crossing	1	2	2	1	4	4	0	2	1	2	1	2	0	
Train collision with pedestrian at a level crossing	0	0	0	0	1	0	0	1	0	0	0	0	0	
Train collision with attended gates at a level crossing	2	4	2	2	2	1	0	1	0	0	0	0	1	
Train collision with road vehicle obstructing the line (not at a level crossing)	2	0	0	0	0	0	0	0	0	1	1	0	1	
Train collision with other obstacle on the line	4	10	8	5	9	17	10	1	7	6	7	29	1	
Train collision with large animal(s) on the line	43	40	42	43	42	33	20	24	35	26	29	9	29	

Figure 12 - Train Collision Statistics detail by year Part 1

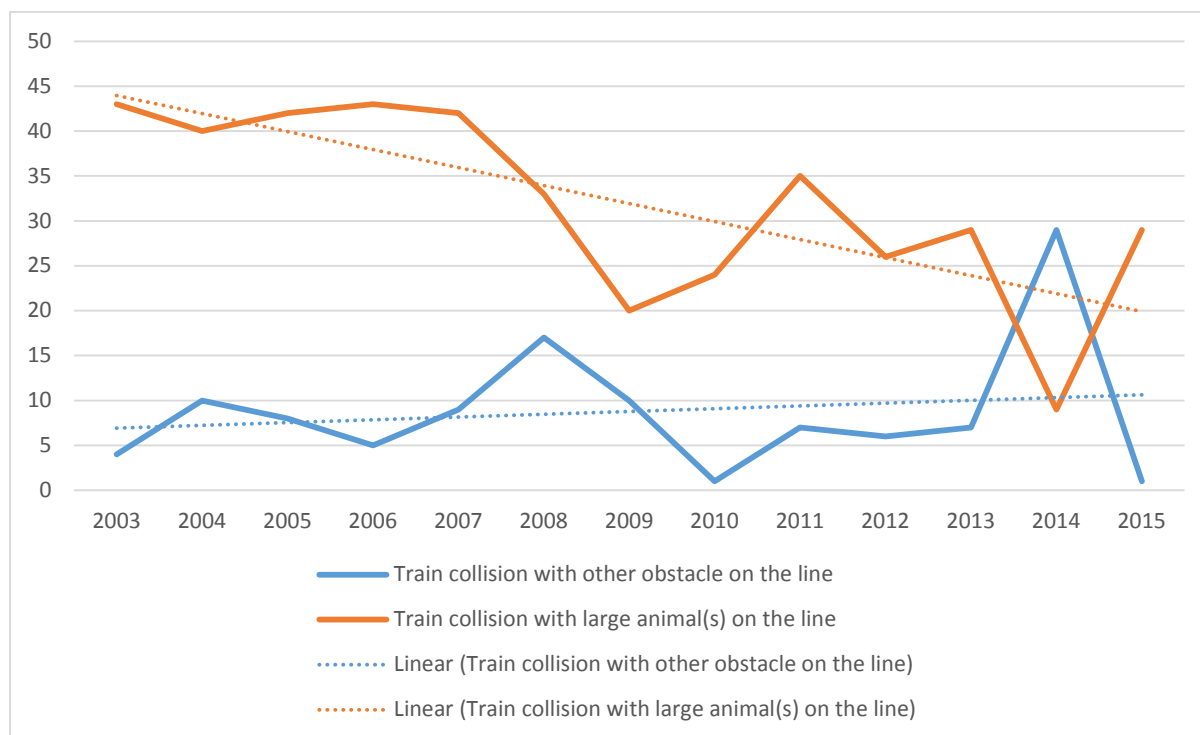


Figure 13 - Train Collision Statistics detail by year, part 2

Total collisions have fallen to 33 in 2015 from 41 in 2014. There has been some volatility in the data between 2013 and 2015, but the trends as shown in the graphs above remain clear. As discussed in previous reports, animals are a major contributor to collision statistics in Ireland. Iarnród Éireann continues to improve those systems protecting incursions to its railway. Analysis can be difficult on the factors that draw animals to the path of oncoming trains as the events appear to be random. It is considered that actions by Iarnród Éireann in enhancing boundary defence systems are a notable contributor. In addition the reduction in the number of level crossings should also be assisting in this trend.

‘Other Obstacle’ collisions have continued to trend down in 2015 after a spike in 2014. Analysis from the railway operator indicates the spike was attributable to adverse effects from storms experienced in certain locations during the early part of 2014.

3.2.3.2 Level Crossings

Level crossings are a significant risk to the railway and to any third parties who use them. The long established trend, as shown in Figure 14 and Figure 15 is a decrease in the number of level crossings; there were 1701 level crossings in 2004 vs 942 recorded for 2015, with 36 being eliminated in 2015.

The CCR has changed its approach slightly in regard to counting level crossings. Previously, total numbers of level crossings were counted rather than those which were active, that is to say the number reported in earlier years would have included level crossings which were present on closed or dormant lines. Since the 2013 report only those level crossings which are

present on active lines are included, since these are the crossings which present risk to the railway and users.

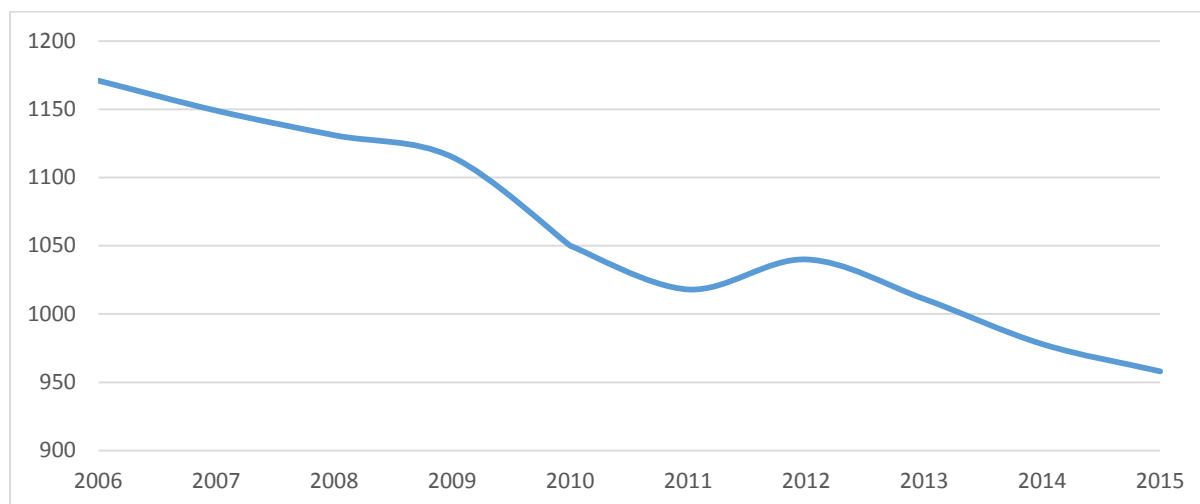


Figure 14 - Number of level crossings by year

The reader may note an upward trend from 2011 to 2012. The number of registered level crossings increased due to the separate classification of pedestrian-only crossing points at certain manned level crossings and the regularisation of a small number of unofficial crossing points on well-established rights of way. The graph also demonstrates the long term trend of level crossing elimination. Sustained efforts by Iarnród Éireann have contributed greatly to reducing the risk presented by level crossings.

The breakdown of level crossings by type and year in Ireland is shown in Figure 15. Level crossings on public roads that require the road user to manually open and close gates remain the highest risk type of level crossing, closely followed by 'Field type' level crossings. Recent years have seen a decline in investment for the removal or upgrade of level crossings. Iarnród Éireann are currently reviewing novel technological designs to enhance safety and operation at user-worked level crossings whilst operating within constrained budgets.

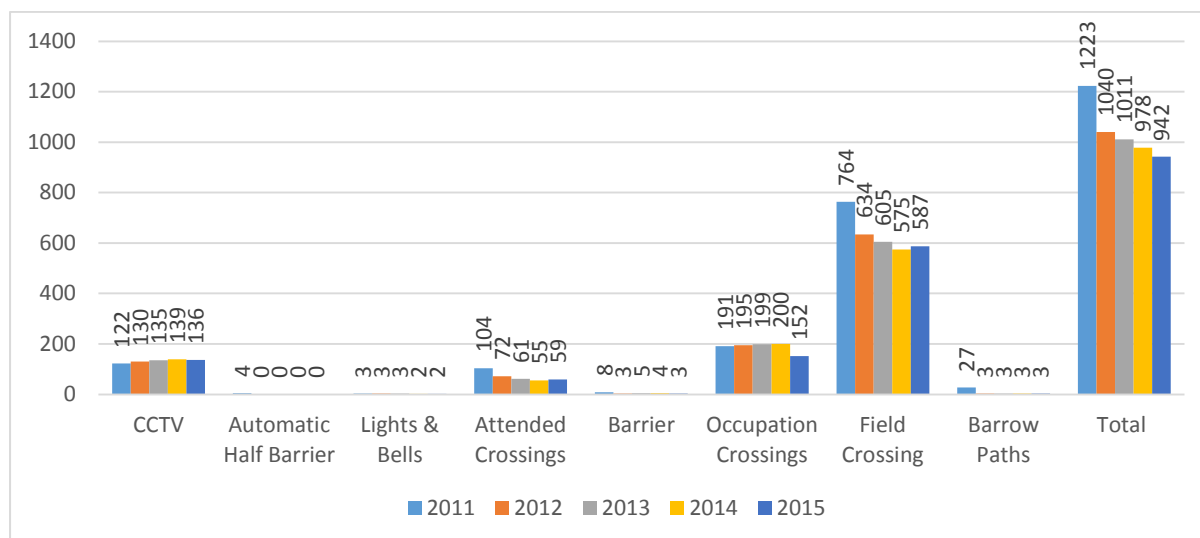


Figure 15 – Level Crossing by type in Ireland

3.2.3.3 Signals Passed at Danger (SPAD)

A SPAD is defined as having occurred when a train passes a stop (red) signal without authority. SPADs are a particular precursor event that the CRR monitors regularly during its supervisory meetings with IÉ. The trend in recent years has been a steady decline, but has started to rise again since the low of 2011.

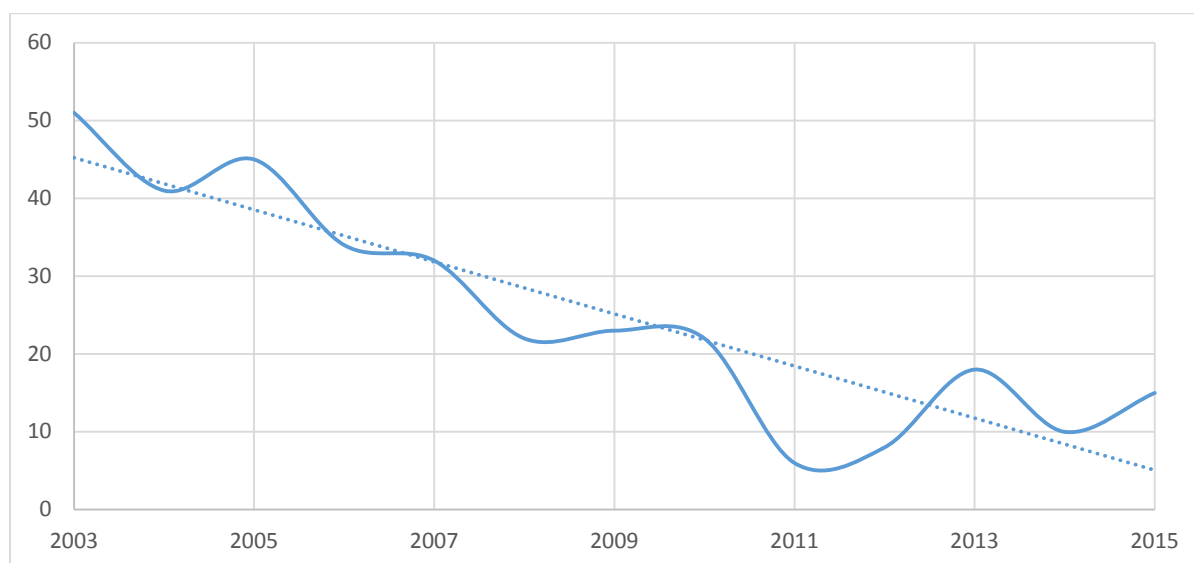


Figure 16 - IÉ SPADs by year

IÉ use a ranking tool developed in Great Britain by an industry body to determine whether each SPAD had the potential to cause an accident. A significant amount of information relating to each SPAD is collated. Using this information, IÉ determine a weighted numeric score for each occurrence and the score dictates the level of internal investigation. SPADs are categorised by type and are grouped into one of 3 severity bands; Low Risk; Medium Risk; and High Risk.

The trend is being monitored as part of specific supervision activities by the CRR, as noted in the Commission's 2013 Annual Report, "there was a significant increase in SPAD events on the IÉ network during that year. Although there was a reduction in the number of incidents in 2014, nonetheless the total for that year was still higher than that experienced in each of the years 2011 and 2012. There was a further rise in the number of SPADs during 2015."

Regardless of severity, all SPADs are investigated by IÉ to determine if there are lessons to be learnt and in such cases where a SPAD occurs where there is sufficient warning, train drivers are placed under additional internal surveillance.

3.2.3.4 Train Derailment

Train derailments remain at low levels. Continued track and rolling stock maintenance, in conjunction with targeted renewals of track, should ensure that this type of incident rarely occurs.

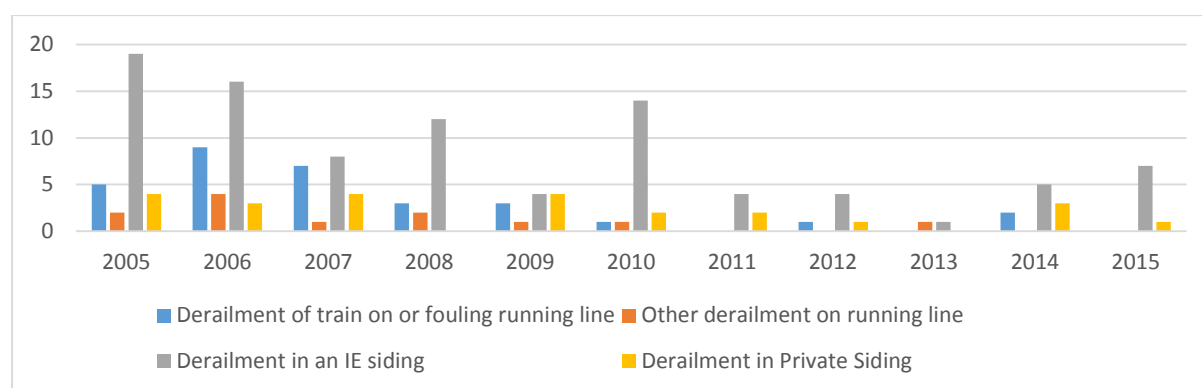


Figure 17 - Train Derailments by Year

Derailments in IÉ Sidings are observed to have continued to increase. IÉ has committed to auditing safety systems for train operations on sidings, and it is expected this will identify several improvements to current procedures.

3.2.4 Iarnród Éireann Rolling Stock Incidents

Iarnród Éireann operates several different fleets in provision of rail services. These include:

- Intercity Diesel Multiple Unit (22000 class)
- Diesel Multiple Unit (29000, 2800, 2600 classes)
- Electrical Multiple Unit (8100, 8200, 8500 classes)
- Locomotives (201, 071 classes)
- Passenger Carriages (Mark IV and DeDietrich)
- Freight wagons

There are a number of key safety performance indicators pertaining to rolling stock and they are:

- Fire or smoke incidents
- A train dividing (parting) while in service

- Failure of Rolling Stock Axle Bearing
- Door issues

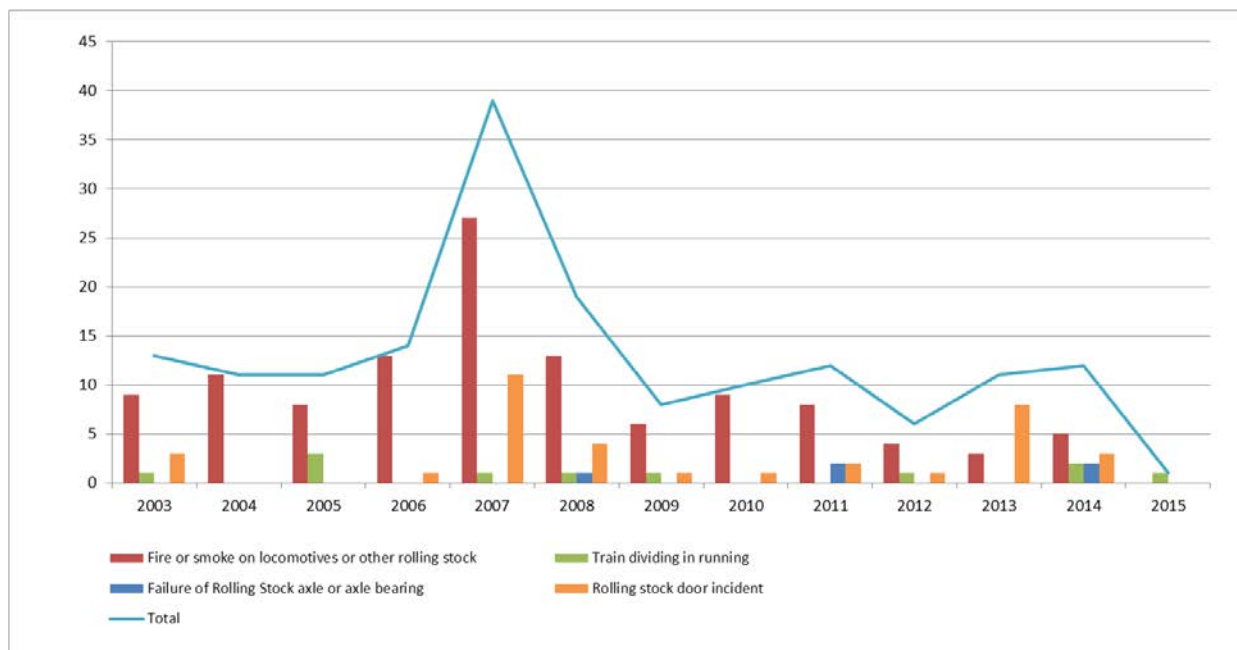


Figure 18 - Rolling Stock Incidents by year

In 2015 there were no reported instances of fire or smoke, or incidents with axle or axle bearings reported.

In the Commission's 2015 Annual Report makes reference to the "monitoring of abnormal wear that has become evident in the IÉ Intercity Rail Car axle journal bearings. Monitoring of the situation by the Commission, through regular meetings and inspections, continued throughout 2014 and 2015 due to the fact that the axle journal bearing life experience on these vehicles was considerably lower than the design level. However, none of the distressed bearing have triggered a Hot Axle Box Detector alarm or an axle box mounted temperature strip indication." Due to the work by Irish Rail no resultant incidents have occurred. Bearing Acoustic Monitoring has been introduced which will assist in defect detection.

There was also single incident with a train divide.

3.2.5 Iarnród Éireann Infrastructure Incidents

IÉ operate and maintain a large number of infrastructure assets including track, stations, bridges, culverts, tunnels, level crossings, buildings, cuttings and embankments, points and crossings, signals etc. all of which must be inspected and maintained at varying prescribed frequencies. Assets can fail due to aging and fatigue and the railway network in Ireland is abundant in legacy structures such as bridges and culverts. Rigorous inspection programme's and preventative maintenance minimise the risk of catastrophic failures. However, from time

to time incidents do occur and data relating to some of these is now presented in sections 3.2.5.1 and 3.2.5.2.

3.2.5.1 Broken Rails and Fishplates

Iarnród Éireann visually inspects the track at least once per week and rails are ultrasonically tested at least every 2 years, with the vast majority tested annually. There was a single broken rail on a passenger carrying line in 2015. Whilst this did not result in a train accident, it is an area where IÉ remains vigilant. The CRR closely monitors Iarnród Éireann's management of its assets through regular supervision meetings.

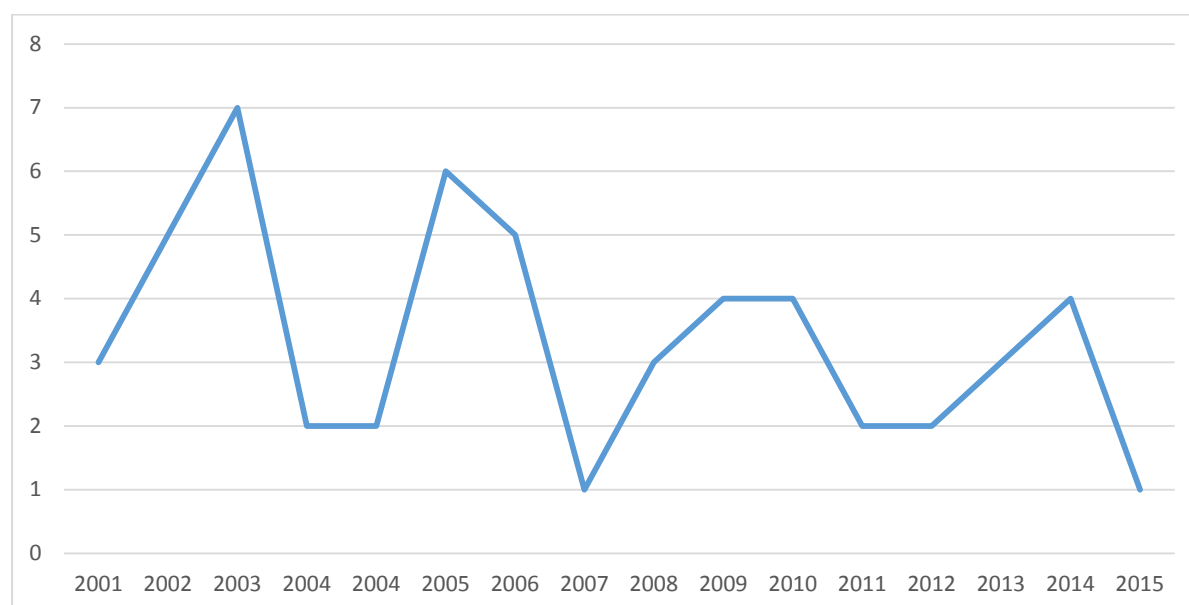


Figure 19 - Broken Rails by year

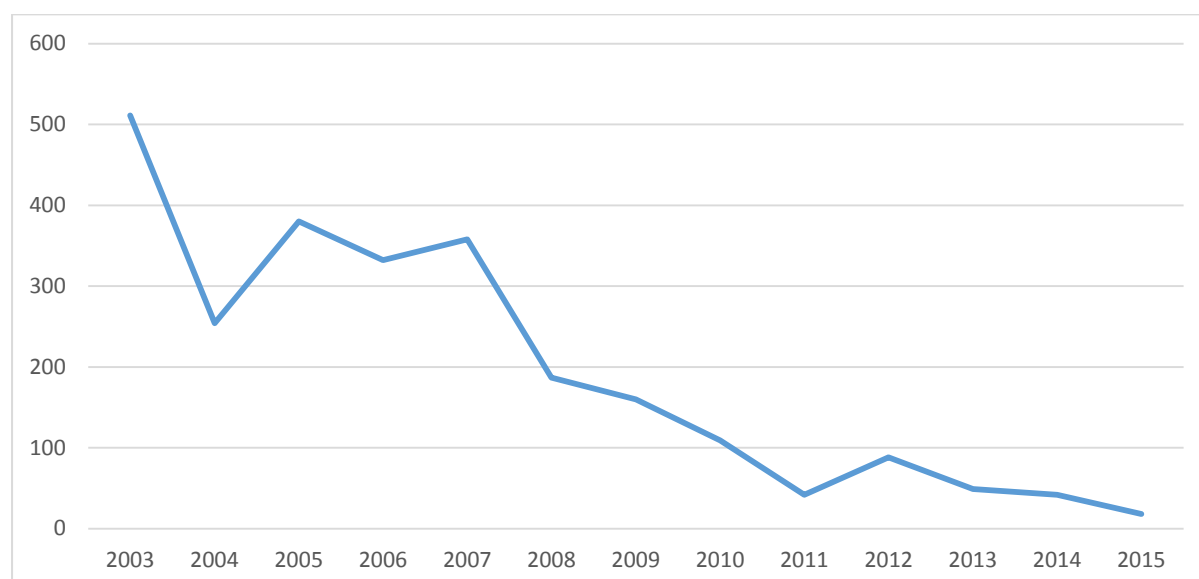


Figure 20 - Cracked or Broken Fishplates on the IÉ Network, by year.

A fishplate is a special bolted connection that joins two rails together. The trend for ‘Cracked’ or ‘Broken Fishplates’ continues on the overall downward direction seen over the last ten years. Following a small rise in 2012, a significant decrease was noted for 2013, with this trend continuing in 2014 and 2015. This decrease is attributable to the installation of continuous welded rail (CWR) under the Railway Safety Investment programme (1998-2013).

3.2.5.2 Bridge Strikes

A railway bridge may be a road over the railway or it may carry the railway over a road. A bridge strike is therefore where a road vehicle strikes the parapet or roadside containment of a bridge over the railway or where a road vehicle strikes the underside of a railway bridge over a road. Both types of incident can, in certain circumstances, result in very severe consequences and road users should be mindful of their driving in the vicinity of the railway. If driving an oversized vehicle, road vehicle drivers should know their vehicle height.

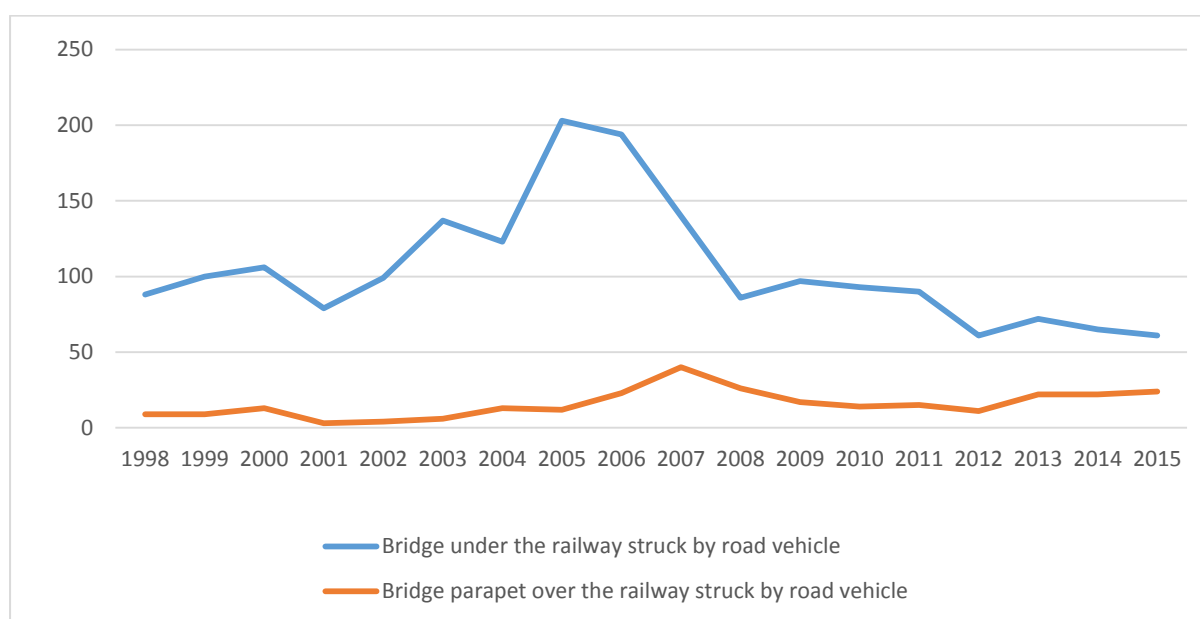


Figure 21 - Railway Bridges struck by road vehicles

The total number of bridge strikes, i.e., under-bridge and over-bridge, in 2015 were down slightly (85 vs 87 in 2014). There does appear to be a trend developing where underbridge strikes are gradually falling, whilst overbridge strikes incrementally rise. This does need to be set against a backdrop of rising road vehicle traffic.

The Road Rail Safety Working Group (RRSWG) is a cross party organisation that tackles this issue, amongst others. They met 3 times in 2015. The group is an advisory one consisting of high ranking officials from the following organisations:

- City and County Councils
- Iarnród Éireann
- Transdev
- Transport Infrastructure Ireland
- An Garda Síochána
- Road Safety Authority
- Irish Road Haulage Association
- County and City Managers Association
- Department of Transport, Tourism & Sport

The RRSWG targets area where the railway and the road intersect, such as at level crossings and bridges over and under railways or tramways. The group aims to facilitate exchange of information, provide advice and support to stakeholders, and discuss mitigation measures which may be enacted.

3.3 Balfour Beatty Rail Ireland

Under Regulation (EU) No.1158/2010 Parts A and B, Safety Certificates covering the operation of on track machines (OTMs) over the Iarnród Éireann network were issued to Balfour Beatty Rail Ireland Limited (BBRI) on 24th February 2014, and they are classified as a Railway Undertaking (RU) under this system. They operate and maintain On Track Machines (OTM) for Iarnród Éireann Infrastructure

This requires they are compliant with the same relevant law as other RUs as they conduct movements on the IE network. A significant number of their activities are safety critical and have potential for significant harm if not properly controlled.

BBRI are a relatively small organisation, and have notified a staff level of 45 employees to the CRR. BBRI do not operate any passenger services, and provide many of their services outside peak and daytime periods. The total train kilometres for 2015 was 64,737 km.

3.4 Transdev (Luas) Statistics

Transdev have been operating the Luas since it commenced operation in June 2004. Passenger journeys increased again in 2015 by 7% to 34.6 million journey, or around 89,000 passenger per day. There were no new extensions or services offered in 2015, although the Luas Cross City is under construction.

3.4.1 Road Traffic Accidents

The Luas by design co-exists with the public and road traffic along significant sections of its alignment, most notably in the city centre. The Luas operates primarily by ‘line of sight’ as typical of the majority of light rail systems around the world. However, given that the Luas shares sections of the carriageway with road vehicles, road traffic collisions (RTCs) can and

do occur. The number of road traffic accidents has fallen from the 2013/2014 numbers to 22 in 2015, see Figure 22

Queen Street continues to be the site of the largest number RTA's. Two other junctions are noted to have 3 RTAs (Church Street and Belgard) each with 2 others noted to as 2 RTAs each. In early 2015 a new system for capturing digital images of cars that do not obey traffic signals was installed. It is intended this will raise awareness and reduce issues at this location.

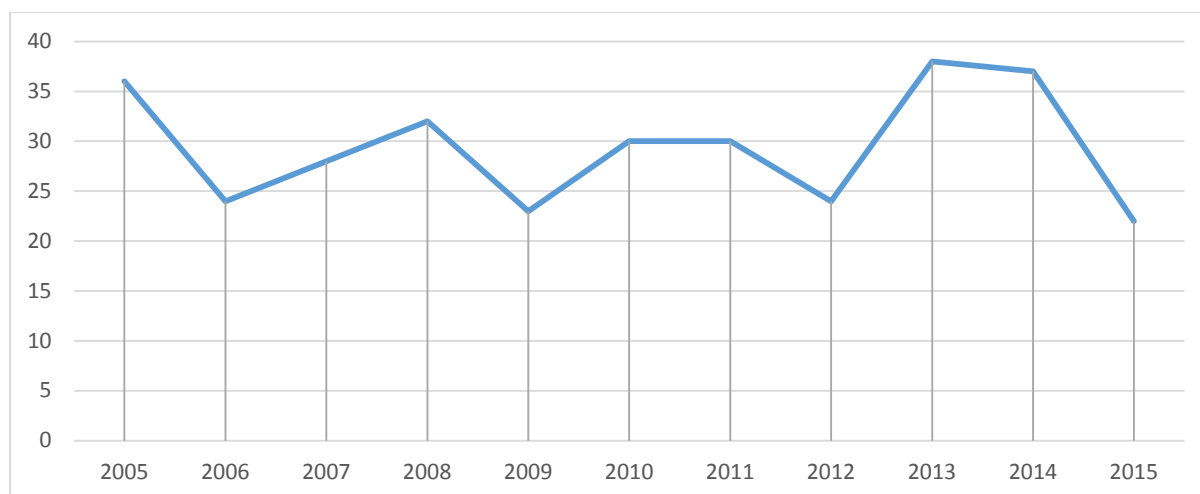


Figure 22 - Number of Road Traffic Accidents involving a tram, by year.

3.4.2 Tram / Pedestrian Contact

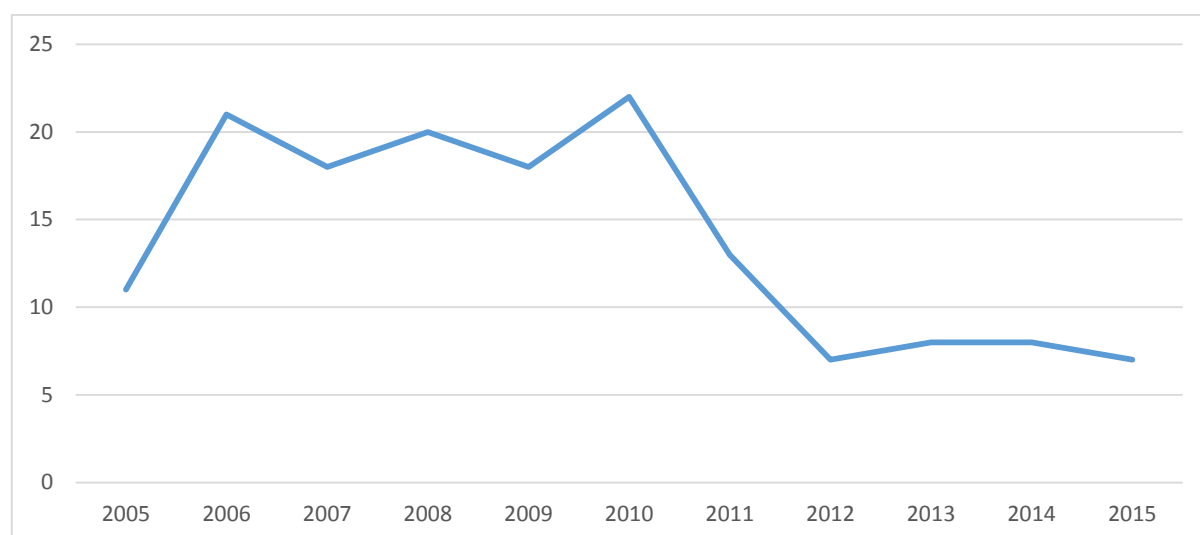


Figure 23 - Pedestrian coming into contact with Tram

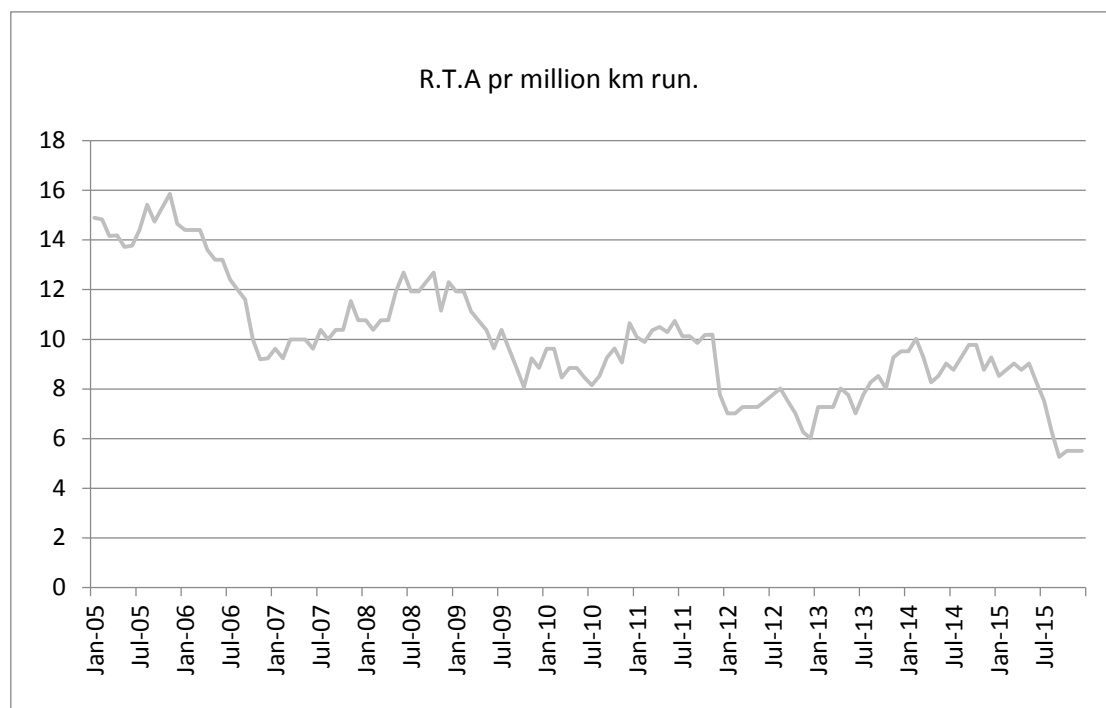


Figure 24 - RTA per million km run

A significant majority of incidents where contact is made between trams and pedestrians occur in and around Dublin city centre. The Luas Red Line in particular operates through 41 signalled junctions which are at grade. Such junctions carry a higher risk of the tram coming into contact with pedestrians. A total of 7 such incidents occurred in 2015, in line with the trend of 7-8 since 2012, of these two were cyclists and 5 were pedestrians. No serious injuries were reported. However, whilst the number of incidents is stable, it should be noted the number of tram km travelled is increasing, Figure 24 shows the effect of this.

3.4.3 Tram Derailments

No derailments have occurred since 2010.

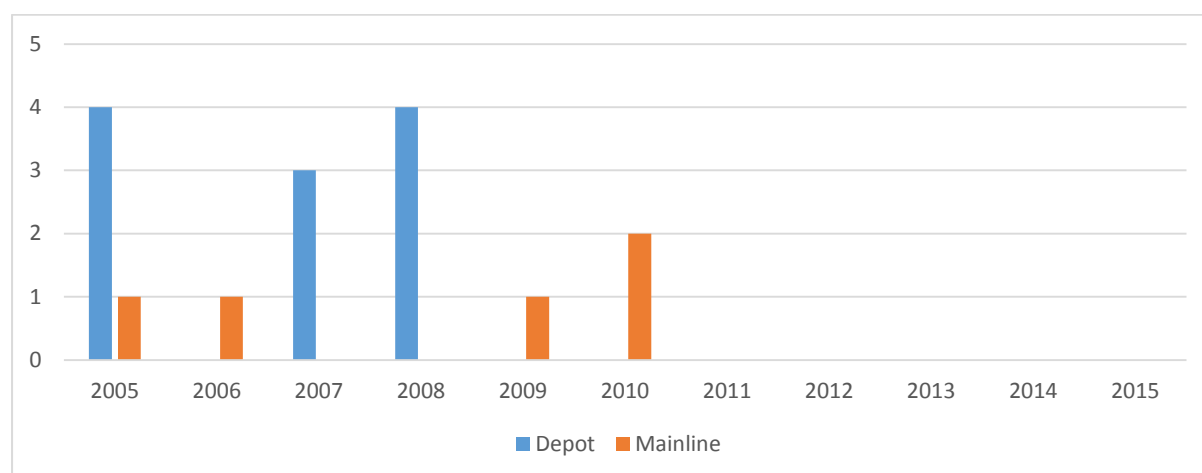


Figure 25 Tram derailments

3.4.4 Tram Emergency Brake Applications

A useful indicator is the number of Emergency Brake (EB) applications which tram drivers make. In addition to its standard brakes, a tram is fitted with an electromagnetic track brake. Tram drivers are trained in defensive driving techniques and are constantly vigilant of pedestrians, cyclists and road vehicles. However, there are occasions when a driver may need to apply the EB to prevent a harmful incident.

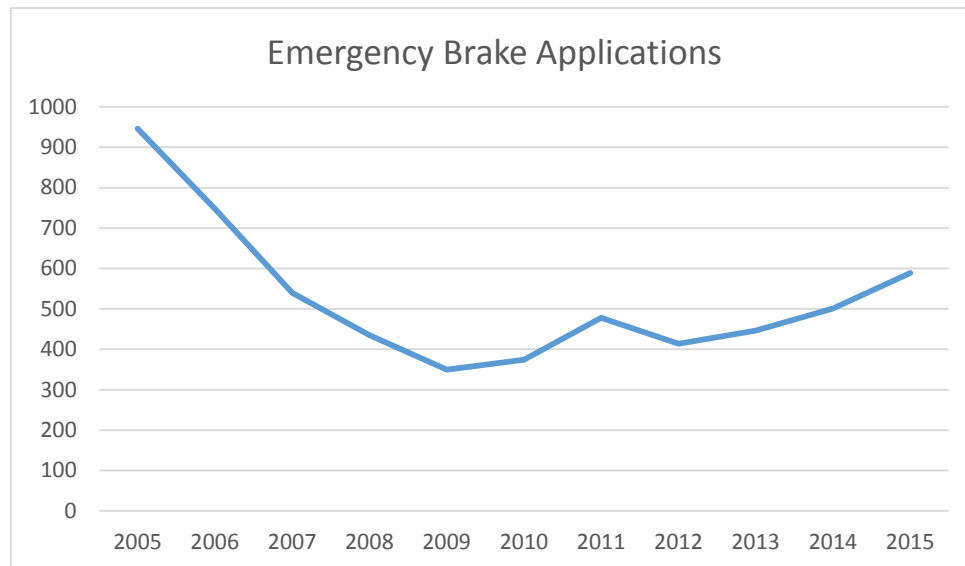


Figure 26 - Emergency Brake Applications

There were 589 EB applications made in 2015 representing about an 18% increase on 2014 figures. Operator analysis of this long term trend since 2009 indicates EB applications are linked to new or changed items on the system such as new drivers, new infrastructure, or modifications to tram signalling systems.

Figure 27 below shows that when EB applications are normalised per 100,000 km travelled, it can be seen that the highest applications occur when the daylight hours are fewest, and school holidays occur, e.g. just before Christmas and the Easter holidays.

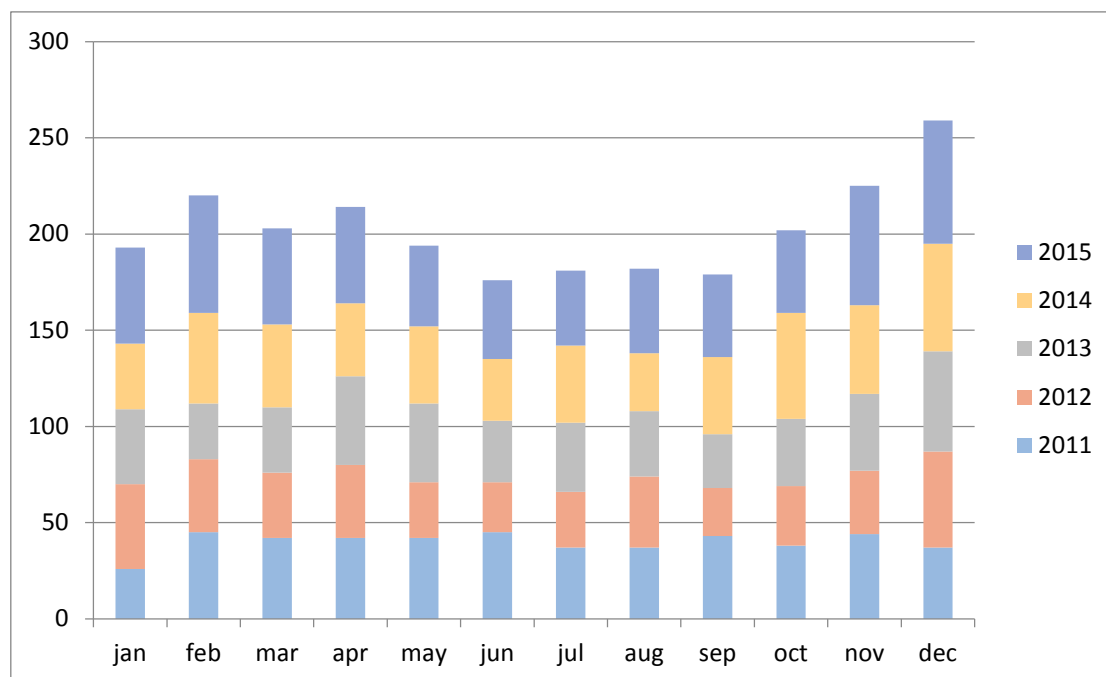


Figure 27 - Number of EB per 100,000 km travelled per month

3.5 Bord Na Móna Industrial Railway Statistics

The remit of the CRR in terms of its oversight of Bord Na Móna's (BNM) industrial railway is limited to where it interfaces with public roads. These interfaces are at level crossings and where there are bridges over the industrial railway. In terms of key infrastructure statistics there are 98 level crossings and 50 underpasses, of which 47 are under roads and 3 are under Iarnród Éireann rail lines.

There were no incidents reported by Bord Na Móna in 2015.

3.6 Heritage Railways

A heritage railway is defined in Irish Legislation as *'a person who only operates train services or railway infrastructure of historical or touristic interest.'* The CRR monitor the operations of 8 self-contained heritage railways. They are:

- Cavan and Leitrim Railway¹
- Diffin Lake railway, Oakfield, Raphoe
- Finntown & Glenties Railway
- Listowel Lartigue Monorail
- Tralee & Dingle Railway¹
- Waterford & Suir Valley Railway (W&SVR)
- West Clare Railway¹
- Irish Steam Preservation Society Stradbally

¹ These railways have not yet received a Safety Management Certificate from the RSC and were reported as being non-operational in 2015

The CRR mandated all heritage railways to document a Safety Management System (SMS) and have it approved by the CRR (then RSC) as of the 1st of January 2014, in line with European standards. CRR guideline 'RSC-G-022' (Issue 2), published 21st of January 2013, outlines the elements a heritage railway must include in its Safety Management System.

No incidents were reported by a heritage railway in 2015 maintaining good safety performance. The CRR undertakes inspections and audits on the heritage railways commensurate to the risk but at a minimum visits each operational railway biennially. The CRR continues to work with a number of heritage railway operators to improve their safety standards and processes. The CRR continues to monitor implementation of corrective and remedial actions.

In addition to the above operations the Railway Preservation Society of Ireland (RPSI) operate steam and diesel hauled heritage trains on the Iarnród Éireann rail network. This can import risk to the mainline railway network, the RPSI is classified as a Railway Undertaking (RU). As an RU it has received safety certification based on the acceptability of its Safety Management System, compliance with which is also supervised by the CRR.

The RPSI ran approx. 4160 miles (6,600km) in 2015, a high number for them, with no reportable accidents or incidents and no issues raised with RPSI as complaints from the Infrastructure Manager.

Railway Safety Trends in Europe



4.1 Introduction

In European terms, the CRR is defined as the National Safety Authority (NSA) for the European railway network in Ireland. Each European member state has an NSA which, in accordance with the Railway Safety Directive (2004/49/EC), must submit its annual report on railway safety to the European Railway Agency (ERA). ERA in turn analyses railway safety on a European scale and publishes its report. ERA reports do not take into account light rail (Luas) or metro systems, or self-contained heritage railway systems.

ERA produces a biennial report, the most recent being published in 2016, which includes data up to and including 2014. A report is not available for 2015 for comparison purposes. Data will be extracted from the publically available E-Rail Database that ERA maintain. This is a repository for European railway safety data, as inputted by National Safety Authorities. Some noteworthy statistics are presented from this database. Definitions for data categories used, where not stated, can be found in the document 'Implementation Guidance for use of Common Safety Indicators', which is produced by ERA and is available at <http://www.era.europa.eu/>.

4.2 Percentage of tracks with Automatic Train Protection (ATP) in operation

One critical measure of railway infrastructure is the percentage of railway fitted with Automatic Train Protection (ATP). The European Railway Agency, in common with most professional railway organisations, consider ATP to be the most effective railway safety measure that railway infrastructure managers can implement to reduce the risk of collisions and derailment on mainline railways. ATP enforces obedience to signals and speed restrictions by speed supervision, including automatic stopping at signals. 25 Member States reported the percentage of lines equipped with such a system. This data is shown in Figure 28. Of the 1683 route kilometre of Ireland's conventional rail network, 53 km are equipped with ATP. In Ireland (IE), ATP is only functional on DART EMU rolling stock that runs on the DART system. All other rolling stock does not have ATP technology fitted, but can still run on this section. The UK figure is slightly distorted in that their network makes wide use of a Train Protection Warning System which does not meet the EU definition of Automatic Train Protection, but does provide the ability to stop trains in the event of Overspeed or after a signal has been passed at danger.

The notable element of the Irish data is a long term trend where ATP coverage has not increased. Most EU states tend to expand ATP over a long period on their rail systems. This is part of a worldwide trend where many developed nations have extensive use of ATP. In the

United States the Federal Administration has mandated a form of ATP (known as Position Train Protection – PTP).

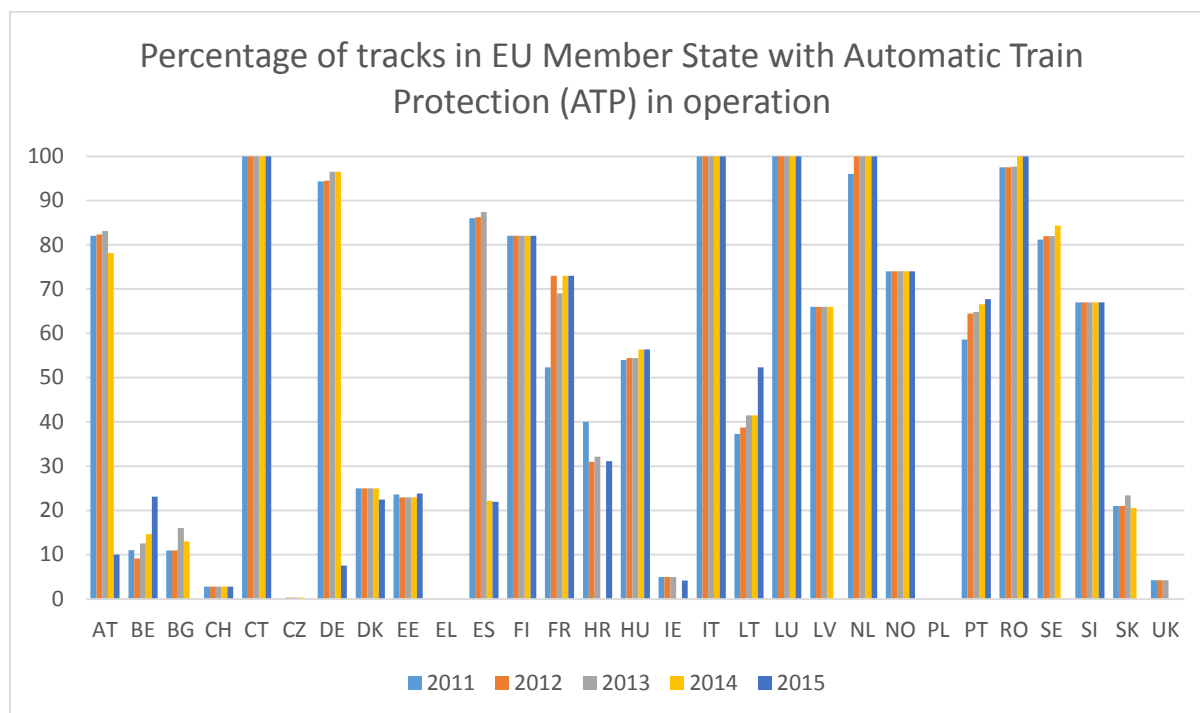


Figure 28 - Percentage of EU/EEA tracks with Automatic Train Protection (ATP) in operation, by country

4.3 Signals passed at danger relative to train km

Earlier in this report it noted that 2015 SPAD performance in Ireland (IE) is no longer improving. Data presented in this chapter shows relative performance using train kilometres travelled on the network. Ireland is not an outlier in terms of SPAD performance, but clearly could do better, as mentioned the RAIU has conducted a review into IÉ SPAD performance, published on 11th April 2016.

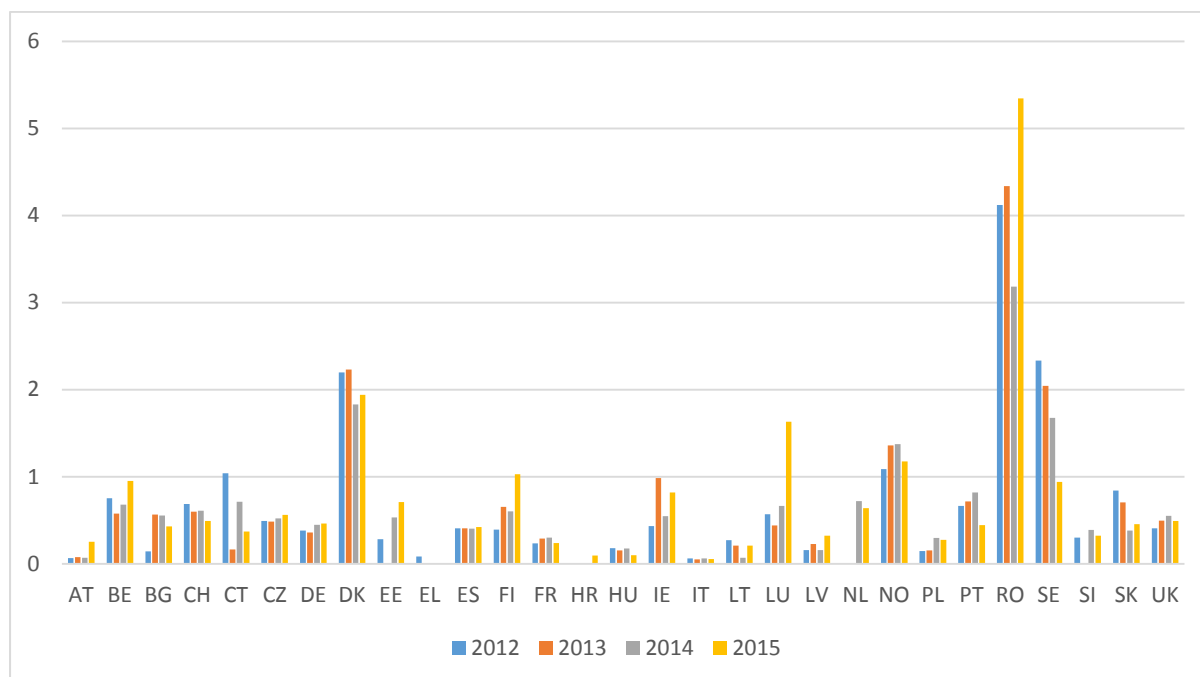


Figure 29 - Signals passed at danger relative to train km

4.4 All accidents relative to train km

In European Terms the Irish Network is quite small, and has had very few passenger fatalities in the last 35 years. However, given the relatively small amount of passenger kilometres measured, a small number of fatalities could change relative performance, which makes it incumbent on all stakeholders to remain vigilant and continuously improve safety systems. All accidents in this instance are those which are reportable within the Common Safety Indicator framework as described in the European Union Railway Safety Directive 2004/49 (as amended).

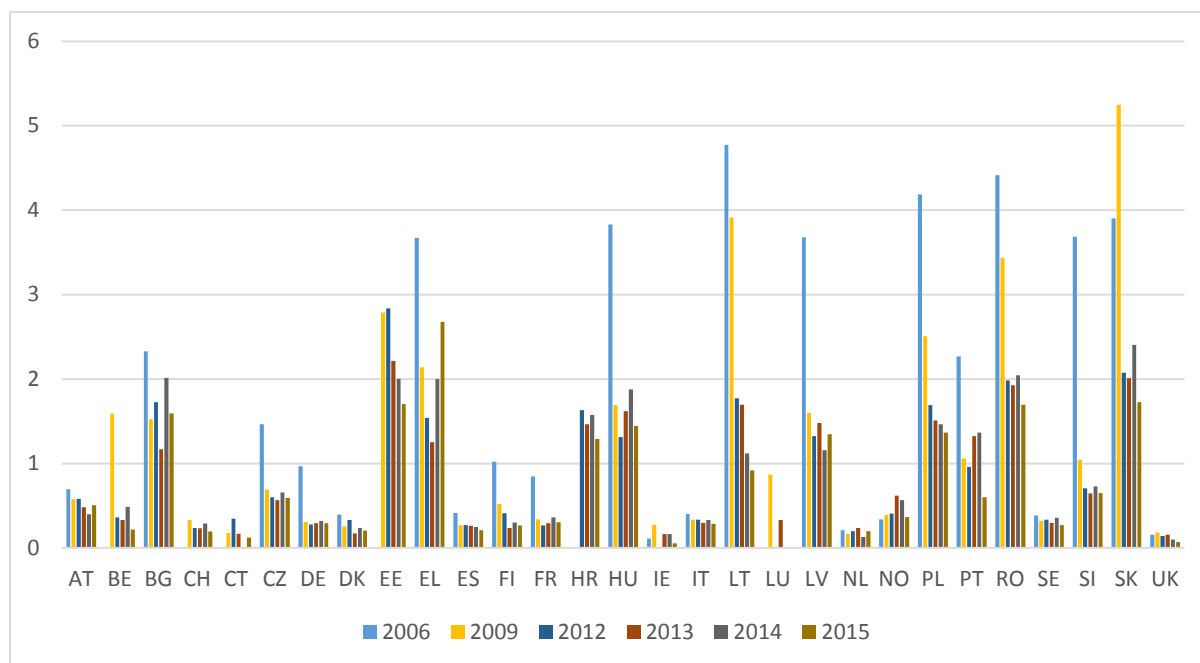


Figure 30 - All accidents relative to train km

4.5 Level-crossing accidents relative to train km

Level Crossings are a significant risk to railway safety. Figure 31 indicates Ireland is just below the EU average when it comes to accidents relative to train kilometres. Ireland, however, is above average for level crossing deployment, indicating good performance in this area.

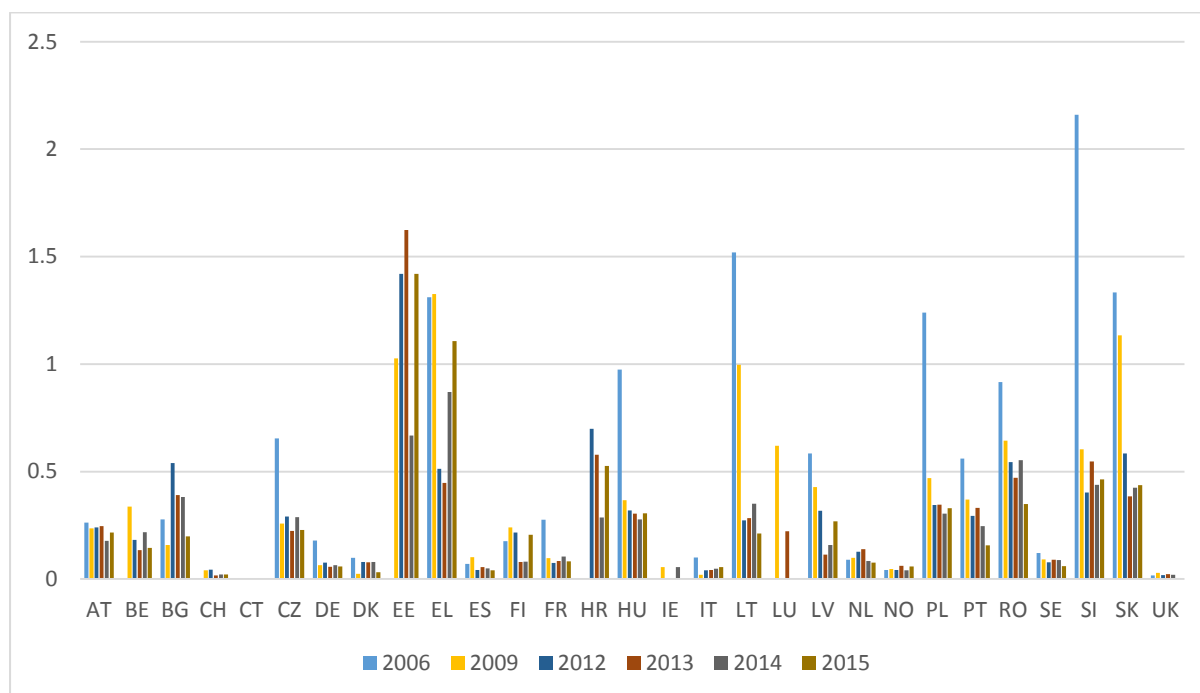


Figure 31 - Level crossing accidents relative to train km

4.6 Derailments of trains relative to train km

The indicators are largely positive for Ireland with regards to derailments. There are favourable comparisons evident with all other major railways in the EU. Whilst the Irish Network is relatively low speed and has low utilisation compared to some other member states, derailment risk still requires careful management in a challenging environment where resources have been reduced in the period under review.

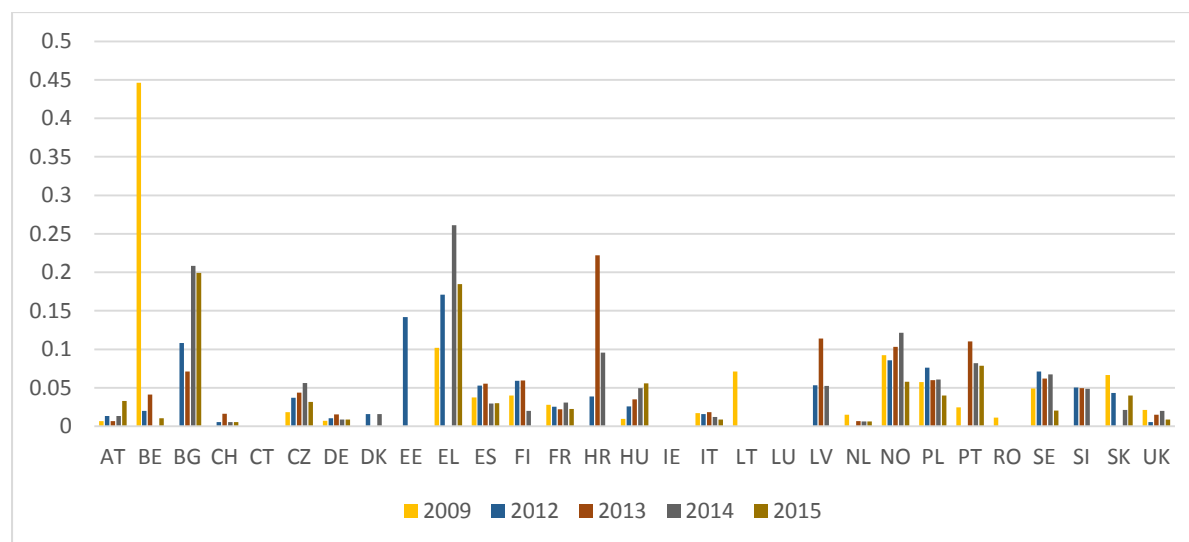


Figure 32 - Derailments of trains relative to train km

4.7 Total number of accomplished safety audits

The European Union has developed specific regulations to ensure that all railway organisations monitor their safety performance. One key measure of this is safety audits accomplished. Railway Organisations are required to audit their compliance with European and National Law, and act on the results accordingly. The CRR closely monitors railway organisations to ensure they comply, and in addition the CRR also regularly audit railway organisations. It can be seen that the absolute number of audits performed in Ireland is relatively few by Irish Rail, however, this is to be expected given it is a small railway network.

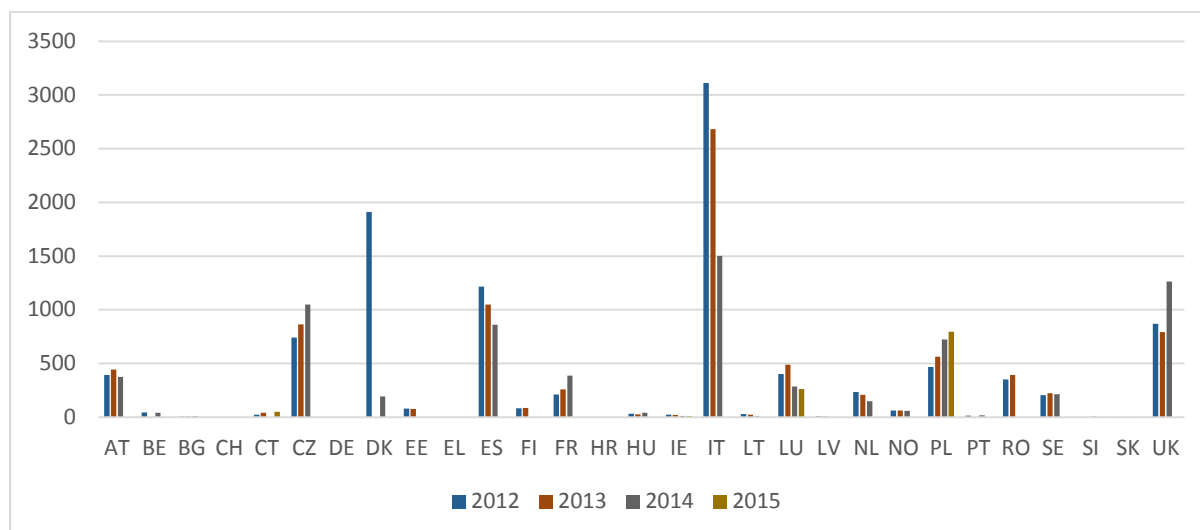


Figure 33 - Total number of accomplished audits

4.8 Network Comparisons

Comparisons are presented below to show the scale of traffic density on the Irish Network in Comparison to other EU Member States.

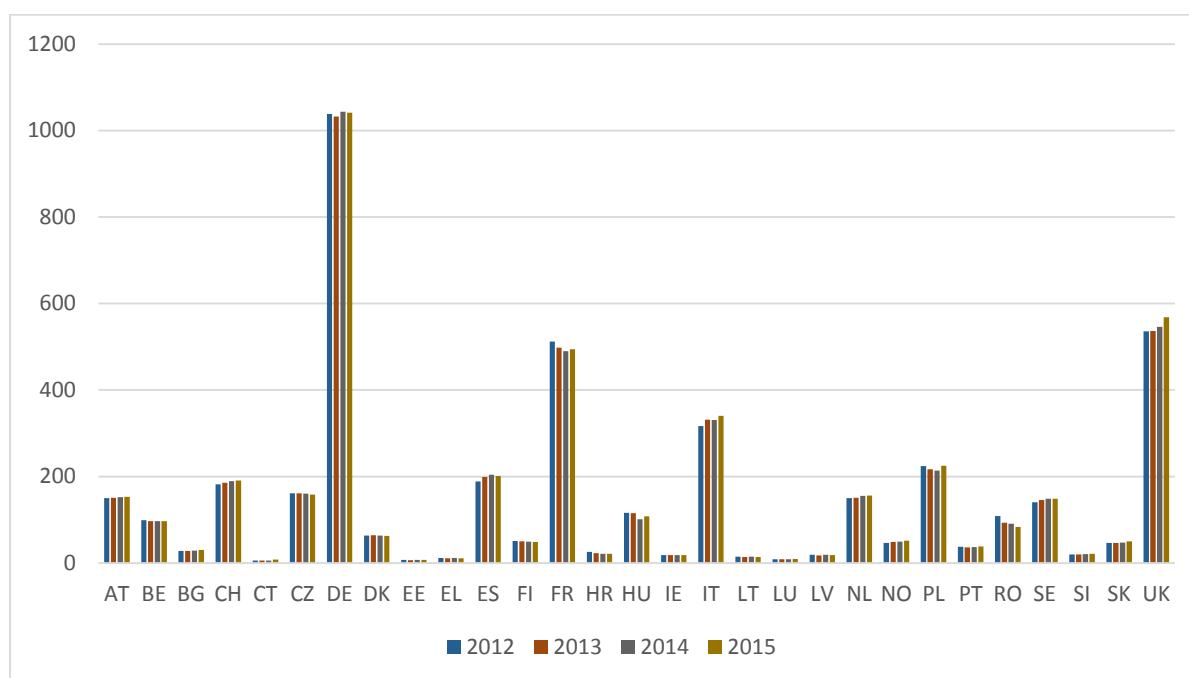


Figure 34 - Total number of train km

It can be seen from Figure 34 that there is quite a small amount of train km measured. Ireland can be seen to have a low number of train km run in the European context, in line with the country's geography and population density, with Germany, the UK, France and Italy having the four largest.

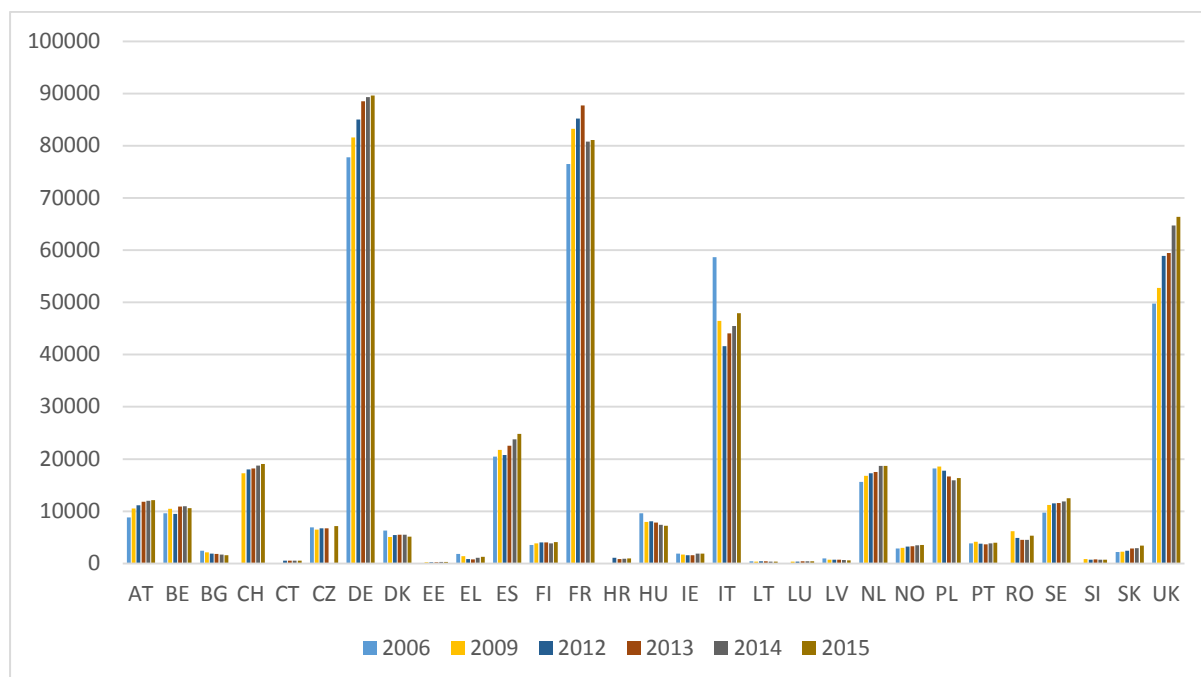


Figure 35 - Number of passenger km

Figure 34 follows a broadly similar trend to Figure 35. The Y-Axis is measured in millions. Many of the countries where there is high passenger numbers generally utilise extensive modal sharing whereby the train might be part of a journey along with bike, bus, tram and car. Ireland is making progress in this area with many projects under development by the National Transport Authority.

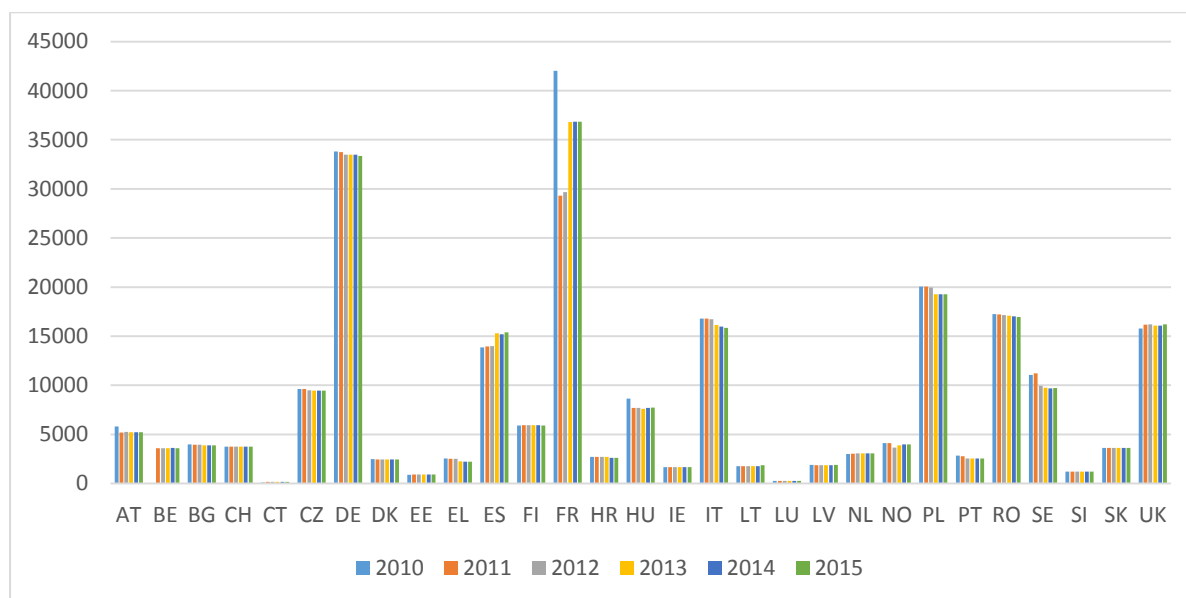


Figure 36 - Number of line kilometers

Figure 36 shows the number of line kilometres, which is a measure of the amount a track in a countries network. It is observed that this indicator remains relatively steady for most member states.

4.9 Major Accidents Worldwide

A number of major incidents on railways in other countries during 2015 provided a stark reminder that despite many indicators showing improvement in overall safety performance, potential still exists for catastrophic accidents. The Commission is in networks with other National Safety Authorities in Europe and similar agencies worldwide regarding such incidents and endeavour to share learning points derived from investigations.

France

Eckwersheim, Eastern France, 14th November 2015. A TGV test train derailed and came to rest partially submerged in the Marne-Rhine canal, resulting in 11 fatalities, and 42 injuries. The train was not in revenue service, and was being used to conduct tests on a new TGV line to Strasbourg from Paris. The train was travelling at up to 352 km/h during the test and 265km/h at the point of derailment. It should have slowed to 176 km/h for the curve where it derailed.

There were investigations carried out as to why there were children (of employees) on the train, why seven people were in the cab, and how the number of people in the cab may have affected the human error of the driver.

Germany

Ibbenbüren, North Rhine-Westphalia, 16 May 2015, a passenger train travelling at around 100 km/h from Osnabrück collided with a tractor which had become stuck on a level crossing. Two people including the driver of the train and a passenger were killed, and 41 others injured. The driver of the tractor may face charges of negligent homicide for blocking the crossing.

India

Uttar Pradesh, northern India, 20th March 2015, Passenger train reported brake failure, and was routed into a siding where the locomotive and two carriages derailed after hitting the buffer stop. This resulted in severe 'telescoping' of one of the carriages, with 58 fatalities and another 150 people injured. An interim enquiry found inconsistencies in the plumbing of the brake system, but further information is not yet available.

Harda, Madhya Pradesh, central India, 4th August 2015, two passenger trains derailed near Kudawa. There were 31 fatalities and over 100 people injured. The cause of the derailments was flash floods dislodging a culvert near the Machak river, leading to track misalignment. Some of the derailed coaches came to rest submerged in the river. It was noted that a train had safely passed 10 minutes before the derailments took place.

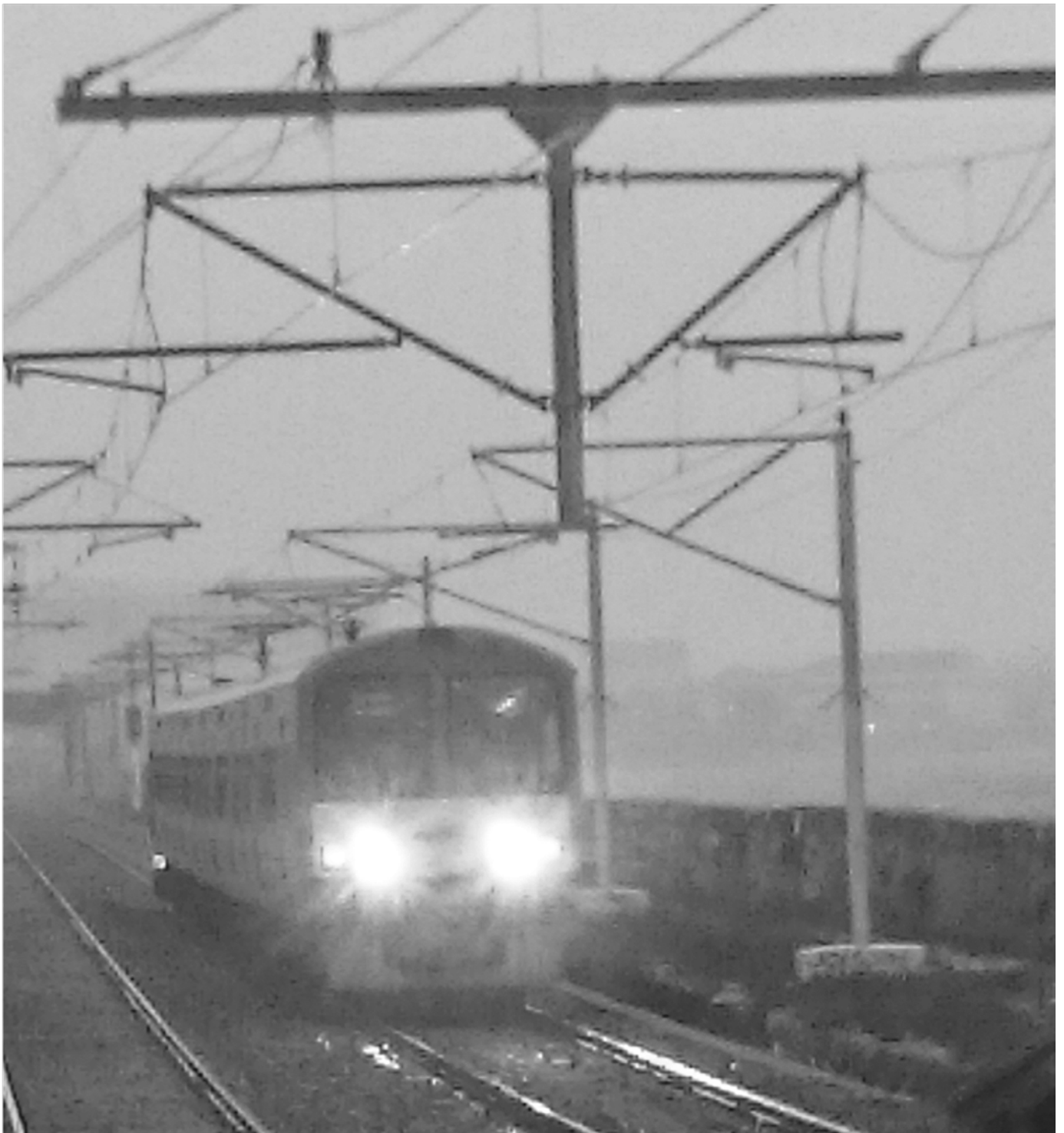
United States of America

Valhalla, New York 3rd February 2015, level crossing incident, with six fatalities. An SUV was trapped between the barriers on the level crossing. There was a single occupant of the SUV, which was hit and dragged 300m by a commuter train at 49mph. It is unusual as the fuel of the SUV appears to have been ignited, and caused a fire in the train, resulting in the further 5 fatalities

Mount Carbon, West Virginia, 16th February, 2015. A crude oil train hauling 107 tank cars of which 26 derailed resulted in an oil spill (110,000 ltrs) caught fire and resulted in the evacuation of hundreds of families from their homes, and the temporary closure of water treatment plants. The cause was found to be a broken rail, leading to the derailment.

Philadelphia train derailment, 12th May 2015, eight fatalities, and over 200 injuries, where a train was travelling through a 50 mph curve at 102 mph. The driver appears to not have been distracted by anything, and the locomotive, only a year old, had no history of unintended acceleration. Loss of situational awareness has been attributed to the incident.

5. Accident Investigations



5.1 Introduction

The Railway Accident Investigation Unit (RAIU) was separated from the CRR on 1st July 2014 and is now a functionally independent organisation within the Department of Transport, Tourism & Sport (DTTAS). The RAIU undertakes ‘for cause’ investigations into accidents and incidents that either meet specific criteria in terms of severity or could have, in slightly different circumstances, resulted in a more serious accident or incident.

The purpose of an investigation by the RAIU is to identify improvements in railway safety by establishing, in so far as possible, the cause or causes of an accident or incident with a view to making recommendations for the avoidance of similar accidents in the future, or otherwise for the improvement of railway safety. It is not the purpose of an investigation to attribute blame or liability. The RAIU’s investigations are carried out in accordance with the European Railway Safety Directive 2004/49/EC and the Railway Safety Act 2005 as amended by S.I. No.258 of 2014.

5.2 RAIU Active Investigations

The RAIU initiated two formal investigations into railway accidents and incidents in 2015, see Table 5-1 for details. The third investigation was a ‘Trend investigation’ into Signals passed at danger’ occurrences. The RAIU have issued reports on these incidents and made recommendations that the CRR will oversee the implementation of.

Date of Incident	Details	Duty Holder
23 rd Oct 2015 & 28 th Nov 2015	Operational Incidents at Ardahan and Spa Road, Castleconnell	IÉ-RU
12 th Sept 2015	Dangerous Occurrence between Ballybrophy and Portlaoise	IÉ-IM
N/A	Trend Investigation into SPAD Occurrences on the Iarnród Éireann Network	IÉ-IM

Table 5-1: RAIU investigations initiated in 2014

5.3 RAIU Investigation Reports

In accordance with the Railway Safety Act 2005, the RAIU endeavours to publish an investigation report not later than 12 months after the date of the incident. In 2015, the RAIU published 2 investigation reports which are listed in table 5-2. As a result of their

investigations the RAIU made a total of 4 safety recommendations which are discussed in section 5.4.

Date Report Published	Title of Report	No. of recommendations made	Duty Holder
30 th April 2015	Collision at XX024	3	IÉ-IM
4 th June 2015	Collision at XM250	1	IÉ-IM

Figure 37 - RAIU Investigation Reports published in 2015

5.4 RAIU Safety Recommendations

The RAIU, through their accident investigations, identify whenever possible the immediate cause, contributory factors and any underlying factors. Having established these, the RAIU may make recommendations and as previously stated, 27 were made in 2014. In accordance with the Railway Safety Directive the RAIU should address recommendations to the safety authority (the CRR) and where needed by reason of the character of the recommendation, to other bodies or authorities in the Member State or to other Member States. Member States and their safety authorities shall take the necessary measures to ensure that the safety recommendations issued by the investigating bodies are duly taken into consideration, and where appropriate acted upon.

The CRR categorise the status of recommendations as being either ‘Open’, ‘Complete’ or ‘Closed’. These are defined as follows;

Open	- Feedback from implementer is awaited by CRR or actions have not yet been completed.
Complete	- Implementer has advised that it has taken measures to effect the recommendation and the CRR is considering whether to close the recommendation.
Closed	- Implementer has advised that it has taken measures to effect the recommendation and the CRR is satisfied that the work has been completed and has closed the recommendation.

A summary is presented below of the actions taken (at the time of writing) in relation to the two RAIU Investigation Reports published in 2015 where safety recommendations were made, and the status of each recommendation.

R2015 – 001- Vehicle struck by train at Corraun Level Crossing XX024*(Report Published 27-02-14)***Summary:**

At approximately 09:55 hours (hrs) on Wednesday 12th February 2014, an An Post van approached Corraun Level Crossing with the Level Crossing gates open and drove onto the Level Crossing. At the same time, the 09:35 hrs Iarnród Éireann (IE) passenger service from Ballina to Manulla Junction was travelling through Corraun Level Crossing and struck the van. On impact, the van was thrown clear of the train and into the adjacent drainage ditch before coming to a stop.

The Local Resident was working in close proximity but out of sight of the level crossing, heard the accident and made his way to the scene where he rendered assistance to the van driver, who was travelling unaccompanied.

The driver of the van was seriously injured and conveyed from the scene by ambulance to Mayo General Hospital, Castlebar. There were no other injuries as a result of this accident. .

Number of recommendations made	3
Recommendation 1 (1-2015)	IE should consider options to upgrade the crossing to minimise direct action by the users
Action/s taken / in progress	IE IM advised the CRR that they will consider what options are feasible and available to upgrade the crossing and minimise direct actions by the users."
Status	Open
Recommendation 2 (2-2015)	IE-IM should carry out a full review of known misused user worked level crossings on public and private roads and either upgrade the level crossing or introduce measures to minimise their misuse..
Action/s taken / in progress	IE-IM advised the CRR that they will review known misused user worked level crossings on public and private roads and determine what if any further actions can be taken to minimise their misuse."
Status	Open
Recommendation 3 (3-2015)	IE should ensure that where a Decision Line is present at a level crossing , that the purpose of this Decision Line is appropriately conveyed to the level crossing users..
Action/s taken / in progress	IE-IM advised the CRR that the Decision line is a term used internally within IE. The line is actually a STOP line at the decision point similar to a stop line on a public road at road junction. There is also a STOP sign positioned beside it. IE IM considers road users who have been issued with a permit or a driver's licence should be familiar with road signage and the rules of the road.
Status	Closed

R2015-002 -Car strikes train at level crossing XM250, Knockaphunta, Co Mayo, 8th June 2014. (Report Published 04-06-15)	
Summary:	
Number of recommendations made	1
Recommendation 1 (4-2015)	The RSC, RSA and IÉ in consultation with any relevant stakeholders should agree a common policy in connection with instructions and warnings related to user worked level crossings.
Action/s taken / in progress	Tri-party meetings have taken place and the outcome of these has been the redrafting of the RSA publication 'the safe use of level crossings' and a tri-party Joint Statement of Intent signed by the respective chief executive officers. Work will continue under the guise of the Road rail Safety Working Group.
Status	Open

5.4.1 RAIU Recommendations Summary

The table below confirms the current status of all RAIU recommendations. (31 December 2015)

Year	No. of Reports	No. Of Recommendations			
		Open	Complete	Closed	Total
2006*	1	0	0	14	14
2007	0	0	0	0	0
2008	1	0	0	7	7
2009	5	0	0	13	13
2010	6	2	2	22	26
2011	6	2	10	5	17
2012	3	2	5	6	13
2013	3	4	4	2	10
2014	6	8	2	17	27
2015	2	3	1	0	4
Totals	33	21	24	86	131
<i>Total Recommendations made to date</i>					131

Table 1: RAIU Recommendations Summary

*CRR Recommendations made prior to establishment of RAIU

6. References



6.1 Documents Used

CRR (2015), “Annual Report”, Railway Safety Commission, Dublin.

ERA (2014), “Railway Safety Performance in the European Union”

ERA (2015), Common Safety Indicator Data, <https://erail.era.europa.eu/> retrieved 10.09.2015