

REVIEW OF DATA QUALITY AND APPROACH OF THE AGENCY  
ANNUAL REPORT ON SAFETY

# Assessment of the Impact of Rail Suicides on EU Railways

European Railway Agency

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**Objective:**

To assess the impact of suicides on railways in the EU and determine appropriate measures and actions at the EU level.

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## **1 EXECUTIVE SUMMARY**

The objectives for the suicide reporting element of the study were to determine the means by which railway suicides are reported, what is the real impact of suicide events on railways in the EU and whether there is a need for any action at the EU level. Specifically the Agency wishes to understand what the cost impact of suicide is at an EU and national level and, in order to facilitate comparison between differing Member States, understand what a suitable normaliser for railway suicide might be.

The conclusions are that:

- The reporting of suicide on railway premises is complex involving multiple actors, decision points and databases. Opportunity exists to harmonise the collection of data so that it is consistent between the databases and within and between Member States.
- Reporting of suicide at railway premises is heavily dependent upon the criteria applied by the national police force. A brief survey of Railpol, Italian, Netherlands and British Police has revealed that there is limited guidance available in this regard.
- A multi-agency approach to the prevention of suicide at railway premises should be adopted involving the infrastructure manager, the railway undertaking, and the police from the Member State to cooperate in sharing data and preventing suicide at railway premises.
- The annual cost of suicide at railway premises in the EU, Norway and Switzerland is very considerable, estimated at €7.1 billion per annum. Currently a minority of infrastructure managers apply a value for preventing a casualty approach to assessing the financial impact of suicide on railway premises and only a half of those responding to the survey had a suicide prevention programme. There is thus a far greater justifiable spend that can be applied to preventing suicide on EU railways and a suicide prevention programme managed through a multi-agency approach, as above, is recommended.
- A suitable normaliser for comparing railway suicides between Member States is the proportion of all suicides that occur on the railway normalised by log train km. This proposed normaliser is statistically significantly different from the currently used normaliser of train km. The proposed normaliser reveals significant differences in the relative performance of Member States which can be used to share best practice and direct the justifiable expenditure identified above. Further studies into the causes of these differences could be usefully undertaken.

## 2 SUICIDE ON RAILWAY PREMISES REPORTING

### 2.1 Overview

Suicide on railway premises accounts for approximately 4% of all suicides in the EU, although substantial variation exists between the differing Member States. It is a particularly under researched area with little practical experience or theory to inform those trying to manage or reduce the incidence of suicide. The under researched nature of suicide on railways was highlighted by the recent RESTRAIL (REduction of Suicides and Trespasses on RAILway property) Project<sup>1</sup> which was a three year project funded under the Framework 7 research programme and which sought to "reduce:

- The occurrence of suicides and trespass on railway property and
- The service disruption and other consequences these events cause

by providing the rail industry with an analysis and identification of cost effective prevention and mitigation measures." In particular its work package one sought to provide a qualitative analysis of suicide and trespass on railway properties.

All suicides are tragic in that they represent the loss of an individual to society and to their friends and family. In 2011 it was estimated that for every victim of suicide there were between 6 and 32 affected family members and friends<sup>2</sup> and that in any given year approximately 7% of the US population knew of someone who had committed suicide in the preceding 12 months<sup>3</sup>. These survivors typically experience a complex set of grief reactions.

The European Railway Agency (the "Agency") is interested in the issue of suicide on railway premises because of the direct consequences of the loss of life but also because of the indirect consequences relating to the railway. These include:

- trauma to the train driver who is often a witness to the suicide and often unable to take preventative or avoiding action and to others who deal with the aftermath,
- delay to passenger and freight services whilst the victim is removed from the railway by specialist staff,
- damage to the train and infrastructure,
- death or injury of passengers and train crew<sup>4</sup>.

The objective of this study is to investigate the means by which suicides on railway premises are reported, to quantify the impact of the suicide in financial terms and to propose a suitable normaliser by which rates of suicide in differing countries can be compared.

Further the study is requested "to assess the added value of an EU-wide database on rail suicide events and make recommendations for any common future action in the problem area".

The rationale for wishing to understand the means by which suicide on railway premises is reported is that suicide on a railway can be difficult to distinguish from an accident to a trespasser. Unlike intentional poisoning or violent death there are not the external clues of toxins present or firearms.

<sup>1</sup> <http://restrail.eu/>

<sup>2</sup> Estimating the Population of Survivors of Suicide: Seeking an Evidence Base, A L Berman, Suicide and Life-Threatening Behaviour 2011, 41(1), pp110-116

<sup>3</sup> Incidence and Association with Suicidal Ideation and Behaviour – United States, A E Crosby and J J Sacks, Suicide and Life-Threatening Behaviour 2002, 32, pp321-328

<sup>4</sup> Although rare such injuries and fatalities can occur particularly if the means of suicide involves a car or other vehicle on a level crossing.

There is concern that variations between Member States in terms of suicide or trespass victims in the reporting may be due to variations in reporting methods rather than real differences in the incidence of intentional or accidental death on the railway.

## 2.2 Survey Methodology

To capture data on the existing national systems for occurrence reporting a survey of National Safety Authorities (NSAs) was prepared. To encourage completion of the survey it was designed to be simple and quick to complete, inviting respondents to provide links to guidance or regulatory documents which could be followed up later. Responses were invited in any language and a contact was given that allowed the respondents to request assistance from a local DNV GL office as necessary. Briefings were provided to the NSA network. The EIM and CER advised that the survey was being undertaken and more importantly the benefit that was anticipated from the survey so that respondents had an appreciation of the context and purpose of the work.

The survey was developed in a commercial electronic platform and was trialled with several NSAs and railway organisations prior to its finalisation. In particular it was trialled amongst non-native English speakers to address issues of clarity of expression and understanding.

Following the trials the survey was distributed by the Agency to the National Safety Authorities through the NSA network on 15<sup>th</sup> January 2015 with a request that responses be received by 14th February 2015. The target audience for the survey was the 26 National Safety Authorities in the EU (Cyprus and Malta have no mainline rail network and have no requirement for an NSA) the Channel Tunnel Safety Authority and the NSAs of Norway and Switzerland as the members of the European Economic Area having a mainline railway. Reminders were sent at intervals during the period that the survey was open and after the survey had nominally closed all of those organisations that had not responded were contacted on further occasions explaining the value that the information requested would have.

A workshop on suicide reporting was held by the Agency, facilitated by DNV GL, at the Agency offices in Lille, France on 5<sup>th</sup> February 2015. This was attended by 34 people representing a wide cross section of the sector, the NSAs and the NIBs. Despite being invited there was no attendance by Police or Judicial officials such as coroners. The workshop was used to both promote the survey and to explore issues of interest to the Agency. Appendix 1 of this report is a short note of the presentations and learning from the workshop.

A presentation on the survey was made at the NSA network meeting (24<sup>th</sup> February 2015), including an overview of the preliminary results from early responders, again stressing the value that the survey would have. The final response rate for the survey within the 29 NSAs was 100%.

Upon receipt of the completed survey the answers were first checked for internal consistency and any responses that were unclear confirmed with the main contact indicated on the survey response. In many cases the survey requested links to legislation or reporting forms. Where these were provided they were followed up and translated into English.

A copy of the survey is included in the Task 1 report.

## 2.3 Results

The outputs of the specific questions asked in the survey are shown below. These demonstrate a far wider set of responses than that for occurrence reporting. In terms of who collects data five organisations attract similarly high responses; namely the NIB, the NSA, the IM, the RU and the police

(figure 1). This data is collected for differing purposes associated with the legally specified objectives of each organisation:

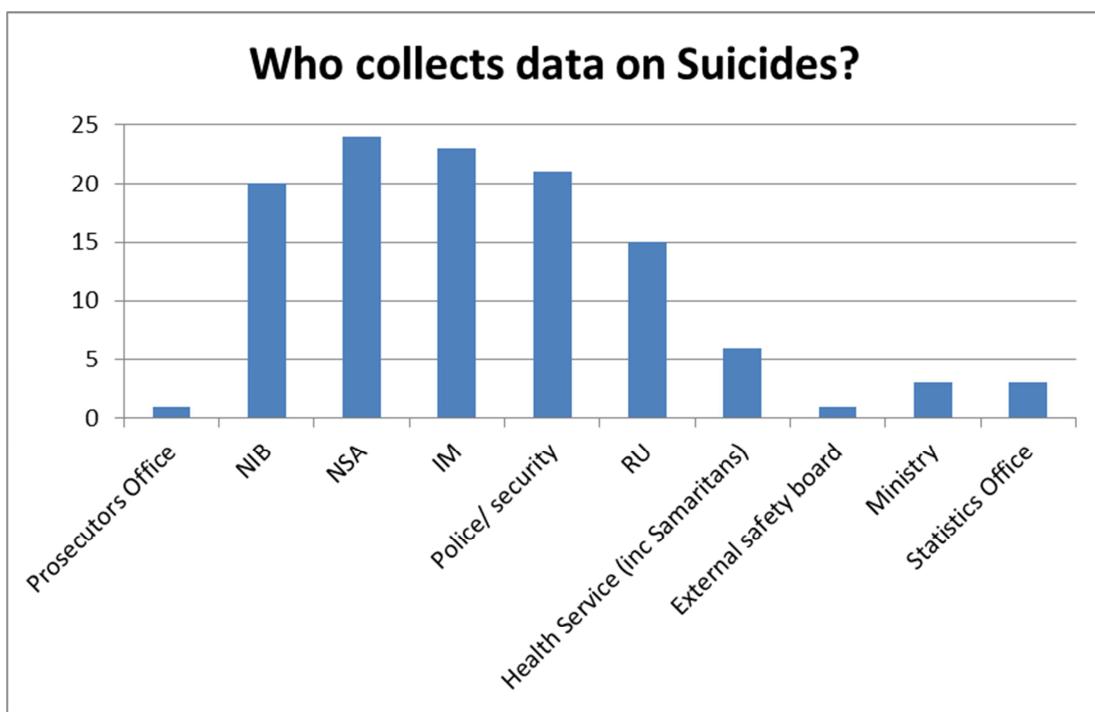
NIB – collected to determine if an accident investigation is required

NSA – collected as a part of monitoring the safety performance of a Member State's railway

IM/RU – collected as a part of safety monitoring and for reporting CSI statistics to the Agency

Police – collected as a part of a determination of criminality or accidental death or suicide.

The overall number counts in figure 1 can be contrasted with the response to the survey question on what the collected data is used for (figure 6). Whilst many organisations collect data, far fewer are clear as to what they do with it. The main uses are to supply data needed for the CSIs and help the IM/RU in suicide reduction measures. The fact that multiple parties collect data without a clear use supports the earlier problem statement that different official sources of suicide statistics provide different pictures of suicide on railway premises. This will be discussed further in the report.



**Figure 1 – A Count of the Responses to the Identity of Those Organisations Collecting Data on Suicide on Railway Premises**

In terms of the events recorded by those Member States who responded to the question, suicides resulting in a fatality are recorded by all Member States, and those resulting in an injury in most Member States (figure 2). Suicide attempts resulting in no injury are only recorded in 11 Member States. The implication of this is that whilst a Member State should have a picture of railway suicides resulting in a fatality it may have a poor picture of all attempted suicides. Possible outcomes from a suicide attempt could be:

- The victim attempts suicide but the result is an injury
- The victim attempts suicide but the result is no injury

- The victim, fully intending to commit suicide, is dissuaded at the last moment or changes their mind
- The victim is prevented from the suicide attempt

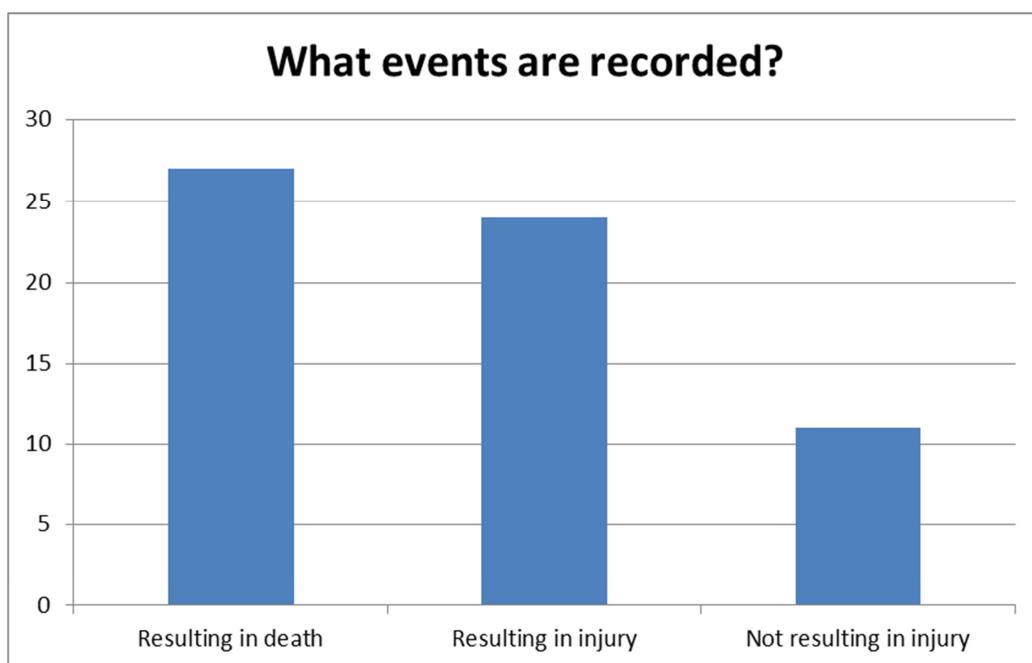
In particular the 3<sup>rd</sup> and 4<sup>th</sup> categories above can be due to suicide reduction measures implemented on the railway such as enhanced “blue” lighting to dissuade potential suicide victims, or victim support posters to change the victim’s mind, or the use of fencing or trained staff to prevent an attempt. The case for making interventions such as these is often predicated on a reduction in the overall number of suicides occurring, but a better means of evaluating the strength of a barrier is to consider the number of suicides that are never attempted as a result of them. This is difficult data to collect and, given that a majority of Member States report not collecting it at all, a clear picture of the effectiveness of suicide prevention measures will be difficult to achieve, as will a comparison between Member States or IM/RUs in their management of suicide.

In discussion at the second Suicide Workshop (28<sup>th</sup> October 2015) it became evident that even within those Member States collecting reports on suicides not resulting in a fatality different scopes and definitions are used. For example one Member State limits its consideration purely to those persons on railway premises whilst others consider those en-route or outside of railway premises. The definitions used in this study, which will be taken into the Task 4 report “Proposal for the Common Occurrence reporting Regimes and Systems Including Taxonomy”, are as follows:

**Suicide** – intentional self-harm on railway premises resulting in a fatality.

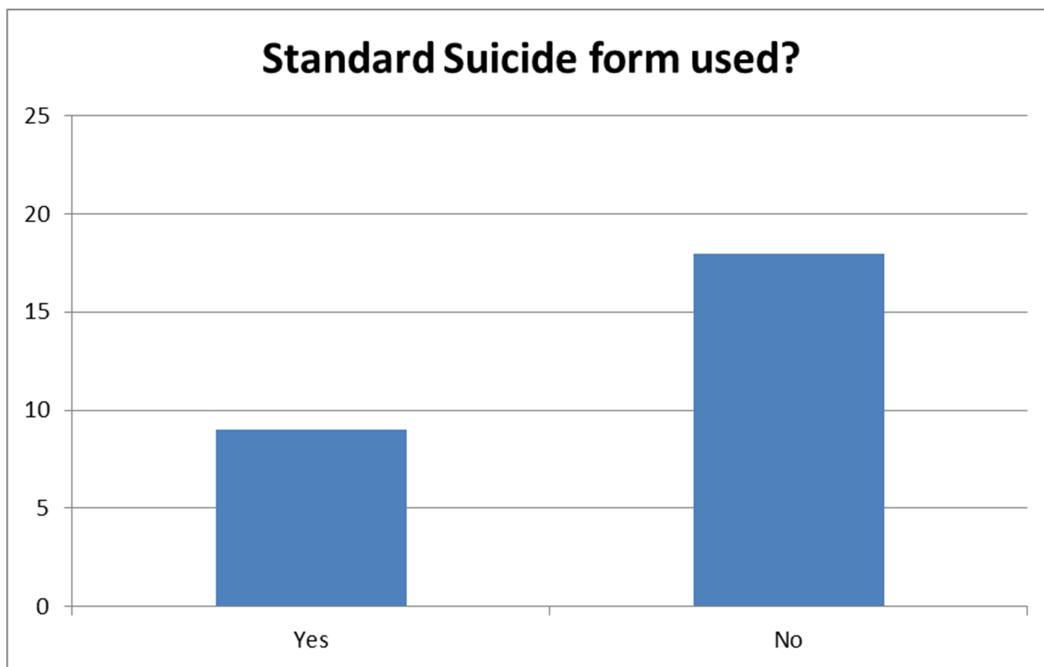
**Attempted Suicide** – intentional self-harm on railway premises resulting in harm to the individual.

**Near Miss Suicide Attempt** – an individual either on or with the intent of going to a railway premises with the purpose of self-harm, but no harm resulting.



**Figure 2 – The Number of Member States Reporting that they Record Suicides and Attempted Suicides**

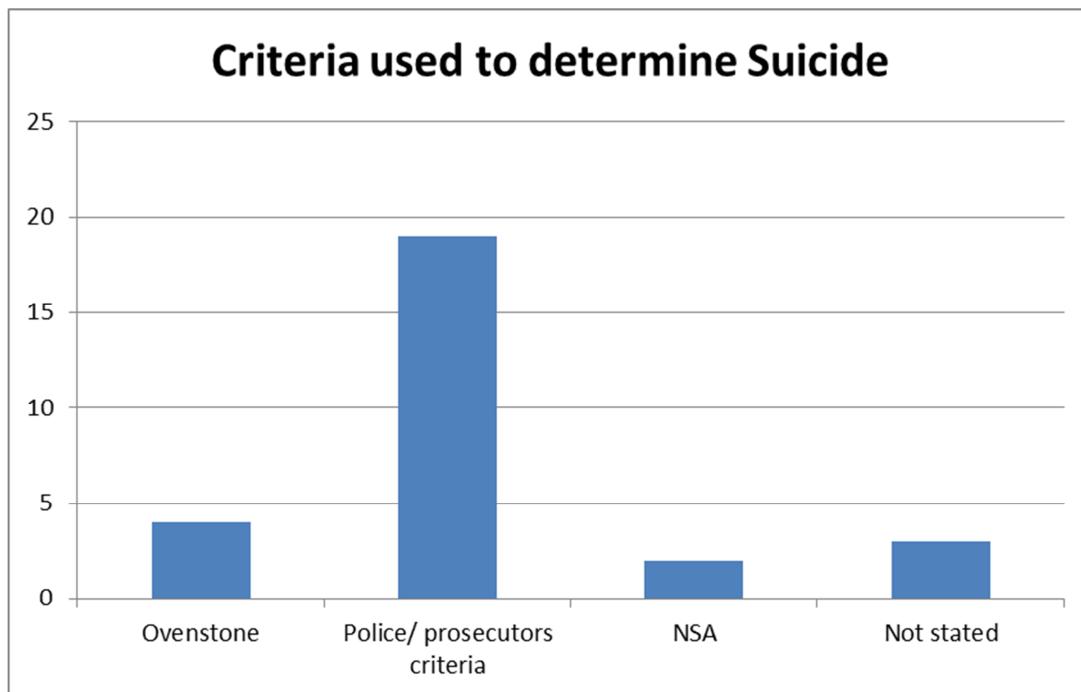
Another interesting feature of suicide reporting is that in the majority of Member States a standard reporting form is not used (figure 3). This is in contrast to occurrence reporting and despite the fact that many Member States record suicide on railway premises in the same reporting system as other occurrences. If a standard form is not used then it is considered highly likely that ad hoc or bespoke systems are used and that consistency of reporting within and between Member States will suffer with a consequent impact on the overall quality of statistical reporting.



**Figure 3 –A Count of the Member States Reporting the Use of a Standard Form to Report Suicides**

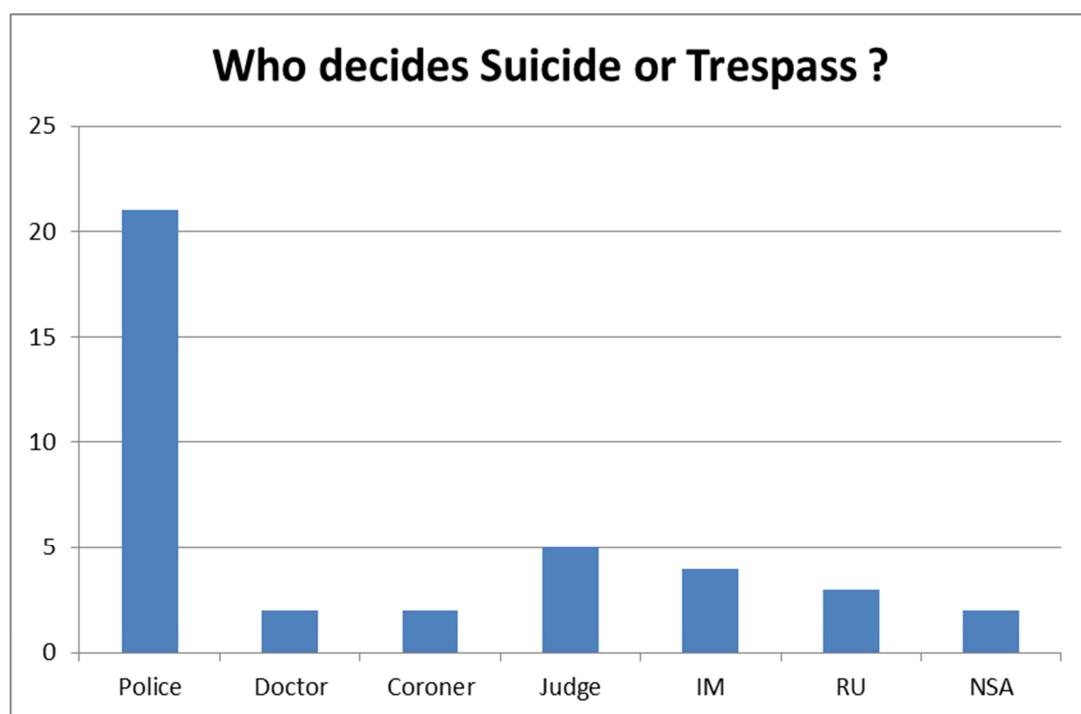
One feature of a fatality on railway premises is that it can be a matter of judgement as to whether the individual was a victim of suicide, died accidentally as a result of trespass or was subject to a criminal act resulting in their death. In terms of what criteria are used to inform this judgement the overwhelming response was that it was criteria set by or used by the police or public prosecutor (figure 4). The Agency guidance on the reporting for the CSIs (Implementation Guidance for CSIs, Annex 1 Directive 2004/49/EC as Amended by Directive 2009/149/EC – ERA/GUI/09-2013) advises that the Ovenstone criteria be used. These were criteria developed in response to a perceived underreporting of suicide and provide structured guidance on whether a fatality is, is not, or may be a suicide. Less than 15% of Member States report that they are currently following the Agency guidance in this regard.

This has significance in terms of the consistency of reporting for the CSIs. If information is not captured in a standard manner in and between Member States, or if similar criteria are not applied in determining if a fatality is a suicide, accident or criminal act then the comparability of figures over time or between Member States is called into question.



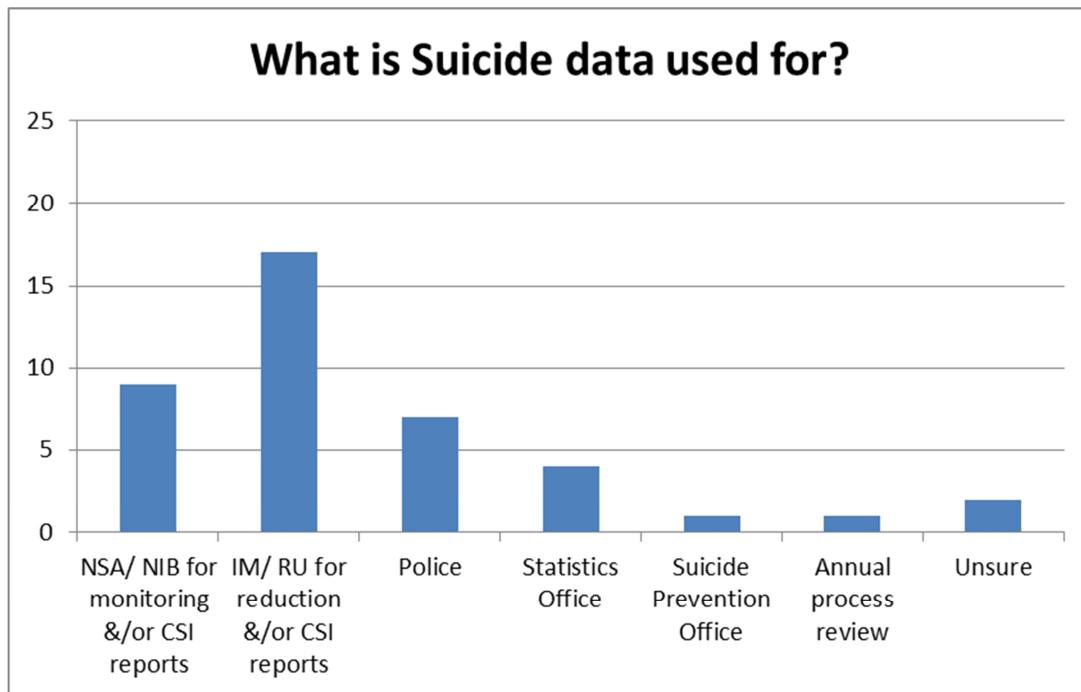
**Figure 4 – A Count of the Responses to the Criteria Applied in Determining if a Fatality on a Railway Premises is a Suicide**

This is also reflected in the identity of the organisation nominated to make the determination of suicide, accident or criminal act (figure 5). Two thirds of Member States report that the Police make this determination with a judge and coroner (combined) providing the second highest response.



**Figure 5 – A Count of the Organisations Making Any Determination of Suicide on a Railway Premises**

The use that the suicide data is put to has been briefly discussed above, but is also of interest in the context of the organisation making the determination of suicide or accident or criminality (figure 5). Police criteria are applied to determine if a fatality is a suicide and it is the police who make this determination. But, the primary organisation making use of the data is the IM and RU for the purposes of CSI reporting and management of the issue (see figure 6). There is thus an evident disconnect between the organisation making the determination regarding suicide and the use of a standard form for recording information and the organisations actually trying to make use of the information.

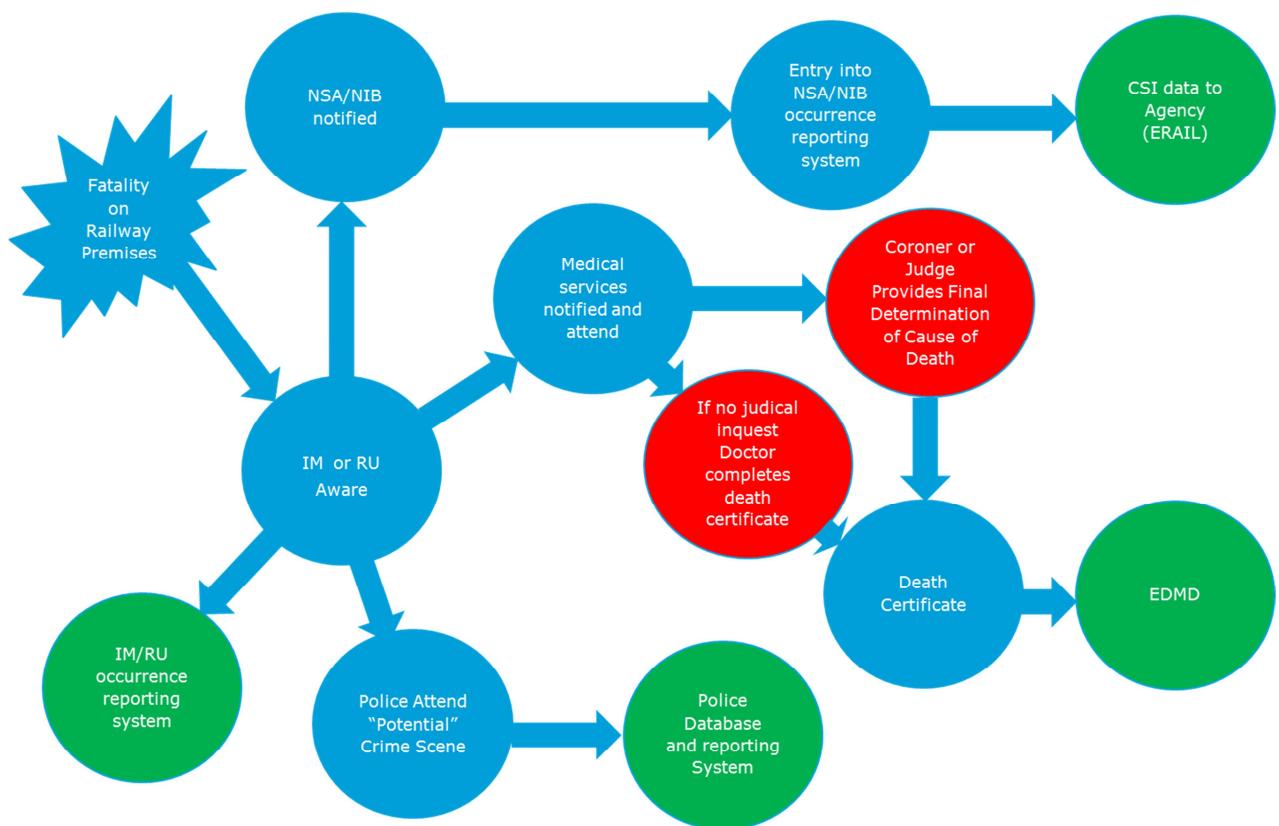


**Figure 6 – A Count of the Reported Uses of the Data on Suicides on Railway Premises**

## 2.4 Discussion

### 2.4.1 Overview

In comparison to the survey findings for occurrence reporting the striking finding in suicide reporting is, for what is a comparatively well-defined incident, just how disjointed are the decision making and reporting. From the information received in the survey and subsequent follow up and the discussion at the Suicide Workshop the typical chain of events in suicide reporting is (figure 7):



Green – Database

Red – Decision maker regarding cause of death

#### **Figure 7 – A Generalised Process from the Discovery of a Fatality on Railway Premises to a Determination Regarding Cause of Death**

The first steps in this process are undertaken most usually in a relatively short space of time and with cooperation between the police, IM/RU and other services (funeral undertakers, medical services). The IM/RU advises the Police, Medical services, NSA and NIB. Typically this results in an entry on the IM/RU occurrence reporting system, an entry on the NSA/NIB national occurrence reporting system and the police database.

The subsequent step in which the formal determination of cause of death is made by a coroner or Judge follows some time later. Possible verdicts that can be delivered in relation to a railway fatality are:

- Suicide
- Open or Narrative
- Accidental or Misadventure
- Unlawful Killing
- Lawful Killing<sup>5</sup>
- Natural Causes

<sup>5</sup> Such as being killed by an act of war or in the course of lawful arrest.

Whilst awaiting a decision from the coroner the IM/RU, police and NSA/NIB have to make provisional determinations on the cause of death for their own purposes. For example the police will have to determine if the fatality was due to a criminal act and potentially launch an investigation. At the suicide workshop it was reported that the subsequent judgement by a coroner as to the cause of death can be months or over a year later and that there is no formal mechanism in some Member States by which the railway actors are informed of the decision. Once informed they would most usually update their databases to reflect the final decision, but if the corner's verdict is an open or narrative one then they may choose to maintain their original judgement of suicide versus accidental death. In summary four different databases can hold data on a fatality on railway premises, all of which have the data entered at a different time. As none are automatically interrelated to each other, allowing updating of all once a final verdict on the cause of death is made, all may hold slightly varying information.

The CSIs are reported to the Agency on an annual basis and it is quite possible that this reporting has to occur before a final coroner's verdict has been reached. Thus, the annual reporting of suicide and accidental death statistics as CSIs may be subject to a process of annual revision as formal determinations can be expected to arrive sometime after the deadline for CSI statistics to be submitted.

In the absence of the final determination of cause of death it is believed that it is either the initial police assessment of cause of death or the IM/RU assessment that forms the basis of reporting to the Agency. Practice around this varies between Member States.

The role of the coroner/judge also varies between Member States. In the event of an open or narrative verdict it is then incumbent on the body responsible for reporting the CSI data to the Agency to determine if the fatality is a suicide or an accident. Other causes of a fatality such as lawful killing or natural causes do not fit easily into the CSI data reporting structure at present, although it should be noted that these would be relatively rare verdicts for a railway fatality.

One Member State (the Netherlands) reported at the workshop held on 5<sup>th</sup> February that their national statistics relate only to their citizens and that the statistics on the 5% of all railway fatalities who are non-Nationals are passed back to the relevant Member State for reporting. So, suicide statistics are reported not at the level of the railway network, where they arise and where the issue is managed, but at the level of nationality.

A final part of the overall process is the collation of statistics for the European Detailed Mortality Database (EDMD). This is a database maintained by the World Health Organisation. The cause of death as recorded on the death certification is placed into one of the International Classification of Disease categories which includes categories relating to intentional and accidental fatality. At the time of writing the data held in the EDMD varied by year between countries with the most up to date being 2013, the majority 2012 and for some countries like the UK and Belgium 2010.

The police and IM/RU databases are most usually confidential. Thus the two publically available reporting channels are via the CSIs (ERAIL) and the EDMD. The main differences between these are listed in table 1 below.

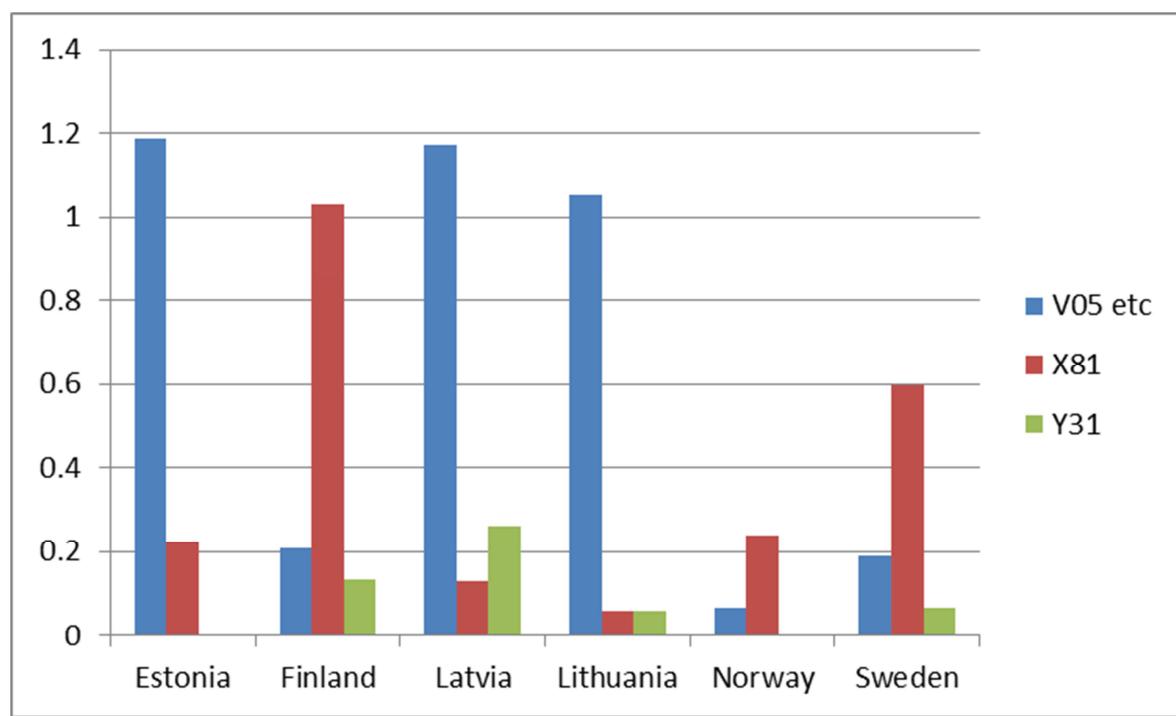
**Table 1 – The Main Features of the Two Differing Suicide Reporting Systems that exist within the EU**

	<b>Common Safety Indicators ERAIL</b>	<b>EDMD</b>
Source of Data	National Occurrence Reporting Systems based upon notification of occurrences by IM/RU	Cause of death as recorded on death certificate, or following coroners verdict
Organisation Responsible for Supplying Data	NSA or NIB	Health Ministry or Statistical Agency
Reporting Periodicity	Annually, six months after end of year.	Varies by country. Typical delay of 2 years for data to be submitted, although it can be longer.
Specific Category for Railway Suicide	Yes	No – classified as intentional self-harm by jumping or lying before moving object.
Organisation Responsible for Database	European Railway Agency	World Health Organisation

At the level of the individual the process of investigation and determination of death is robust. Most usually there is a police investigation and medical examination followed by a coroner's verdict on the cause of death. However, at an aggregate level in which overall statistics are important the situation is complicated with several different parties making assessments as to the cause of death at various points in an extended timeline and with a general absence of feedback loops so that all parties may not have the same common data on the fatality. This is further complicated by the fact that open or narrative verdicts leave the final categorisation of the fatality open.

In this situation it can be expected that accurate statistics will take one to two years to emerge, so that the current CSI reporting requirements for annual reporting cannot be achieved with accuracy.

Depending on the number of open or narrative verdicts as a percentage of all verdicts then it is possible that different Member States are classifying these differently as either suicide or accidental death. Certainly wide variations are seen in the statistics reported by Member States in similar geographical regions (figure 8).



**Figure 8 – Showing Fatalities per Hundred Thousand Population for Member States in a Similar Geographical Region for Intentional, Accidental and Undetermined Intent on Railway Premises from the EDMD.**

The above figure 8 shows an extract of the European Detailed Mortality Database for 2005/6 for the number of fatalities per hundred thousand of the population for the categories:

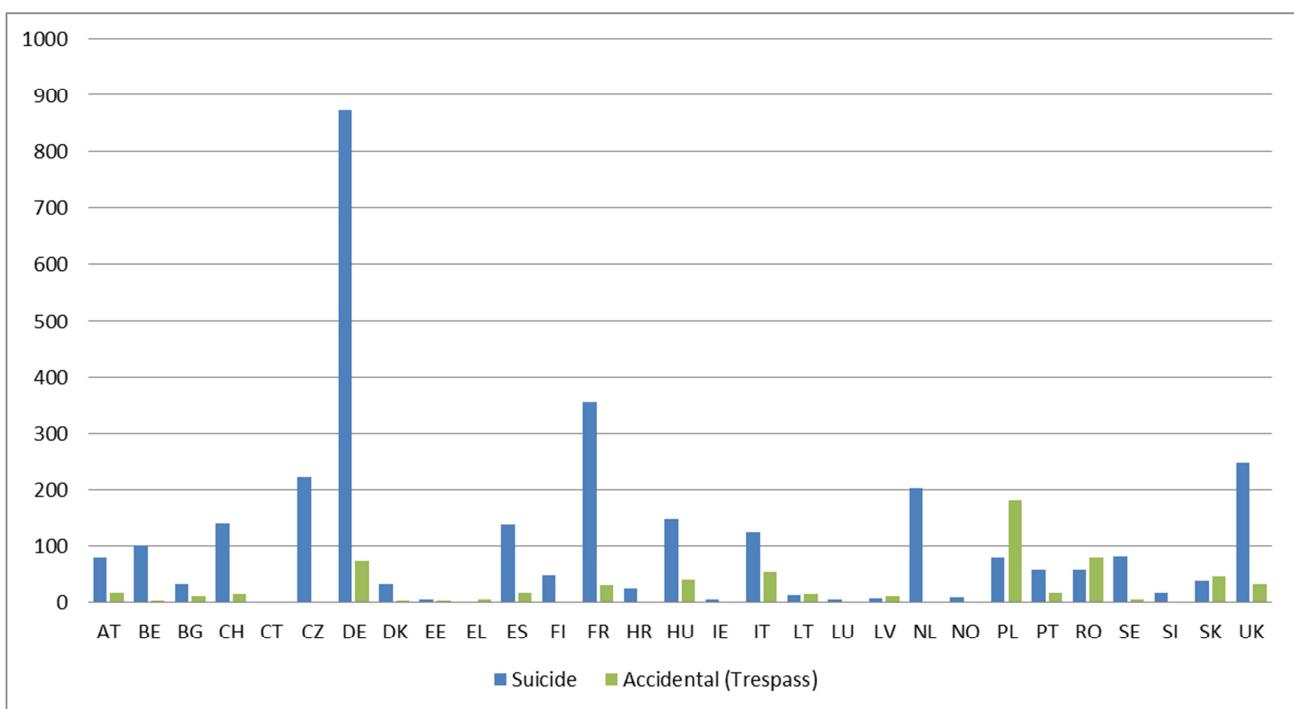
V05 etc. – Trespass (accidental) fatality on a railway

X81 – Intentional self-harm by jumping or lying before a moving object

Y31 - Falling, lying or running before or into moving object, undetermined intent

Differences are evident in the relative proportion of fatalities attributed to suicide and accidental death or undetermined intent.

Similarly for the data reported in the CSIs for 2012 for fatalities to unauthorised persons due to rolling stock in motion and suicide (figure 9):



**Figure 9 – 2012 CSI Data from the ERAIL Database for the Numbers of Suicide and Accidental Death on Railway Premises in the EU, Norway and Switzerland**

Poland, Romania and the Slovak Republic all report more accidental deaths than suicides in contrast to other Member States. It is also evident that the railway statistics as reported to the Agency as CSIs show far more suicide events than accidental deaths than when compared to the medical statistics collated into the European Detailed Mortality Database.

Guidance as to what constitutes a suicide or an accident is provided by the Agency in Implementation Guidance for CSIs, Annex 1 Directive 2004/49/EC as Amended by Directive 2009/149/EC – ERA/GUI/09-2013. This recommends the Ovenstone criteria. However the survey results indicate that few Member States apply these. The most commonly applied criteria are those of the police. Communication with RailPol has revealed that no EU level guidance on this is available to the various EU police forces.

At a national level specific contact with the police forces in the UK, Netherlands and Italy has revealed that national guidance does not exist in any of these countries. In the UK each police force applies its own policy. In the case of railway suicide the British Transport Police apply the Ovenstone criteria as informed by English common law in England and Wales and Scottish law in Scotland, with any coroner's verdict providing the final determination. Other police forces in the UK may have subtly different or no guidance, although all operate under the same legal framework. Common criteria for determining if a railway fatality is a suicide or an accident do not exist at an EU level and even at a national level.

## 2.4.2 The Role of the Police

During the project attempts were made to survey the police forces in relation to their role in suicide on railway premises. First contact was made through RailPol who initially agreed to help but then responded that they were unable to as surveying their members was an additional burden on the police forces. Approaches were then made to selected national police forces either directly or through the relevant Infrastructure Manager. With the exception of the British Transport Police in the UK it proved difficult to engage with the national police forces with the stated reason being given that they were prioritising resource on other issues such as illegal immigration and counter terrorism.

It can readily be appreciated that limited budgets necessitate any organisation having to focus their activities. But it is evident from the preceding discussion that in the management of suicide on railway premises the police have a central role to play both in terms of investigating whether it is suicide or trespass and in terms of the data they hold. At the second Suicide workshop (28<sup>th</sup> October 2015) one IM stated that in actively managing suicide on their infrastructure it would help their management to understand what motivated the individual to attempt suicide on a railway as opposed to any other method, but that this was difficult as much of this data was held by the police and not available to them.

It is believed that no fundamental barrier exists to the sharing of this data; data protection laws only being applicable to the living. Clearly there may be sensitive issues contained in the data but it is considered that suitable means of sharing data in an anonymised or confidential manner could be found. The IM concerned believed that the main barrier to the police sharing their data with them was purely one of other issues having priority.

In the previous section the absence of transparent guidance in many Member States concerning how the police arrive at a determination of suicide or trespass was discussed. Together with the issue of police data it is apparent that an opportunity exists for greater collaboration between the police and the railway actors in the management of suicide in making decisions both more transparent for more accurate reporting and in sharing data to help the victims of suicide.

### 2.4.3 Summary

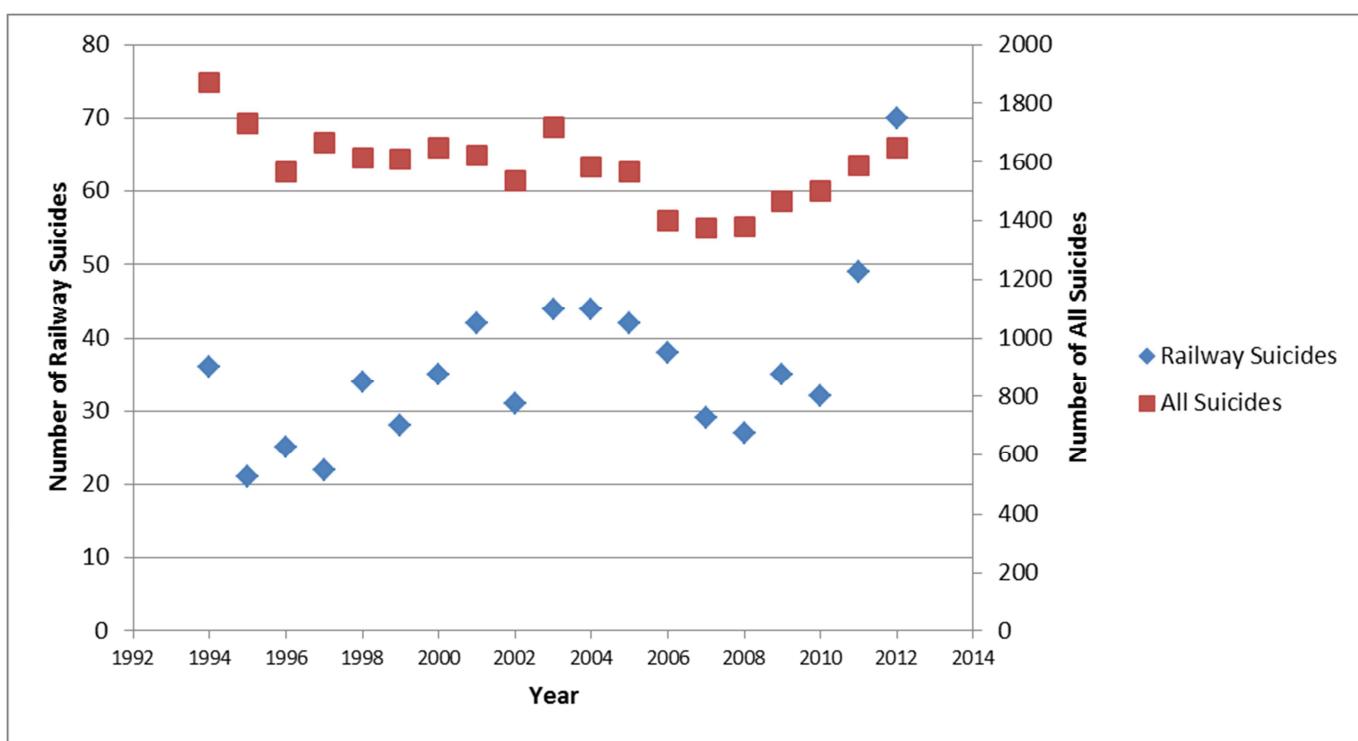
In summary the processes applied around suicide and accidental death on railway premises are robust at the level of the individual suicide victim. At a national reporting level processes are complicated with multiple organisations being involved, with timescales for decisions that lie outside of the reporting time scales for the CSI statistics and differing national requirements in each Member State that make the reporting against a single EU level guidance document difficult at present.

### 3 NORMALISERS

#### 3.1 Objectives

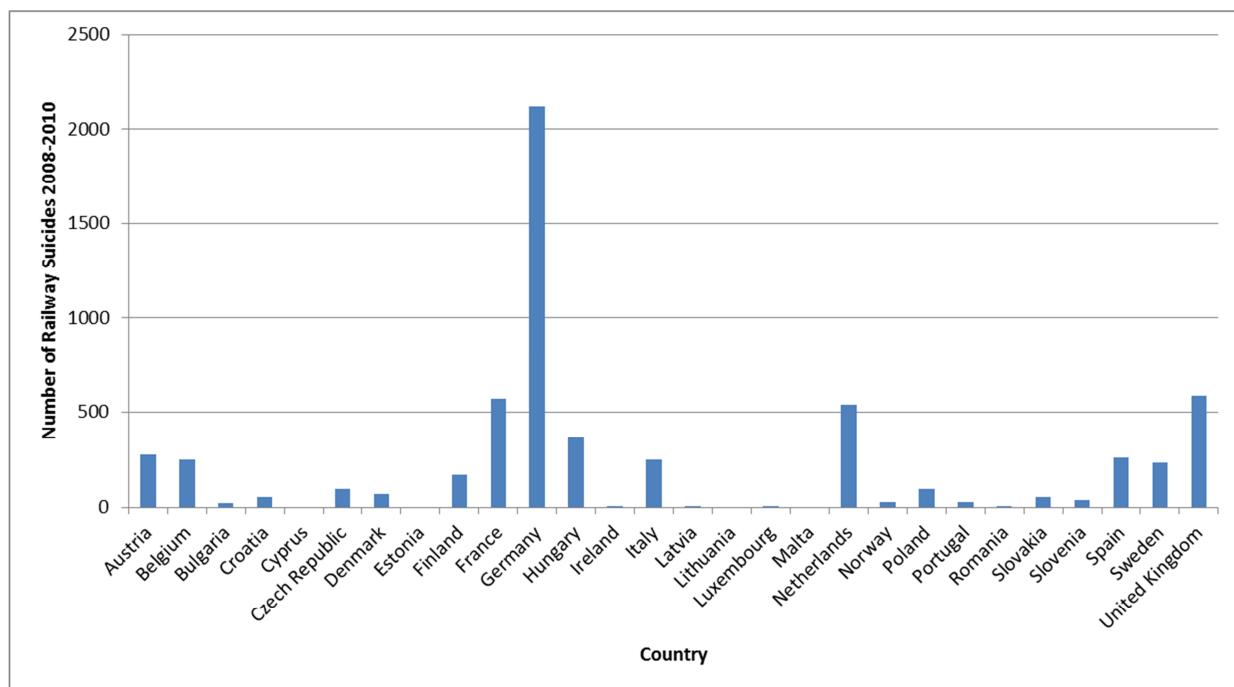
The objective of this section is to provide both time based comparison of railway suicide within one or more Member States and direct comparison between the prevalence of railway suicide between Member States. Normalisation refers to the creation of shifted and scaled versions of statistics, where the intention is to allow comparison of corresponding normalized values for different datasets in a way that eliminates the effects of certain gross influences.

Railway suicide is a complex phenomenon that is influenced by many factors. It is firstly influenced by all of the factors that typically influence the rate of suicide within a country such as economic performance or access to a means of committing suicide. In seeking to understand how railway suicide is being managed, and particularly whether it is an improving or deteriorating situation, the influence of these external factors needs to be considered. Figure 10 below plots the number of all suicides and railway suicides in the Czech Republic per annum using the EDMD data. Variations over time in the overall number of suicides are clearly evident. The number of railway suicides shows a similar variation. In order to make a time based comparison of railway suicide in the Czech Republic the railway suicides must be normalised to remove the influence of changes causing a variation in the overall number of suicide victims with time such as the impact of economic cycles.



**Figure 10 – The Changes in the Number of Suicides and Railway Suicides each Year in the Czech Republic**

Similarly differences exist between the Member States in terms of the number of railway suicides in them, Figure 11.



**Figure 11 – The Number of railway Suicides by Member State for the Period 2008-2010**

This figure takes no account of differences in the relative population in each Member State or the relative size of the railway network. The objective of this aspect of the project is to identify suitable normalisers that permit comparison of railway suicide over time and between differing Member States. This is summarised in the table below:

**Table 2 – The Differing Requirements of a Normaliser for Railway suicides**

Purpose	Underlying Problem Driver	Normaliser Required
Permit Comparison Between Differing Member States	Member States vary in size of population.	Normaliser needed that accounts for the fact that the larger the population the greater the number of potential railway suicide victims there are.
	Member States vary in terms of economic performance and in the stage of the economic cycle (growth or recession).	Normaliser needed that accounts for differing economic performance between Member States that drives differing overall rates of suicide that in turn would be expected to drive differing rates of railway suicide.
	Member States vary in regard to their cultural attitudes to suicide.	Normaliser needed that accounts for differing cultural attitudes that may affect differing overall rates of suicide and in turn differing rates of railway suicide.

<b>Purpose</b>	<b>Underlying Problem Driver</b>	<b>Normaliser Required</b>
	Member States vary in the size of their railway system and traffic volumes.	Normaliser needed that accounts for the differing size of railway in Member States.
Permit comparison over time	Exposure (population, size of railway) and economic growth varies over time.	Normaliser needed to account for variation in population and size of railway over time.
	Economic performance can affect suicide rates in a Member State and this varies with time.	Normaliser needed to account for changes in economic performance of a Member State over time.

The desired outcome is that once the normalisers are applied to the data on railway suicide then the variation seen in the number of railway suicides each year or between countries will primarily reflect differences in the management of railway suicide as a railway problem and not external factors such as economic growth.

## 3.2 Identifying Potential Normalisers

As a first step DNV GL undertook a short literature review to identify those railway features which influence the rate of railway suicide. It has been assumed that the tendency for an individual to commit suicide is independent of the presence of a railway, in that a railway may represent means but does not represent motivation. Certainly no evidence has been found to suggest that the presence of a railway is anything more than a possible means of committing suicide. As such the analysis of normalisers for railway suicide statistics has been considered as a part of the question "why would an individual choose a railway as a means of committing suicide as opposed to any other method?"

From first principles it can be expected that the number of suicides that take place on a railway is governed primarily by the number of suicides overall. Evidence correlating railway suicide to overall suicide is mixed with one study in 2010<sup>7</sup> identifying such a trend and a further study correcting for underlying suicide rate in a country<sup>8</sup>. However an earlier study on suicide on the Munich subway<sup>9</sup> between 1980 and 1999 found no such link. This may well be attributed to the specific nature of one subway in one city in which many specific factors affect overall city wide suicide rates and the attractiveness of the railway as a means of committing suicide.

In general it can be reasonably expected that a Member State with a very high prevailing rate of suicide will have a higher rate of railway suicide than a Member State with a very low prevailing rate of suicide. Underlying rates of suicides have also been associated with broad trends in society such as economic<sup>10</sup> (suicides rising in a recession). Account also needs to be taken of overall population size within a

<sup>7</sup> Train Suicides in the Netherlands, C van Houwelingen, A J F M Kerkhof and D G M Beersma, Journal of Affective Disorders, 2010, 127, pp281-286

<sup>8</sup> Suicide on Railway Networks: Epidemiology, Risk Factors and Prevention, K Krysinska and D de Leo, Australian and New Zealand Journal of Psychiatry, 2008, 42, pp763-771

<sup>9</sup> Patterns of Suicidal Behaviour in a metro Subway System, K-H Ladwig and J J Baumert, European Journal of Public Health, 2004, volume 14, pp291-295

<sup>10</sup> <http://www.bbc.co.uk/news/health-24123677>

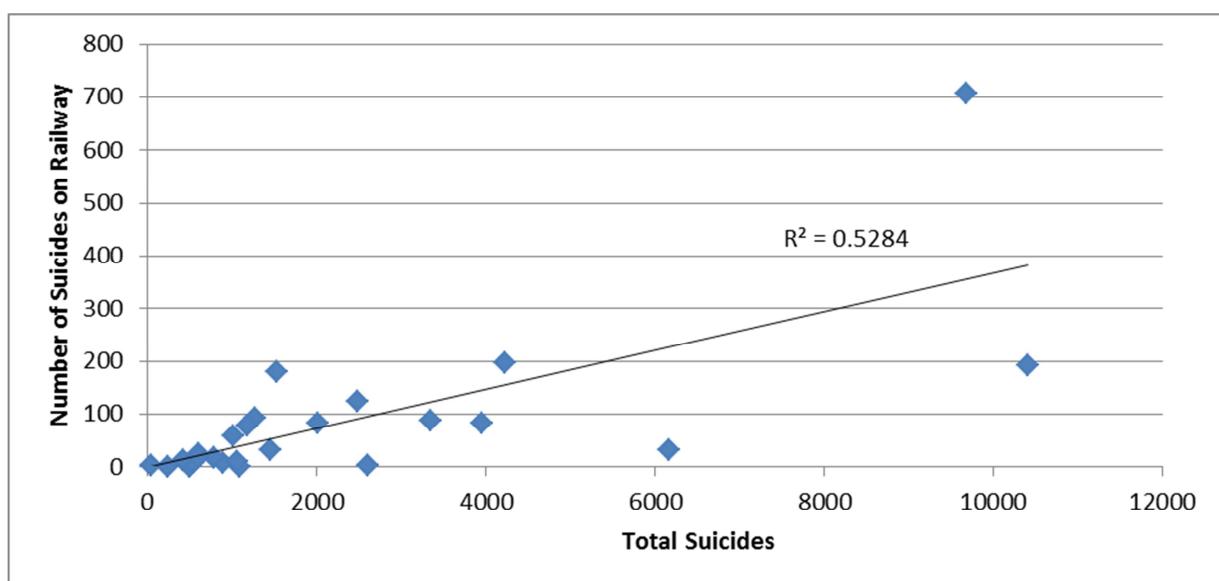
Member State in that those Member States with large populations can be expected to have more suicides than those countries with smaller populations.

To determine the number of railway suicides and the total number of all suicides data was extracted from the EDMD using the ICD-10 coding system<sup>11</sup>, downloaded January 2015. The precise ICD-10 categories used to determine this statistic are shown and discussed in the table 3 below.

**Table 3 – The ICD-10 Categories Used in the Analysis of Normalisers**

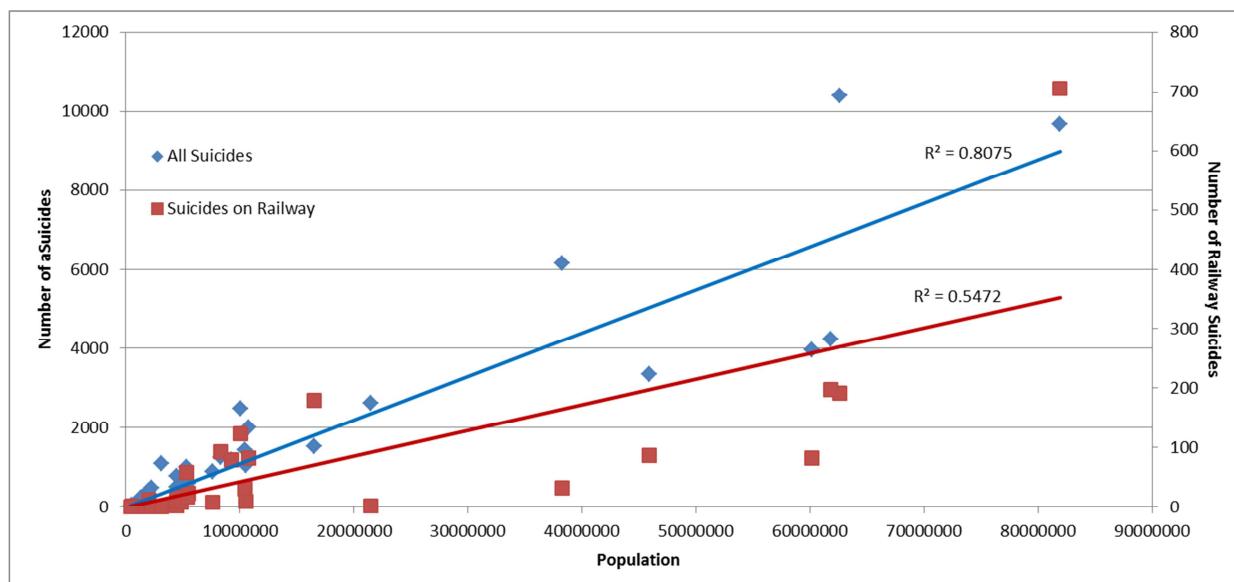
Categories	Definition	Comment
X81	Intentional self-harm by jumping or lying before moving object	Predominantly those struck by trains, but this category includes those that are hit by road vehicles.  This measure is used as a substitute for railway suicides (i.e. suicides on the roads are ignored).
X60-X84	All "Intentional self-harm" categories	Considered to be a robust measure of all suicides.

Figure 12 plots the number of railway suicides against the total number of suicides in a Member State for the period 2008-2010 using the data from the EDMD. As expected above railway suicide shows a correlation to overall rates of suicide in a Member State. Using total numbers of suicides as a normaliser then allows all those external factors that affect suicide rates to be accounted for. This includes changes in economic performance, changes in population size and cultural attitudes to suicide. In essence changes in these will be reflected in changes in the overall suicide rate and in the rate of railway suicide.



**Figure 12 – The Number of Railway Suicides versus the Number of all suicides for the Member States described in Table 4, 2008-2010**

<sup>11</sup> <http://data.euro.who.int/dmdb/>



**Figure 13 – The Variation of All Suicides and Railway Suicides with Population for the Member States listed in Table 4, for the period 2008-10**

Figure 13 shows the variation in suicide rates for all suicides and railway suicides with population. As expected the overall suicide rate is correlated with population, as is the railway suicide rate to a lesser degree. This lesser degree would be expected to be due to railway specific factors. Normalisers for these will be discussed later.

In order to test for suitable railway specific normalisers the statistic used was simply  $X81/(X60-X84)$  for each member state. This measures the number of railway suicides as a proportion of all suicides. The advantage of using this as a statistic to test railway related normalisers against is that it is dimensionless and accounts for variations in external (to the railway) factors related to suicide including population, economy, and cultural values.

### 3.3 Un-normalised Statistics

The scope in terms of countries studied was the European Union plus Norway and Switzerland, but EDMD data was missing for Switzerland and Greece. This resulted in a study set of 28 countries, which are visible in the tables and charts that follow in this section.

The 3-year period from 2008 to 2010 was selected for this data collection because ICD-10 data was available for all 28 countries for that period. This three-year period included 175,924 suicides in the 28 States studied, of which 6133 fell into the X81 category (3.5%). The extracted data is shown in table 4 below:

**Table 4 – The Data Extracted from the European Detailed Mortality Database for the Three Year Period 2008-2010**

Country	X81	X60-X84	Proportion of suicides that take place on the railway
Austria	278	3799	0.0732
Belgium	248	6024	0.0412

<b>Country</b>	<b>X81</b>	<b>X60-X84</b>	<b>Proportion of suicides that take place on the railway</b>
Bulgaria	23	2666	0.0086
Croatia	54	2362	0.0229
Cyprus	0	112	0.0000
Czech Republic	94	4345	0.0216
Denmark	71	1788	0.0397
Estonia	0	734	0.0000
Finland	172	3015	0.0570
France	574	31212	0.0184
Germany	2118	29043	0.0729
Hungary	368	7429	0.0495
Ireland	7	1519	0.0046
Italy	248	11862	0.0209
Latvia	1	1479	0.0007
Lithuania	0	3267	0.0000
Luxembourg	7	145	0.0483
Malta	0	80	0.0000
Netherlands	538	4560	0.1180
Norway	26	1624	0.0160
Poland	97	18497	0.0052
Portugal	29	3164	0.0092
Romania	5	7824	0.0006
Slovakia	52	1823	0.0285
Slovenia	36	1269	0.0284
Spain	261	10044	0.0260
Sweden	236	3548	0.0665
United Kingdom	590	12690	0.0465

It is clear that there is a considerable variation in the proportion of suicides that take place on the railway, as expected.

It is also clear that this proportion will naturally be dependent on how much railway activity there is in a country. Specifically, if there is no railway, there can be no railway suicides and if there is only very little track coverage or few trains, then it is also likely to be low. Studies have indicated that the proportion will grow linearly as the railway is developed before levelling off as most potential railway suicide victims have reasonably easy access to the railway. DNV GL has attempted to incorporate this general asymptotic behaviour in the choice of normalising measure as described in the sections following.

The study seeks to identify a suitable measure to account for this expected behaviour and therefore for a way of revealing differences between member states that are not merely reflections of population, propensity for suicide or whether potential victims have access to a railway.

### 3.4 Previous Work

Very few studies have been undertaken into the variability seen in railway suicides between differing national networks.

Van Houwelingen et al<sup>12</sup> in a comparison between suicide in Germany and the Netherlands attributed the greater proportion of railway suicides to all suicides in the Netherlands to the greater train frequency in the Netherlands compared to Germany. Other studies have ascribed suicide rates to urban population density adjacent<sup>13,14</sup> to railways on the basis of an observation that most suicides are in urban environments and suicide victims tend not to travel far in order to commit suicide.

At the first suicide workshop, research from the UK was presented which sought to model suicide rates at stations and level crossings. The factors associated with suicide were as in the following table 5.

**Table 5 – Specific Factors Raised at the Agency Suicide Workshop as Associated with Suicides at Stations and Level Crossings**

Station	Level Crossing
Number of entrances/exits	Number of trains
Percentage season ticket holders	Surroundings (urban or sub-urban)
Percentage non stopping trains	Level crossing barrier type
Station type	Interval between trains
Percentage tracks with an adjacent platform	

Debbaut et al<sup>15</sup> and Andriessen and Krysinka<sup>16</sup> identify the characteristics of suicide hot spots on the railway as being:

<sup>12</sup> Train Suicide Morality and Availability of Trains: A Tale of Two Countries; C van Houwelingen, J Baumert, A Kerkhof, D Beersma and K-H Ladwig, Psychiatry Research, 2013, 209, pp466-470

<sup>13</sup> Suicides and Other Fatalities from TRAIN-Person Collisions on Swedish Railroads: A Descriptive Epidemiologic Analysis as a Basis for Systems Oriented Prevention, H Radbo, I Svedung and R Anderson, Journal of Safety Research, 2005, 36, pp423-428

<sup>14</sup> Main Characteristics of Train-Pedestrian Fatalities on Finnish Railroads, A Silla and J Luoma, Accident Analysis and Prevention, 2012, 45, pp61-66

<sup>15</sup> Characteristics of Suicide Hot Spots on the Belgian Railway Network, K Debbaut, K Krysinka and K Andriessen, International Journal of Injury Control and Safety Promotion, 2014, Vol 21, No,3, pp274-277

- Accessibility
- Anonymity
- Presence of a mental health institute
- Ease of access (absence of fencing, presence of a level crossing)
- Proximity of a medical institute.

These factors are too detailed to use as normalisers at a national level because collecting information on the number of exits and entrances at all EU stations (for instance) would be a costly and difficult exercise.

### **3.5 Candidate Normalising Factors**

Features that a good normalising variable should have are as follows.

1. The normalising value must be easily obtainable for all EU railways. There is no point recommending a measure as a normaliser that cannot be measured accurately at a reasonable cost.
2. The normaliser should relate in some way to the causal events relating to railway suicide. In other words, there should be some plausible mechanism by which the proportion of suicides might be linked to the normalising measure. It should not represent a randomly established correlation.
3. The normaliser should be capable of explaining a significant amount of the variability seen in railway suicide between Member States.

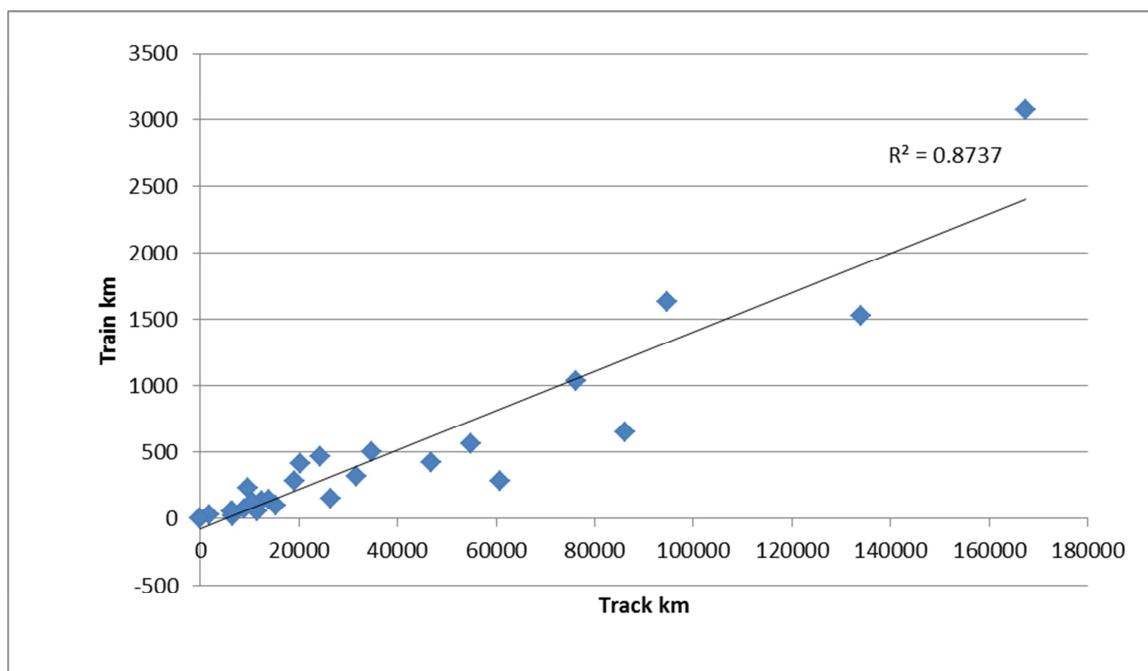
#### **1) Data Availability**

Variables which are readily available in the ERAIL database are passenger km, train km and track km, which are identified as being correlated with suicides by train<sup>16</sup>. Of note is the fact that all of these are closely correlated. The greater the number of track km the greater number of train km run over them carrying more passengers. See figure 14 as an example.

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<sup>16</sup> Railway Suicide in Belgium 1998-2009 K Andriesssen and K Krysinska, Crisis, 2012, Vol33 (1), pp39-45

<sup>17</sup> Suicide on Railway Networks: Epidemiology, Risk Factors and Prevention, K Krysinska and D de Leo, Australian and New Zealand Journal of Psychiatry, 2008, 42, pp763-771



**Figure 14 – The Relationship Between Train km and Track km from the ERAIL Database 2008-2010 for the Member States Considered in Table 4**

## 2) Causality

Having considered potential normalisers that are advantageous because they are readily available, it is then worth considering the second criteria that the normaliser should relate to railway suicide events in a causal manner. The vast majority of railway suicides involve being hit by a train, although a small number of electrocutions and falls from bridges or viaducts are also recorded each year. Of the three normalisers noted above (train km, track km and passenger km), train km has a clear preference on this basis, as it is the train that is inherently involved in the majority of suicides whilst the track or line is merely the location at which it happens. Passenger km appears to be unrelated although there are suggestions in the literature<sup>18</sup> that familiarity with railways as a regular passenger may be weakly associated with a propensity for suicide.

## 3) Explaining Variability

The final consideration is the proportion of variability that exists between the various Member States' railways that the normaliser can explain. This was assessed through a series of regression analyses of the three years' data from the European Detailed Mortality Database (2008, 2009 and 2010) described above. This period was chosen as it provided a relatively recent and coherent set of reported data, noting that some Member States have not reported the most recent year's mortality data into the database.

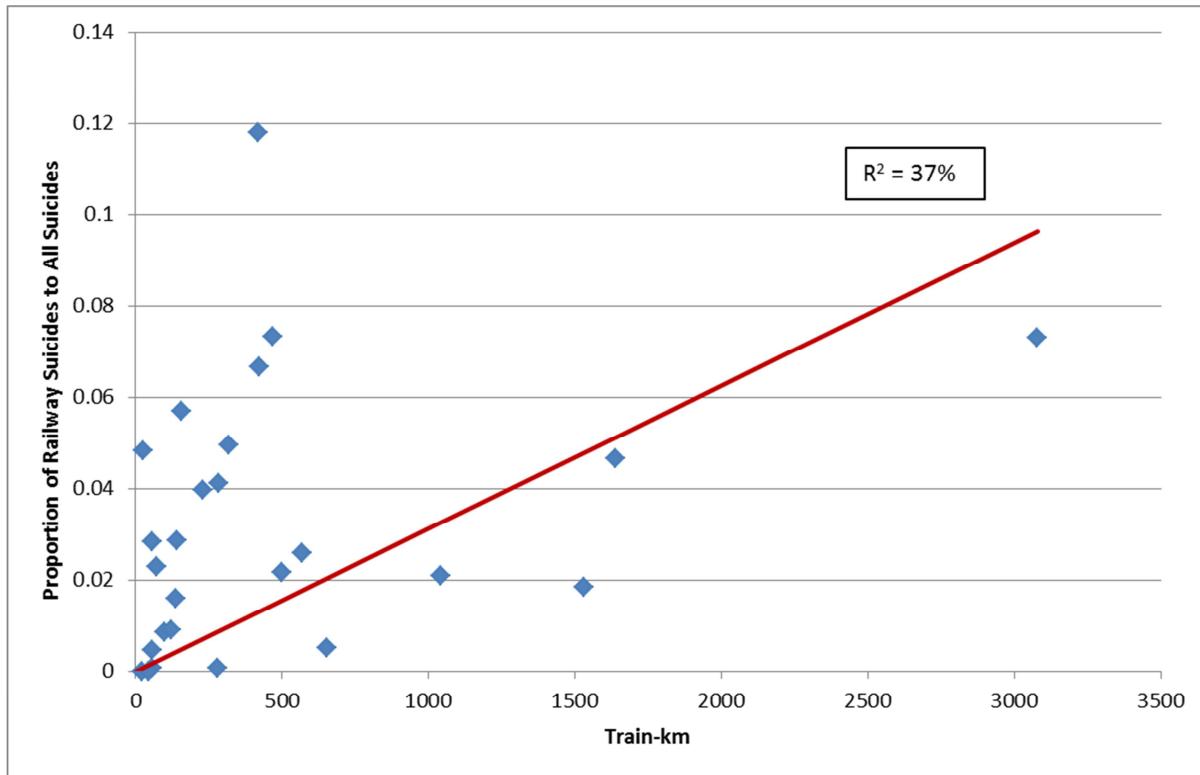
In order to account for inter-year variations in suicide rates and variations between Member States the railway suicides (X81 in the ICD-10 classification system) were considered as a proportion of all suicides in the country. This is supported by van Houwelingen<sup>19</sup> who concluded that railway suicides vary with trends in the general population of suicides.

<sup>18</sup> Suicide on Railway Networks: Epidemiology, Risk Factors and Prevention, K Krysinska and D de Leo, Australian and New Zealand Journal of Psychiatry, 2008, 42, pp763-771

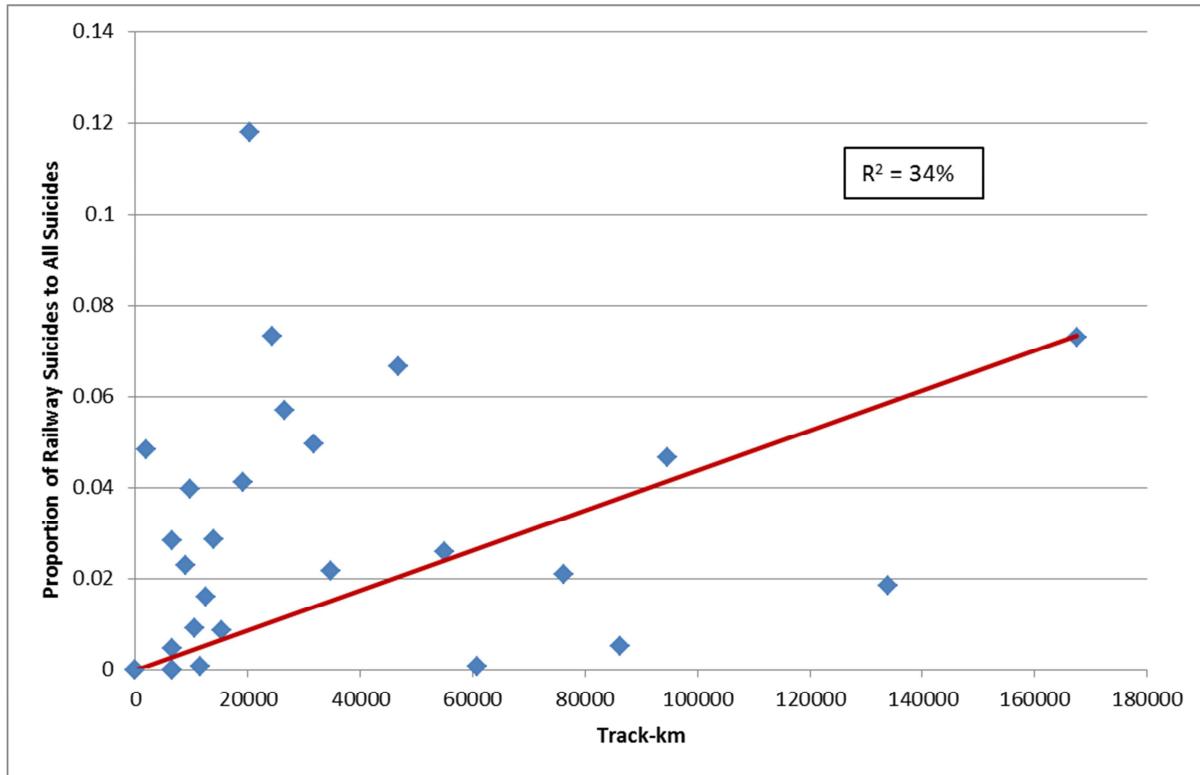
<sup>19</sup> Train Suicides in the Netherlands, C van Houwelingen, A J F M Kerkhof and D G M Beersma, Journal of Affective Disorders, 2010, 127, pp281-286



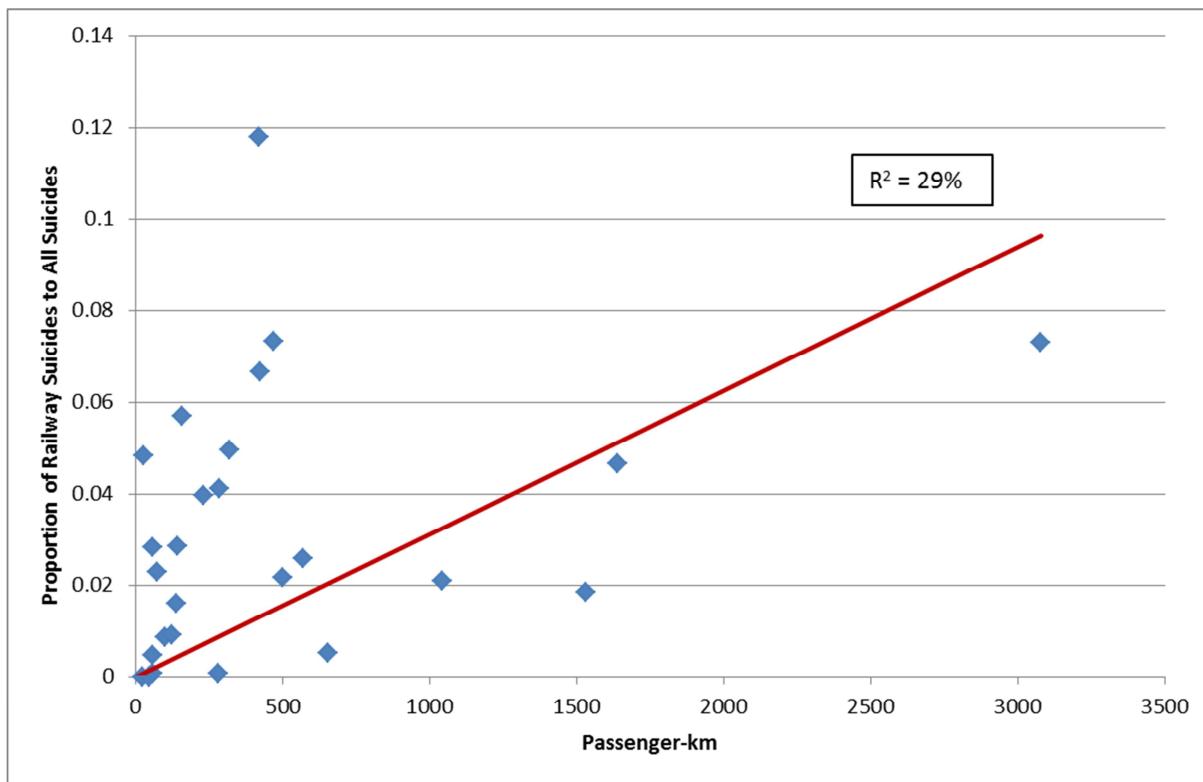
In the following section, the figures 15, 16 and 17 show this X81/(X60-X84) statistic plotted against the candidate normalisers and table 6 summarises the statistical analysis.



**Figure 15 – Proportion of Railway Suicide to all Suicides Versus Train - km**



**Figure 16 – Proportion of Railway Suicide to all Suicides Versus Track - km**



**Figure 17 – Proportion of Railway Suicide to all Suicides Versus Passenger - km**

**Table 6 – Summary of Candidate Measures Degree of Correlation and Significance**

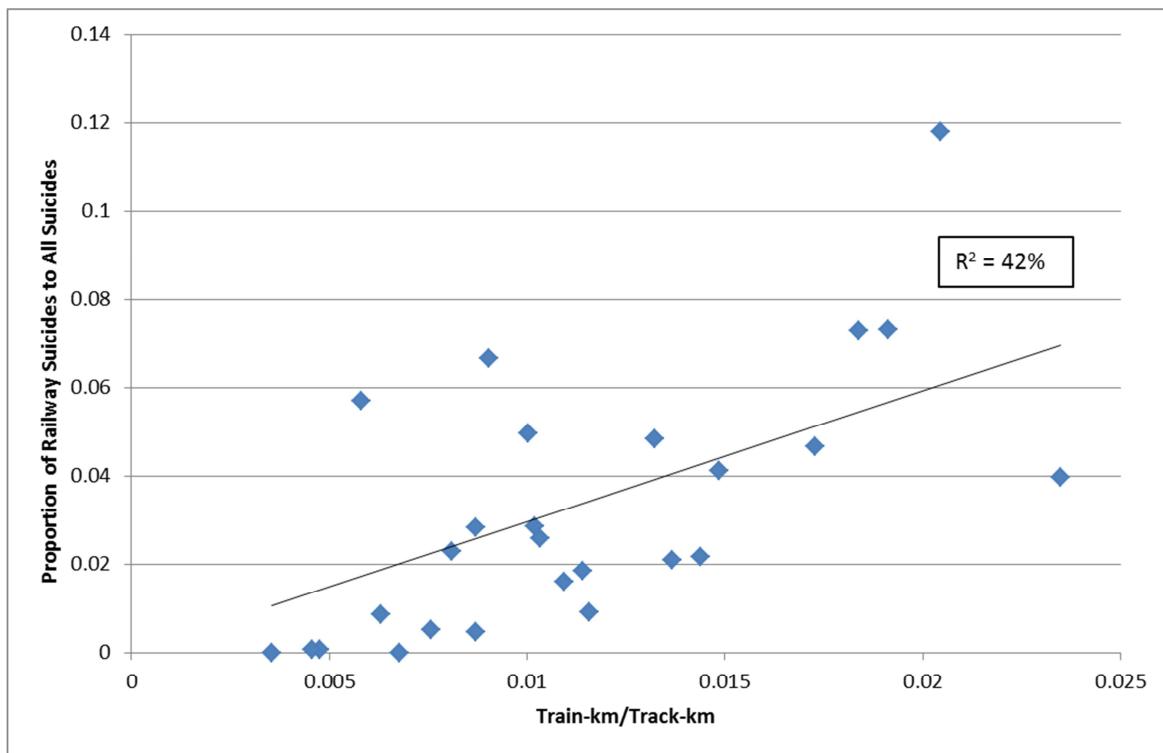
Candidate measure against proportion of railway suicides to all suicides.	R-squared value	T-Test Probability	F-Test Probability
Train km	37%	0.000514	0.000514
Track km	34%	0.000934	0.000934
Passenger km	29%	0.00245	0.00245
Train km/Track km	42%	-	-

Whilst the linear relationships tested for the proportion of railway suicide against train km, track km and passenger km are significant in terms of the t and f test none of them is strongly correlated, with R-squared values of typically one third. Indeed visual inspection of the three graphs indicates that while more train, track and passenger km generally result in an increase in the proportion of suicides there are many outlying data points that do not fit this trend.

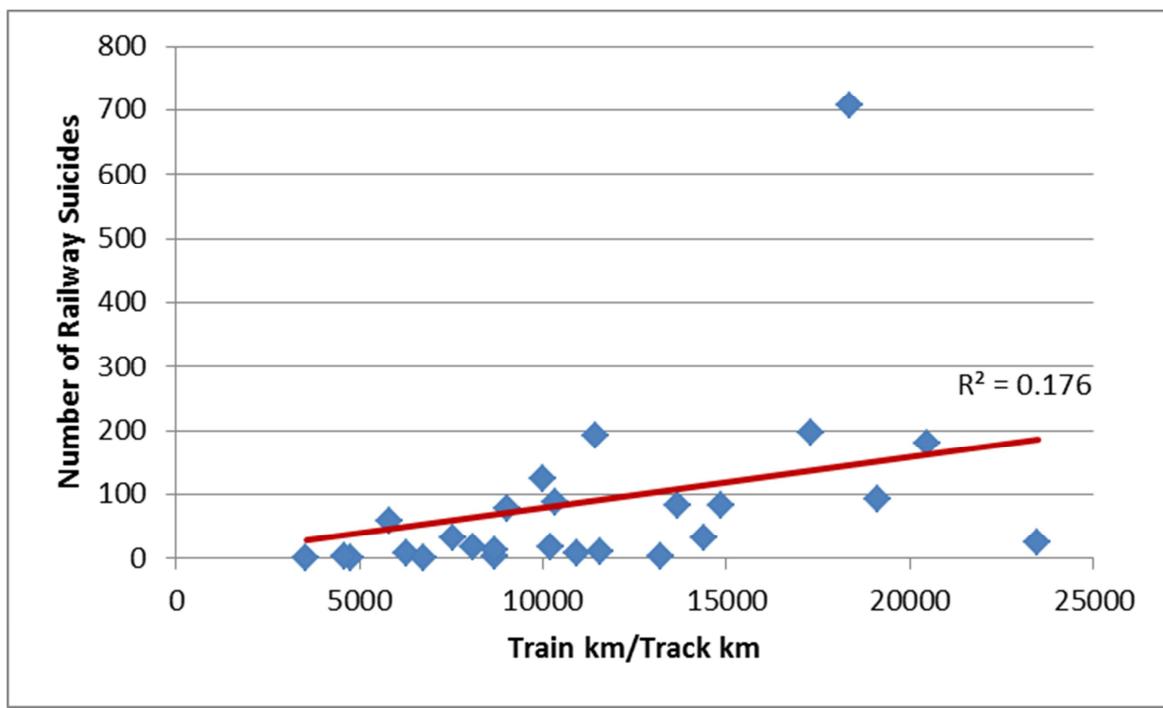
A further normaliser tested was train frequency as was proposed by Van Houwelingen et al<sup>20</sup>. This is expressed as the proxy value of train km/track km as data for actual train frequency are not readily

<sup>20</sup> Train Suicide Morality and Availability of Trains: A Tale of Two Countries; C van Houwelingen, J Baumert, A Kerkhof, D Beersma and K-H Ladwig, Psychiatry Research, 2013, 209, pp466-470

available for all EU Member States. This is shown in figures 18 and 19 for both the proportion of railway suicide to all suicide and for the number of railway suicides.



**Figure 18 - Proportion of Railway Suicide to all Suicides Versus Train km/Track km**



**Figure 19 - Absolute Number of Railway Suicides Versus Train km/Track km**

The R-Squared value as a proportion of railway suicides to all suicides (figure 18) is marginally improved to 42%. However, because of the close correlation between train km and track km (see figure 14) a full

regression analysis is not meaningful and has not been undertaken, and hence no T- or F-Test probabilities are provided.

### 3.5.1 Normalising Study Results Modelling the Effect of Levelling Off

As mentioned previously, studies have indicated that the proportion of suicides that take place on the railway will grow linearly as the railway is developed before levelling off as most potential railway suicide victims have reasonably easy access to the railway<sup>22</sup>. DNV GL's method for incorporating this behaviour into the regression models is to use as the independent variable a logarithmic transformation of the measure under consideration rather than the raw measure itself. This provides a mathematical description of this linear growth followed by a levelling off.

In addition to the desired logarithmic response, it is essential that the model correctly models the fact that the statistic will be zero in countries with no railway. To accomplish this, the independent variable was chosen to be

$\ln(Y + 1)$ , where

$\ln()$  is the natural logarithm function

$Y$  is the raw candidate normalising measure

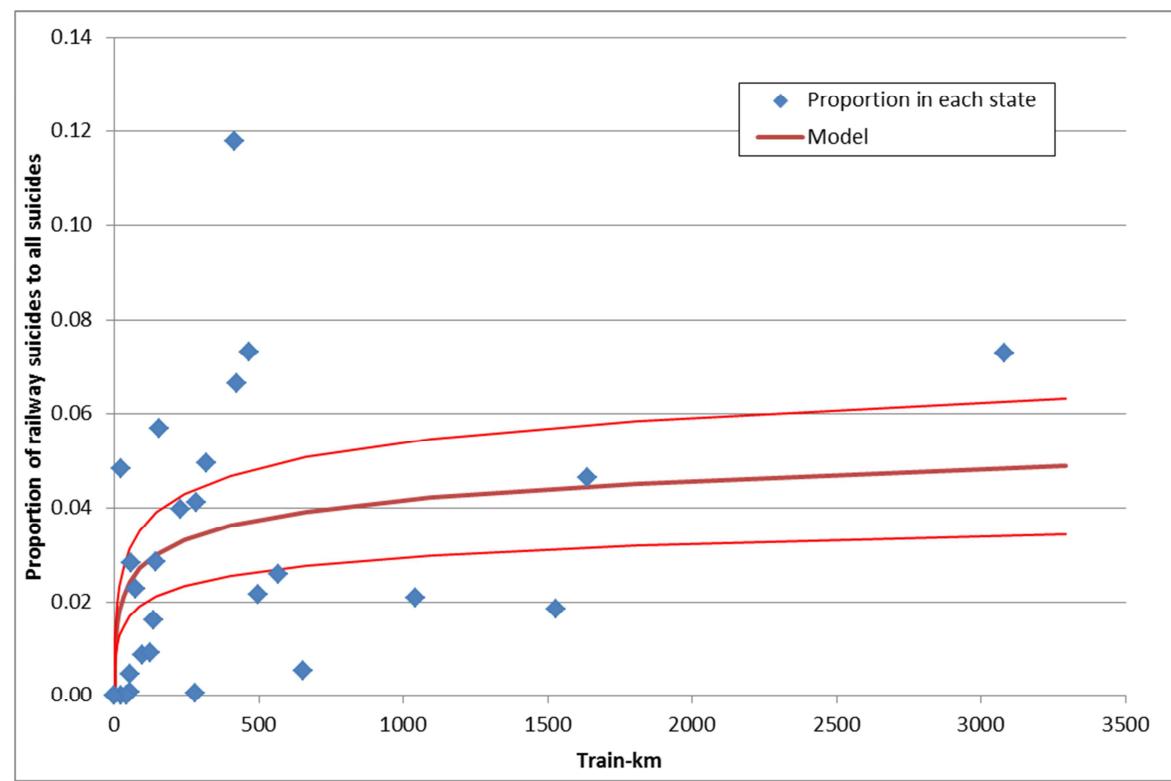
This makes it possible to force the regression to yield a zero result when the distance measure is zero.

The results of the regressions are shown in the following section in graphical form and discussed subsequently.

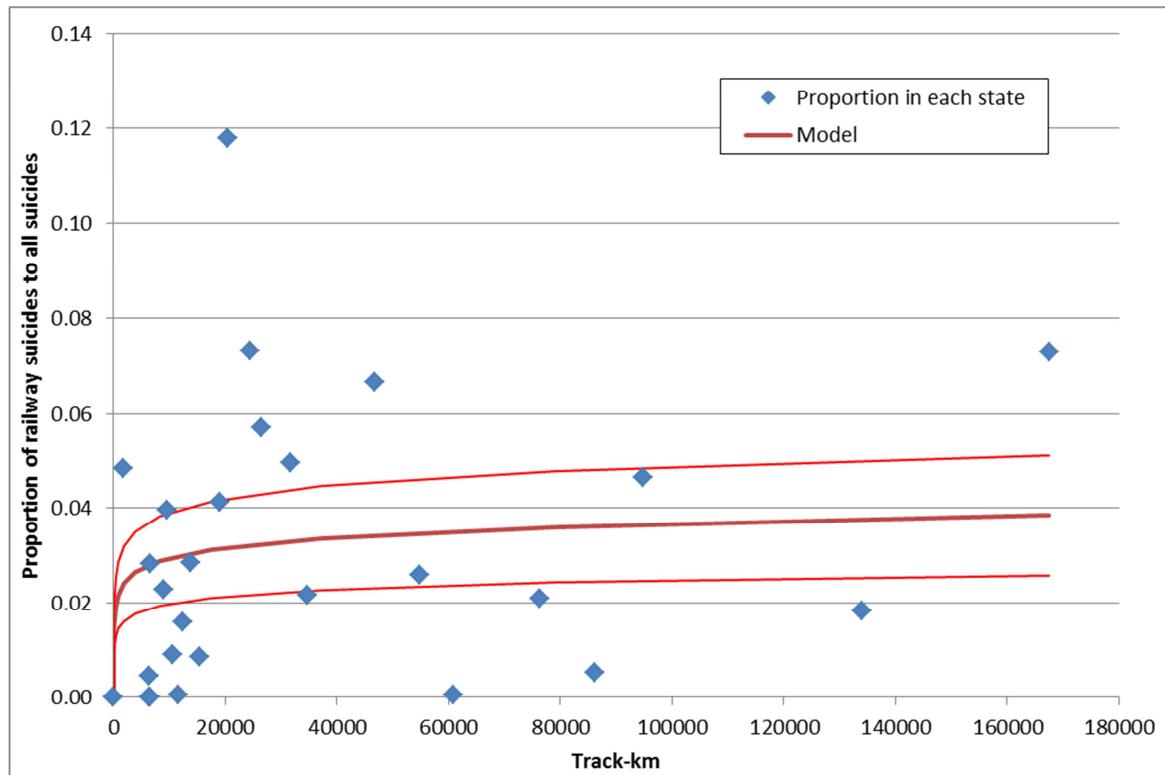
The results are shown in figures 20, 21 and 22 and table 7. The central red line on the graph (the Model) represents the proposition tested i.e.  $\ln(\text{train-km} + 1)$ . If this normaliser explained all the variation seen then all the data points would sit on this line. The two finer lines either side of the central model represent the 95% confidence limits.

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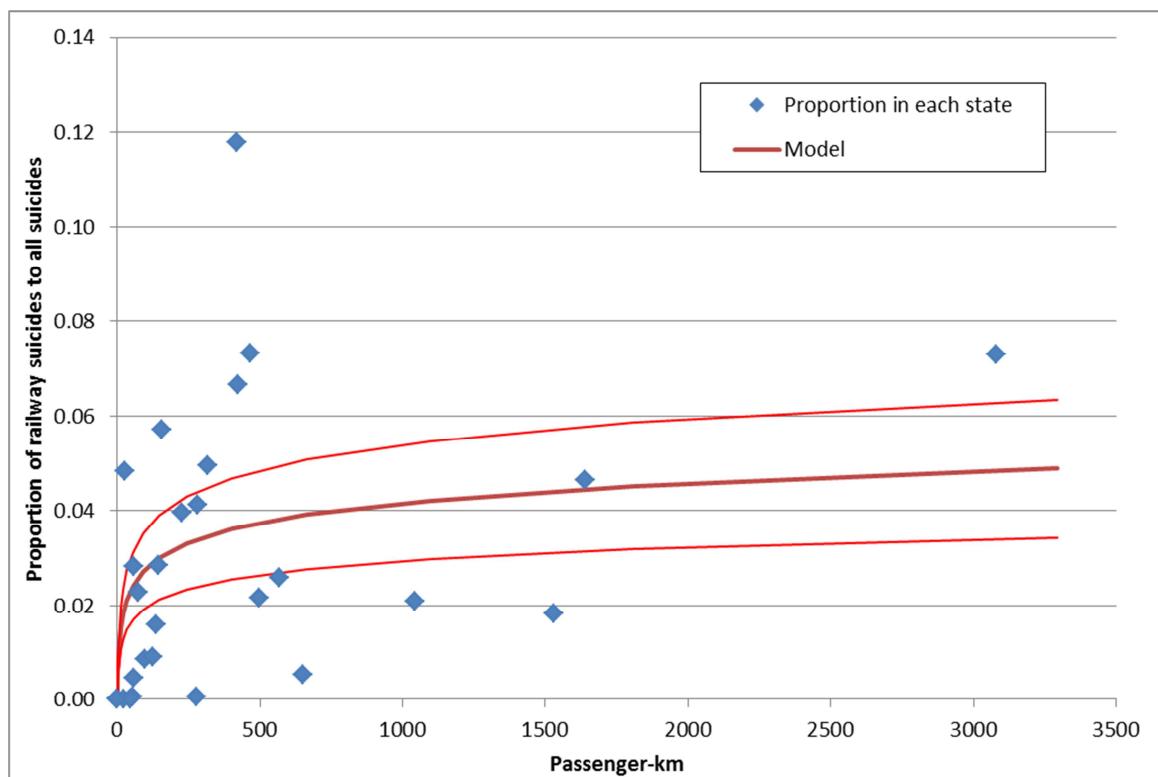
<sup>22</sup> Railway Suicide in England and Wales, 1850-1949, M Clarke, Social Science Medicine, 1994, Volume 38, No.3, pp401-407



**Figure 20 - Proportion of Railway Suicides to all Suicides versus Train km**



**Figure 21 - Proportion of Railway Suicides to all Suicides versus Track km**



**Figure 22 - Proportion of Railway Suicides to all Suicides versus Passenger km**

The data in each of the charts above exhibits the expected near-linear rise in response to the distance measure, following by a levelling-off, which is in agreement with the studies referenced previously.

The regressions were simple 1-variable linear regressions, with forced zero intercept, with the chosen statistic (the proportion of suicides that take place on the railway) as the dependent variable and  $\ln(Y+1)$  as the independent variable.

The fit of the regression model to the data is shown in the graphs above. Although the regression was performed on the logarithmic measure, the fits are shown on linear charts to show the model response more clearly. The best estimate of the model is shown as the bold line.

Each regression produced an “R-squared” value, which can be interpreted as the proportion of variability in the statistic that is explained by variation in the independent variable. The three percentages of the total variability explained by the three candidate normalisers were as follows.

**Table 7 – The Total Variability Explained by the Three Candidate Normalisers**

Candidate measure	R-squared value	T-Test Probability	F-Test Probability
Train km	62%	4.11256E-07	4.11256E-07
Track km	57%	2.19006E-06	2.19006E-06
Passenger km	61%	6.45523E-07	6.45523E-07

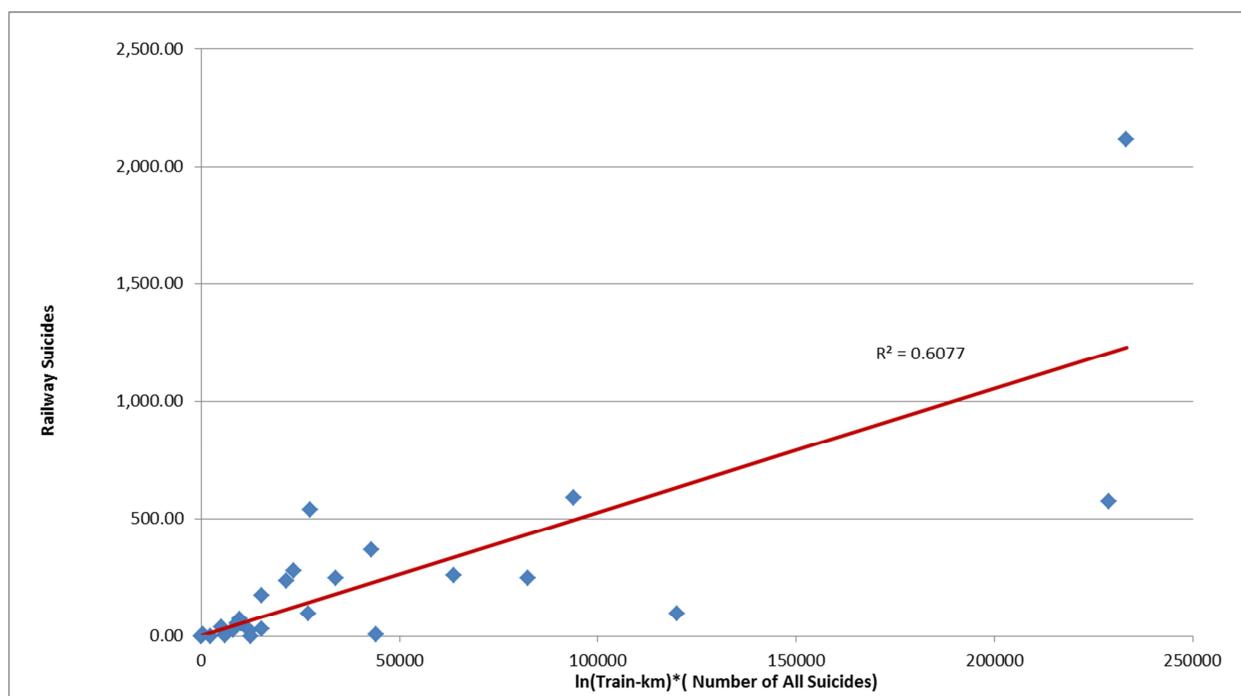
A t test and an f test were undertaken to confirm that these results were significant and did not occur by chance. In all cases the probability that the described association was purely random was below 1%.

Whilst each of these are approximately equivalent, the use of train km is recommended due to the causal link between the train and the suicide event that does not exist for the other variables considered. As previously described train km, track, km and passenger km are closely related in reality as the greater the amount of track the more and further trains will run and the further the passengers in those trains will travel.

In conclusion the proposed normaliser for railway suicides (as a fraction of all suicides in the Member State) is  $\ln(\text{train km}+1)$ . Reformatting this so that it is expressed as a normaliser for the absolute number of railway suicides:

$$\ln(\text{train km}+1) * (\text{Number of all suicides})$$

This is shown in figure 23.



**Figure 23 – The Correlation between the Number of Railway Suicides and In (train-km) \* Number of All Suicide from 2008-2010**

Table 8 summarises the suggested normalisers against the identified purpose from table 2.

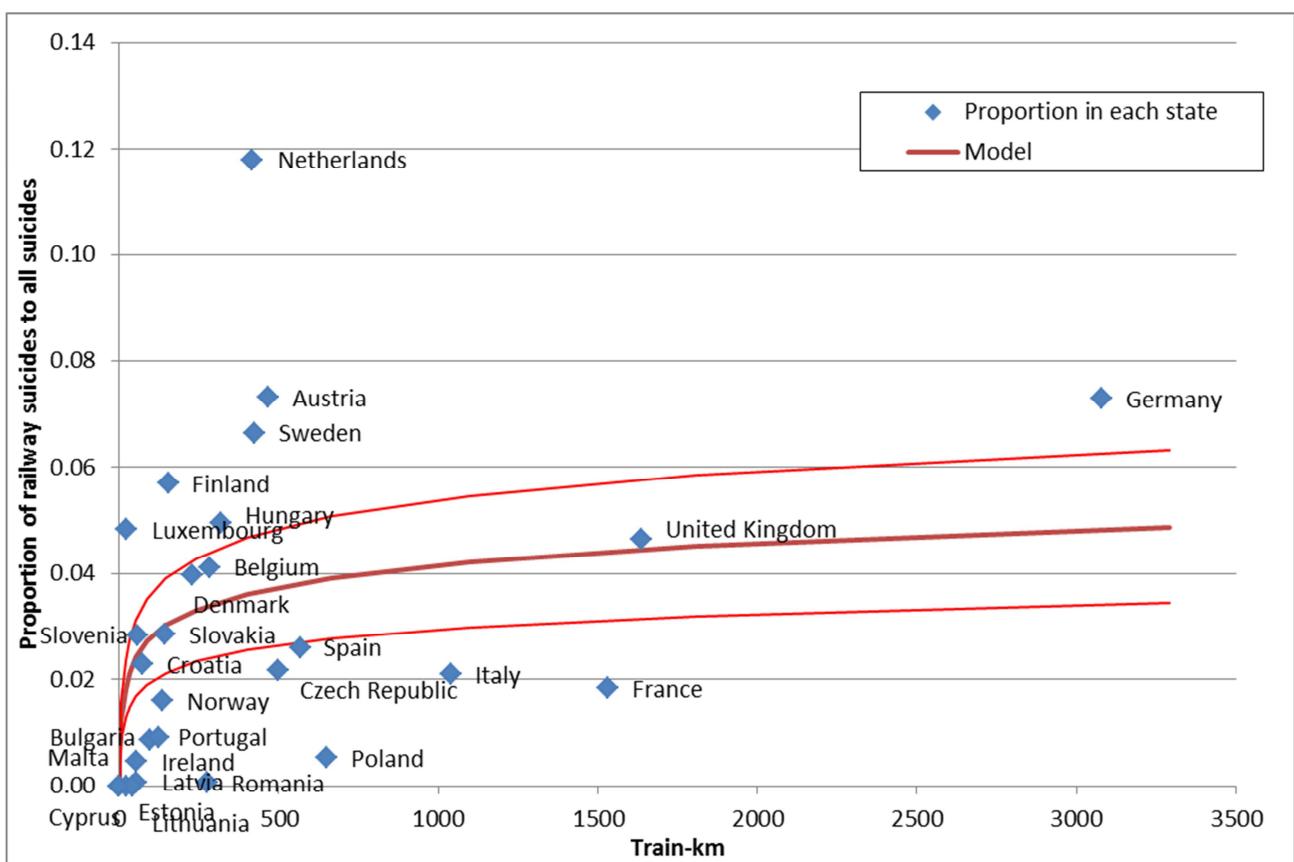
**Table 8 – Summary of the Proposed Normalisers**

Purpose	Underlying Problem Driver	Suggested Normaliser
Permit Comparison Between Differing	Member States vary in size of population.	Overall number of suicides per annum in the Member State

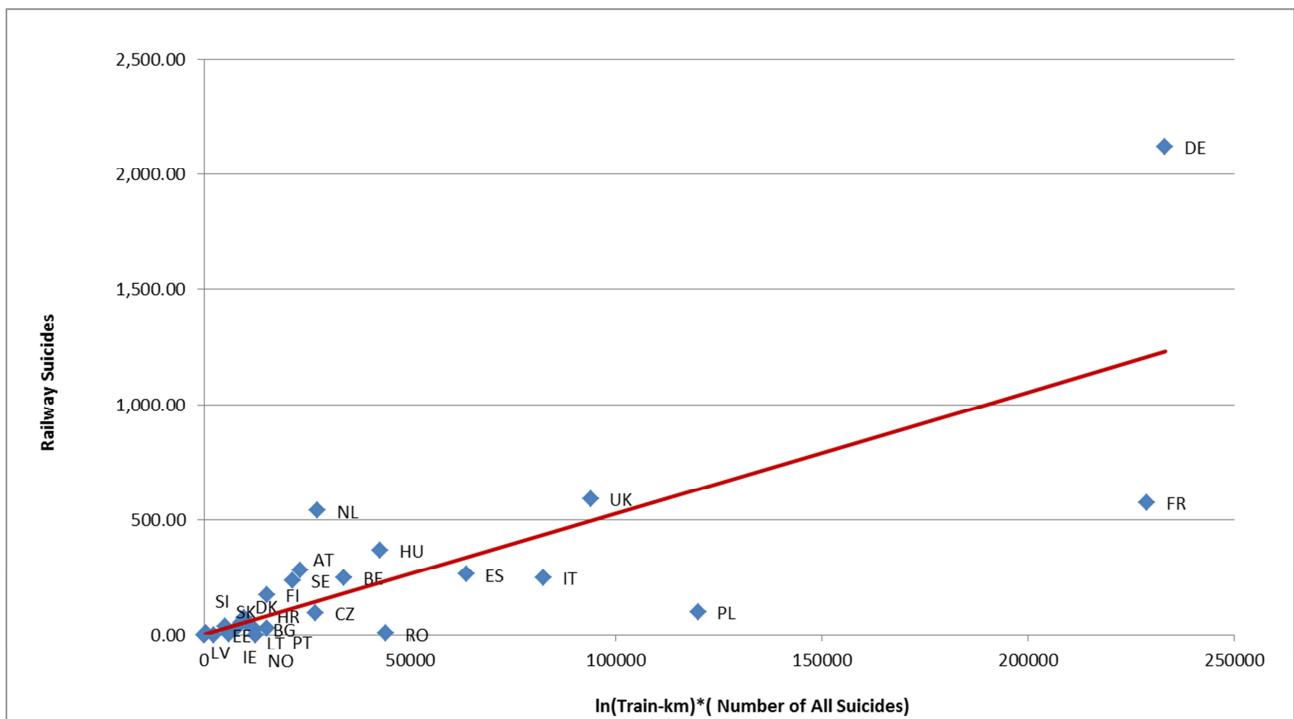
<b>Purpose</b>	<b>Underlying Problem Driver</b>	<b>Suggested Normaliser</b>
Member States	Member States vary in terms of economic performance and in the stage of the economic cycle (growth or recession).	Overall number of suicides per annum in the Member State
	Member States vary in regard to their cultural attitudes to suicide	Overall number of suicides per annum in the Member State
	Member States vary in the size of their railway system and traffic volumes	Ln (train-km)
Permit comparison over time	Exposure (population, size of railway) and economic growth varies over time	Overall number of suicides per annum in the Member State
	Economic performance can affect suicide rates in a Member State and this varies with time	Overall number of suicides per annum in the Member State

### 3.5.2 Application of the Proposed Normaliser

Applying the suggested normaliser to the data and showing the Member States illustrates those performing above or below the expected level, as in the Figure 24 and 25 below:

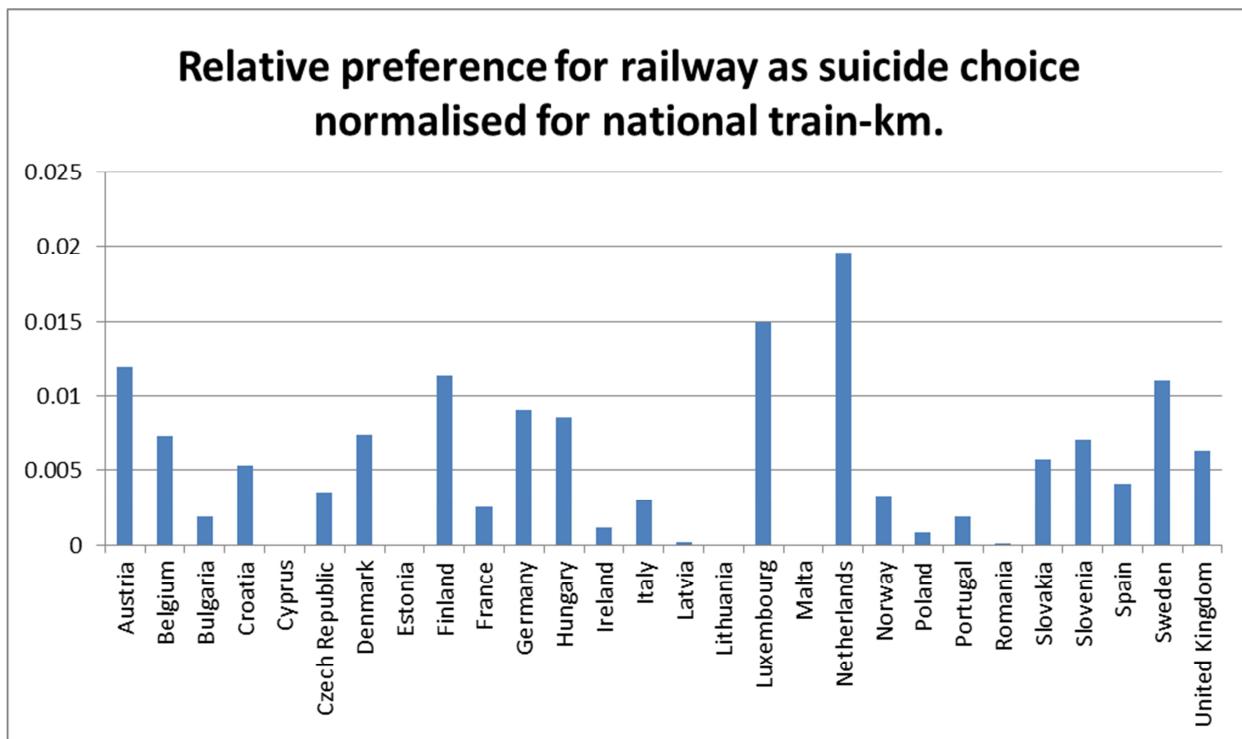


**Figure 24 - Proportion of Railway Suicides to all Suicides versus train km showing Individual Member States**



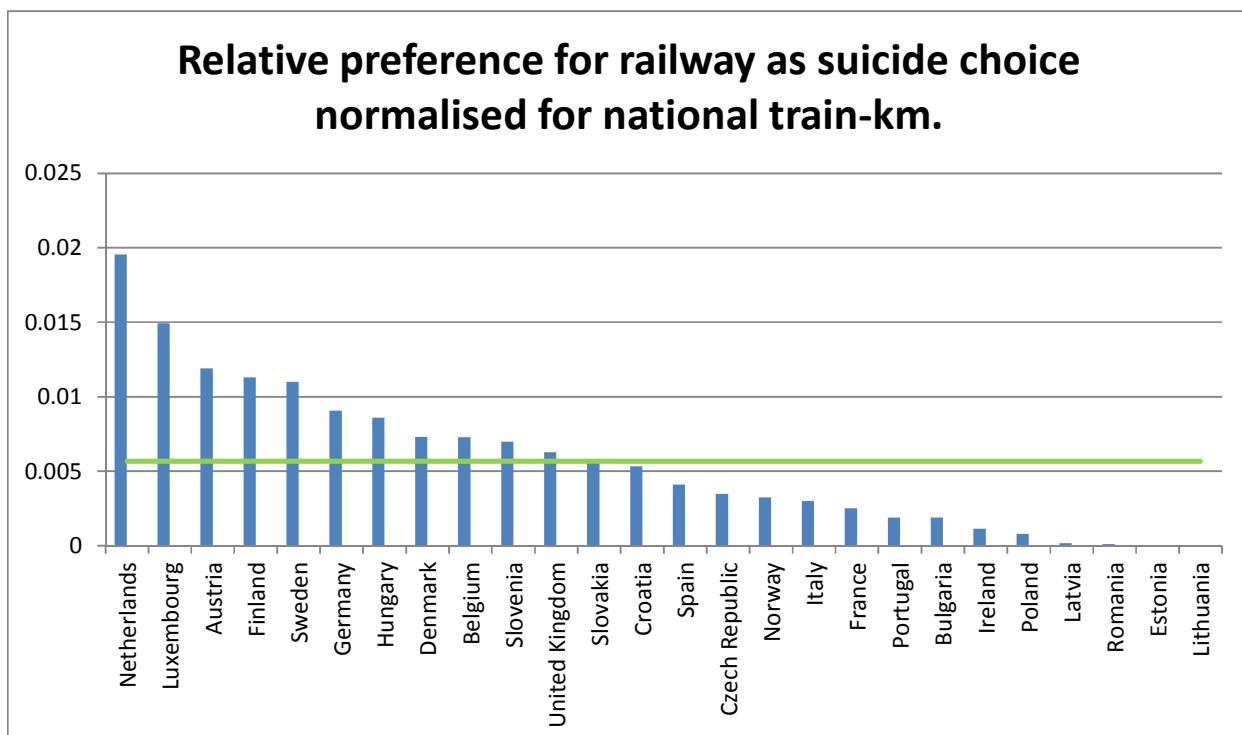
**Figure 25 – Number of Railway Suicides to all Suicides versus train km showing Individual Member States**

These results can also be shown on a bar chart:



**Figure 26– The Relative Proportion of Railway Suicides to Overall Suicides Normalised for National train km**

Or when ranked with the mean shown as the lateral line.



**Figure 27 - The Relative Proportion of Railway Suicides to Overall Suicides Normalised for National train km**

There will be a natural variation in the level of suicide reflecting differences in reporting as highlighted earlier. Also, within the European Detailed Mortality Database, X81 is described as intentional self-harm by jumping or lying in front of a moving object. The largest component of this is suicide on the railway, but it also addresses jumping or lying in front of lorries and buses. At the Agency's first suicide workshop, representatives from Finland informed the group that Finland experienced a larger number of these than other countries although no data to support this has been received. However, a simple explanation such as this could account for the ranked position of Finland on this chart.

Of note is the high level of normalised railway suicides in the Netherlands and Luxembourg and the very low levels in countries such as Ireland, Poland, Romania, Estonia and Latvia. Other marked differences are that between Sweden and Norway or Belgium and France. It has been suggested that the culture or prevailing religious attitudes in a country may affect the propensity towards suicide and how it is reported, but these explanations fail if the differences persist when the number of suicides on the railway is normalised by the total number of suicides, as in the results shown in this study. There is no immediately obvious way that cultural or religious factors might influence a person's choice of suicide method. Therefore, while this may have some residual impact it would not appear to be a determining factor. It is more likely that some underlying characteristic of the railway itself or the reporting differences lie behind these differences.

### 3.5.3 Possible Underreporting and Data Quality

One area of concern in any reporting system is the robustness of the reporting, particularly in areas in which a judgement is required as to the correct cause of the occurrence. In the instance of suicide it is highly unlikely that a fatality would be missed given the level of official oversight into fatalities on a railway. As previously stated the investigation into a fatality on the railway is considered robust. However, the final determination of whether a fatality is a suicide or an accident can often take some time to be made, a timescale that extends beyond the reporting requirements of the CSIs. Under (or over) reporting can also distort the impact of a normaliser.

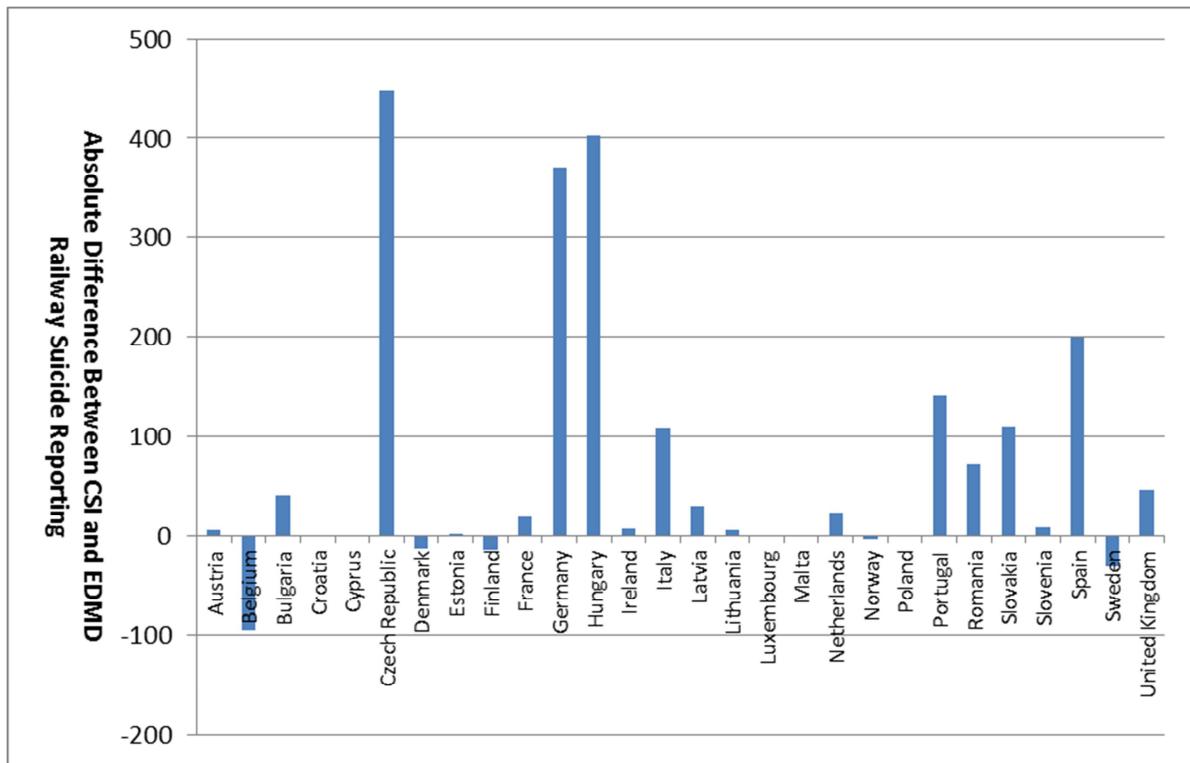
As stated earlier two independent reporting regimes exist for suicide reporting on railways; the CSI regime which is primarily mandated on railways and National Safety Authorities and the regime facilitated by the World Health Organisation (European Detailed Mortality Database) which primarily falls upon health ministries. Reporting for both is against slightly different criteria. In the CSIs railway suicides are reported whereas in the ICD-10 classification used in the EDMD the reporting category is "Intentional self-harm by jumping or lying before moving object" which would include suicide involving trains, lorries, buses or any other moving object. As stated before the vast majority of those fatalities contained in X81 would be expected to involve trains.

If the reporting regimes were perfectly aligned one should expect the results reported under them to be similar with a slight excess for X81 over the CSI due to the additional suicides from lorries. Figure 28 below shows the difference in reporting between the ERA CSI data for 2008-10 and the EDMD for the same period (CSI data – EDMD data).

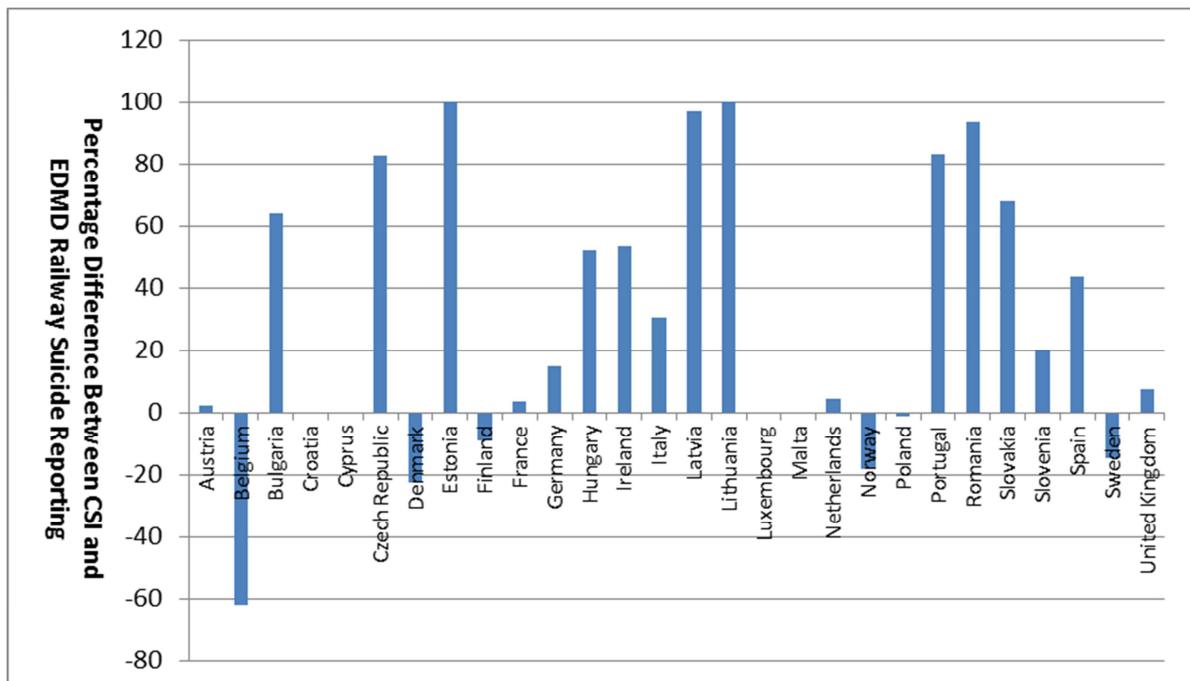
As before a small negative variation would be expected as the scope of reporting under X81 in the EDMD is wider than the CSI scope. This is seen for the Baltic States (Norway, Sweden, Finland and Denmark) and Poland with there being no variation for four additional states. Very large variations are seen in other Member States and it should be noted that these are positive variations (a greater number of railway suicides being reported under the CSIs than under the EDMD) which would not be expected from a simple consideration of the difference in the scope of reporting between the CSIs and X81. However, it should be noted that this takes no account of differing populations or numbers of suicides in a Member State. When this variation is expressed as a percentage difference (figure 29) Member States such as



Germany exhibit a smaller relative variation due to its overall number of railway suicides. Others such as Estonia have very high percentage variation due to the low number of overall railway suicides in that state.

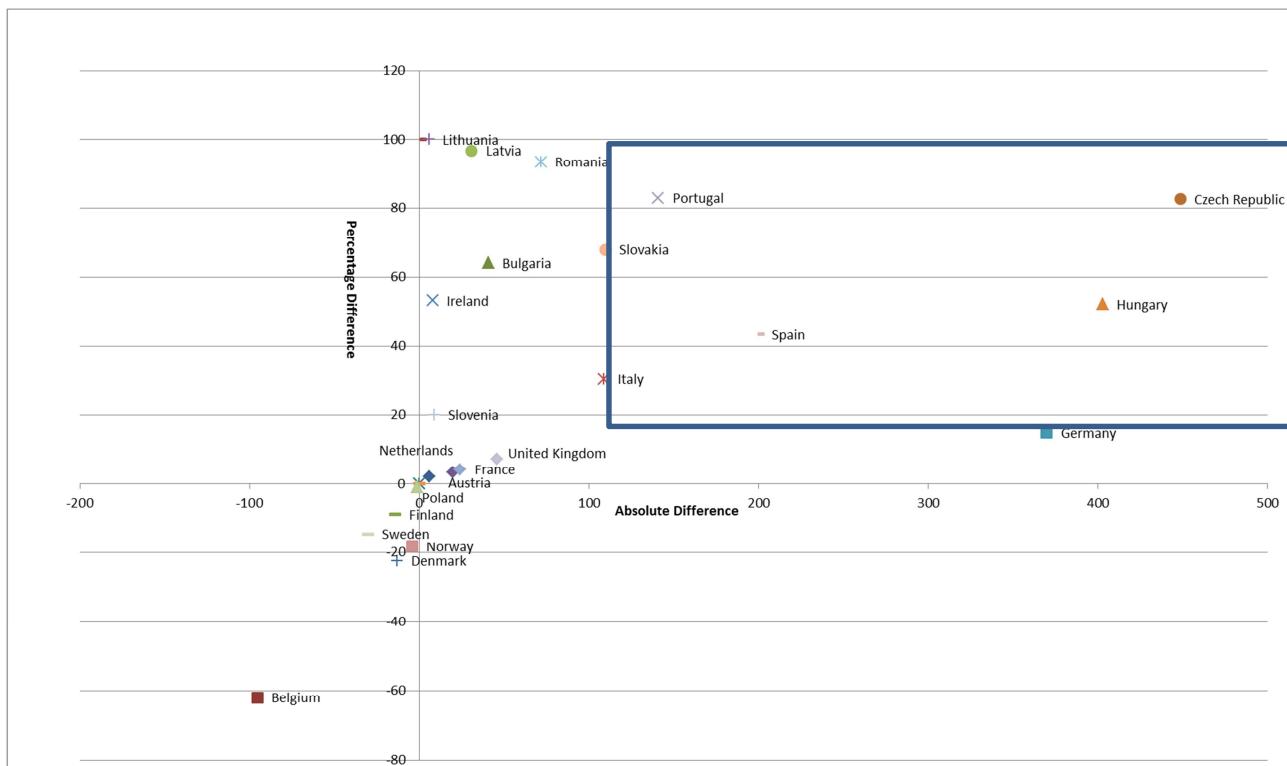


**Figure 28 – The Absolute Difference Between the two Suicide Reporting Regimes (CSI and EDMD) for the Period 2008-10**



**Figure 29 – The Percentage Difference Between the two Suicide Reporting Regimes (CSI and EDMD) for the Period 2008-10**

Figure 30 seeks to explore the variations both in percentage and absolute terms. This strongly suggests that there is very little underreporting of railway suicides. Only Belgium shows a significant deviation indicative of under reporting. It does however indicate a bias in a number of Member States towards over reporting. In particular it would suggest over reporting in Czech Republic, Hungary, Spain, Portugal, Slovakia and Italy in both absolute and relative terms, defined as a positive variation of over 100 fatalities over the period, and representing 20% of the overall number of fatalities.



**Figure 30 – The Percentage Difference Versus the Absolute Difference for Differences in Suicide Reporting between the CSI data and EDMD for the Period 2008-10**

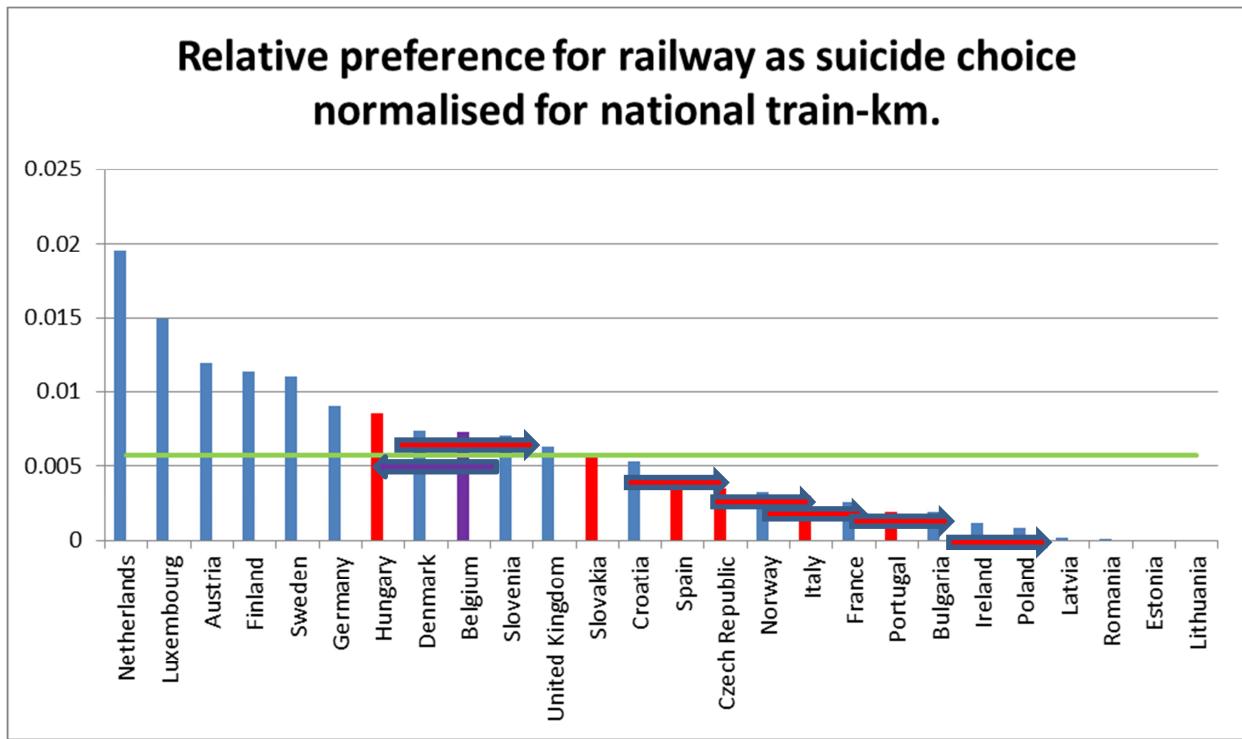
Figure 31 shows the relative ranking of these Member States on a normalised basis as before. Most Member States that are over reporting exhibit relatively low preference for the railway as a suicide choice per train-km. If they are over reporting then this would act to reduce their relative ranking further, with perhaps all of them then being below the mean. The suggested under reporting in Belgium would act to increase it in the relative rankings moving it closer to its near neighbours of the Netherlands and Luxembourg.

In summary the only suggested area of underreporting is in relation to Belgium, and whilst a majority of Member States appear to be over reporting this appears to be most significant in Hungary, Czech Republic, Spain, Italy, Slovakia and Portugal.

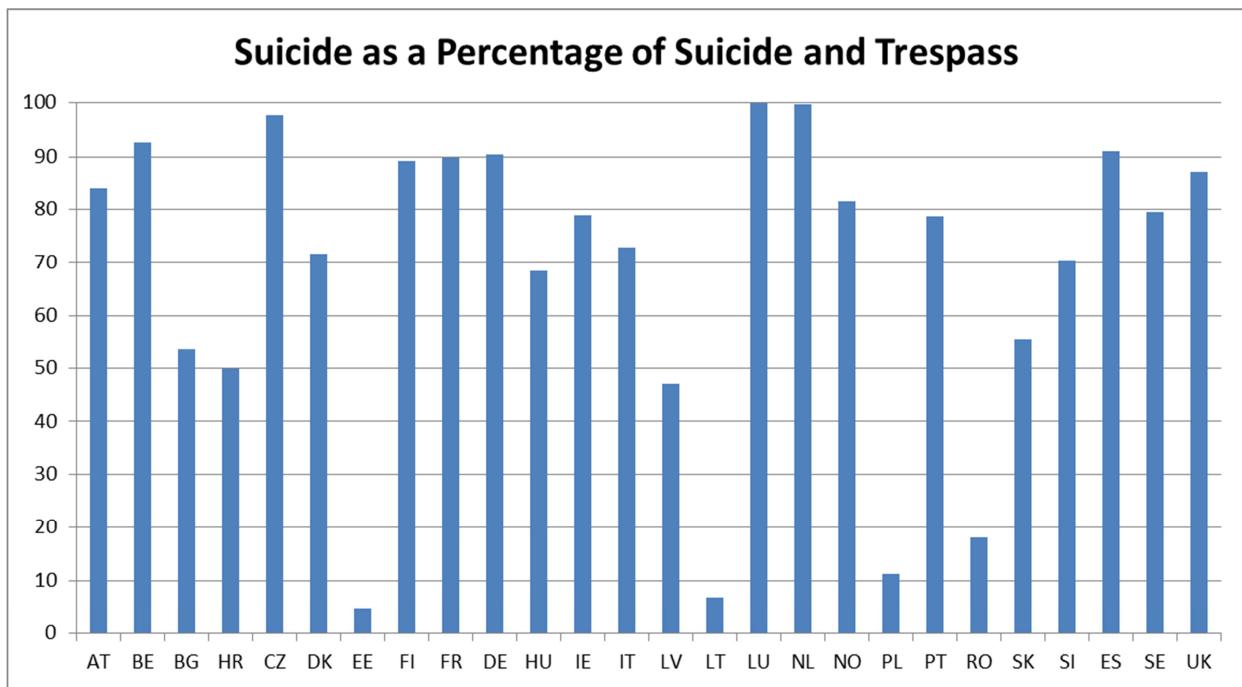
### 3.5.4 Trespass and Suicide Combined

It has been suggested that in future trespass and suicide reporting should be combined as this would avoid difficulties encountered in the classification of a fatality. This analysis has been undertaken and the same normaliser as is recommended in 3.5.2 applied. The data for trespass and suicide on railway premises has been sourced from the ERAIL database for the period 2008-2010 as trespass as a category does not exist in the EDMD. The EDMD does contain a code V05 "Pedestrian injured with railway train or railway vehicle", but this could apply to level crossing users as well as trespassers. The normalising by overall suicide rate in the Member State however does come from the EDMD as no equivalent is available

in the ERAIL database. This use of two differing databases is a limitation on this analysis that should be recognised; in particular for those countries identified in section 3.5.3 as having large variances between the ERAIL and EDMD for suicide over or under reporting.



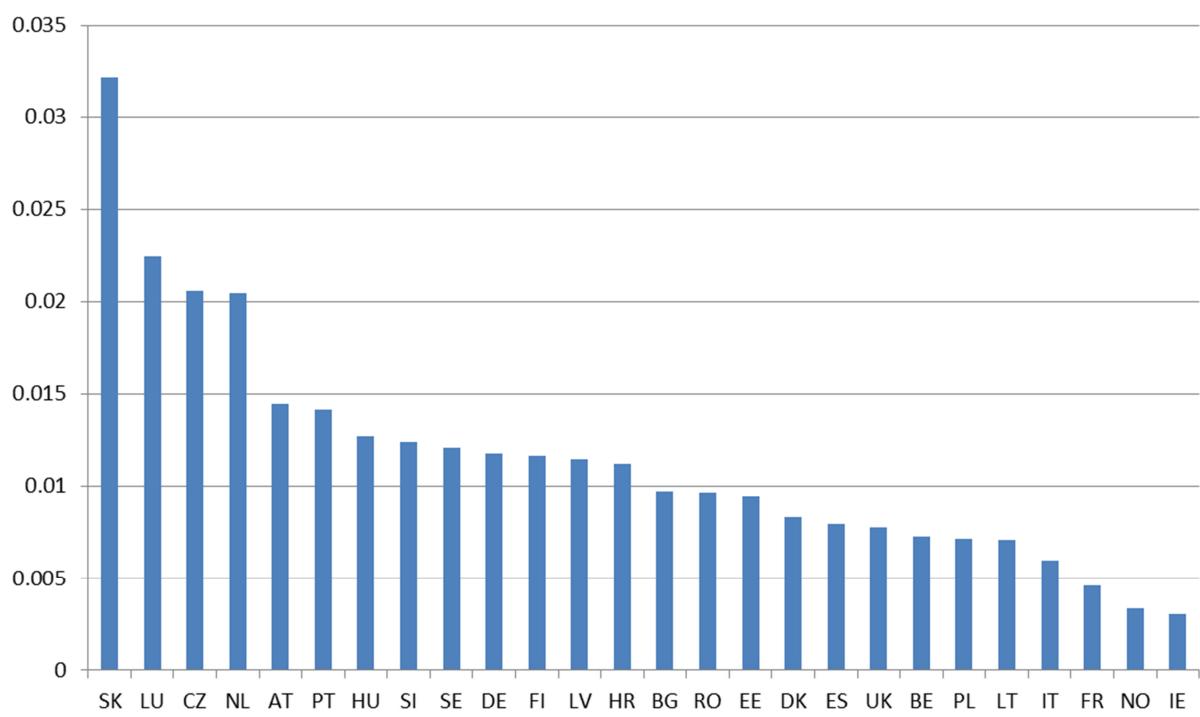
**Figure 31 – Relative Ranking for Railway as a Suicide Choice Normalised for National Train – km Illustrating the Impact of Over and Under Reporting.**



**Figure 32 – The Percentage of Suicides and Trespass that is Suicide from 2008-2010 by Member State**

Figure 32 shows the percentage of suicides and trespass fatalities that are suicide from 2008-2010. For most Member States this percentage is in a consistent band from 50 to 100%. However four Member States exhibit much lower figures indicating that they have very few suicides relative to trespass. These are Estonia, Lithuania, Poland and Romania. These are not countries for which underreporting was suspected from the comparison of ERAIL and EDMD data, in other words the low suicide figures are consistent with coroner or death certificate records. It would suggest that either these countries have very low rates of railway suicides that should be a source of learning or that perhaps some wider cultural aversion is affecting reporting.

### **Suicide and Trespass Fatalities Normalised by Overall Suicides and National Train-km**



**Figure 33 – Suicide and Trespass Fatalities 2008-2010 Normalised by Underlying Suicide Rate in the Member State and Train-km.**

Figure 33 shows the Member State data on a normalised basis. The normalised Member States that had high levels of suicide on railway premises on a normalised basis, Luxembourg, Netherlands, and Austria are again high when trespass fatalities are added. This would indicate that the high normalised levels of suicide on railway premises seen in these Member States are not simply due to other Member States classifying suicide as trespass. Nothing in the relative percentage of suicide to trespass or a comparison between the ERAIL and EDMD would indicate a reporting or classification problem.

## **3.6 Comparison between Existing and Proposed Normaliser**

The normaliser proposed in the sections above differs from the existing normalised measure used by the Agency for suicide reporting. It is of interest to determine whether these two measures differ in a significant way, to decide whether the existing measure can act as a satisfactory proxy for the proposed measure.

The existing normalised measure for a particular country is

$$\frac{\text{Number of suicides on the railway of that country}}{\text{Train km in that country}}$$

The normalised measure proposed in the present report for a particular country is

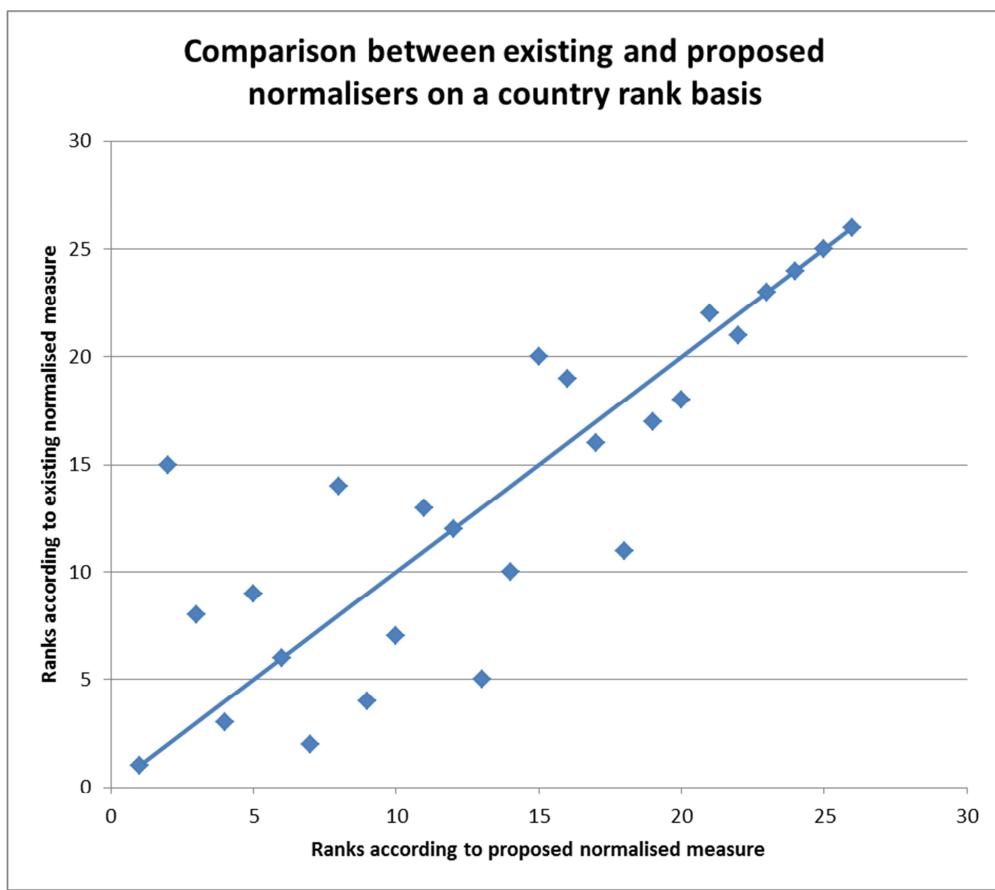
$$\frac{\text{Number of suicides on the railway of that country}}{(\text{Number of suicides in that country}) \times \log(1 + \text{Train km in that country})}$$

In order to compare the two normalisers, they have both been computed using the EDMD data for the period 2008-2010 for each country. Cyprus and Malta were omitted because they do not have any railway. Because the measures are very different in terms of units, they have both been transformed into country ranks (1-26) for the purposes of comparison. This information is shown in the table and figure below.

**Table 9 - Ranks Produced by the Two Normalisers**

Country	Rank using proposed normaliser	Rank using existing normaliser
Austria	3	8
Belgium	9	4
Bulgaria	20	18
Croatia	13	5
Czech Republic	15	20
Denmark	8	14
Estonia	25	25
Finland	4	3
France	18	11
Germany	6	6
Hungary	7	2
Ireland	21	22
Italy	17	16
Latvia	23	23
Lithuania	26	26
Luxembourg	2	15
Netherlands	1	1
Norway	16	19
Poland	22	21

<b>Country</b>	<b>Rank using proposed normaliser</b>	<b>Rank using existing normaliser</b>
Portugal	19	17
Romania	24	24
Slovakia	12	12
Slovenia	10	7
Spain	14	10
Sweden	5	9
United Kingdom	11	13



**Figure 34 - Comparison Between Existing and Proposed Normalisers On a Country Rank Basis**

The figure reveals that although there is a clear correlation between the two measures, there are also large differences in some country ranks. In order to assess whether the differences observed are significant, a statistical test was sought. Because there is no a priori information on the population distribution of these measures, a non-parametric test was indicated. In particular, the test required would be from the family of rank correlation tests.

The following table outlines some candidate rank correlation tests with comments to explain the final choice.

**Table 10 - Possible Candidate Tests**

Candidate test	Remarks
Spearman rank correlation statistic with significance tables	This is the most common, simplest and most applicable test for comparing two simple, paired sets of ranks.  Tables of critical values for the Spearman rank correlation statistic exist in literature. However, the significance tables are always prepared for testing the hypothesis that the two samples are completely independent, which is not the question to be answered here. It is possible to adapt this test for the opposite hypothesis, but the test is very weak in this case and yielded no conclusion in this case.
Wilcoxon signed rank test	A non-parametric test designed to compare two separate rankings of preference, arranged in pairs. This is described in more detail and pursued below.
Kruskal-Wallis test	A natural and general non-parametric analogy to the parametric ANOVA test. However, the test is designed to compare a single ranking of preference split across pre-defined groups and is therefore inappropriate for the present case in which there are two (not numerically comparable) rankings and no pre-defined groups.
Sign test	A simpler version of the Wilcoxon signed rank test that discards the absolute size of the difference in ranks. Not pursued as Wilcoxon signed rank test provided a clear conclusion.
Friedman test	Another ranking test for the equal means hypothesis for multiple testers and groupings. Not pursued as Wilcoxon signed rank test provided a clear conclusion.

By using the ranks as the “underlying” data for the test, the Wilcoxon signed rank test can be used to assess the hypothesis that two ranking systems produce the same ranking for the same set of data.

The procedure is described in the literature.<sup>23</sup> The result indicates that at the 99% confidence level the rankings are significantly different.

Given that the proposed normaliser addresses all the requirements in Table 2 in terms of important external influencing factors, allowing the management of railway suicide to be better understood, it is recommended that it replaces the existing normaliser.

<sup>23</sup> F Wilcoxon and RA Wilcox, Some Rapid Approximate Statistical Procedures (Pearl River, New York: Lederle Laboratories, 1964)

## 4 COST IMPACT OF SUICIDE AND ATTEMPTED SUICIDE

### 4.1 Overview

The impact of a suicide on railway premises is tragic and profound and is capable of impacting a large number of people. In general it will attract the impact of a suicide in any other situation and then in addition to this a number of railway specific impacts.

The impact of suicide has only recently been addressed by research studies. In general these consider the cost of suicide against three components:

- **Direct Cost:** The cost of services leading up to and immediately following the suicide such as the cost of emergency services attending the scene, funeral costs, court or coroner costs, insurance claims, cost of medical intervention.
- **Indirect Cost:** The cost to society from the loss of productive output from the victim, time lost from work of those impacted by the suicide.
- **Human Cost:** Lost years of disability free life of the victim and pain and grief experienced by survivors.

Estimates of these are given in the table below:

**Table 11 – Estimates of the Cost to Society from the Death of a Suicide Victim**

Country	Cost of a Suicide	Year	Reference
Ireland	£1,400,000	2001/2	<sup>24</sup>
Scotland	£1,290,000	2004	<sup>25</sup>
England	£1,450,000	2009	<sup>26</sup>
New Zealand	NZ\$2,931,250	2002	<sup>27</sup>
USA	\$1,061,170	2005	<sup>28</sup>
USA	\$1,164,499	2010	<sup>29</sup>
Australia <sup>30</sup>	A\$633,894	2012	<sup>31</sup>

These figures are broadly consistent with each other, once allowance is made for the inherent judgement necessary in such a process for estimating the overall cost of a suicide to society. What is also of note is that they are also consistent with the values for preventing a casualty (VPC) on the railway from a safety accident. The Agency guidance on the CSIs provides such VPC values based upon a willingness to pay

<sup>24</sup>The Economic Cost of suicide in Ireland, B Kennelly, 2007, Crisis 28(2), pp 89-94

<sup>25</sup>Evaluation of the First Phase of Choosing Life: The National Strategy and Action Plan to Prevent Suicide in Scotland: Annex 2 – The Economic Costs of Suicide in Scotland 2004, S Platt, 2006, The Scottish Government

<sup>26</sup>The Cost of Suicide to Society, D O'Dea and S Tucker, 2005, Ministry of Health, Wellington, New Zealand

<sup>27</sup>Mental Health Promotion and Mental Illness Prevention: The Economic Case, M Knapp, M McDaid and M Parsonage, 2001, PSSRU, LSE and Political Science

<sup>28</sup>Centers for Disease Control and Prevention. *Cost of Injury Reports* 2005. Available online at <http://wisqars.cdc.gov:8080/costT/>. Last updated May 2012.

<sup>29</sup>Centre for Disease Control and Prevention, Web-based Injury Statistics Query and Reporting System, 2010, [http://wisqars.cdc.gov:8080/costT/cost\\_Part1\\_Finished.jsp](http://wisqars.cdc.gov:8080/costT/cost_Part1_Finished.jsp)

<sup>30</sup>Excluding Human Cost.

<sup>31</sup>The Economic Cost of Suicide in Australia, Prepared for Meslink by KPMG, October 2013

approach. In essence this involves surveying a population to determine how willing a society is to invest to prevent a casualty.

This raises the philosophical question of whether a victim of suicide should be treated any differently to the victim of an accident on the railway as regards applying a VPC criterion. The principle argument against applying a VPC argument to suicide is that suicide is a deliberate decision whilst an accident is an unfortunate and often random event. So if an accident, such as a derailment due to poor track condition, can be prevented through application of proper maintenance then that accident is prevented for as long as the proper maintenance is applied. The train does not simply derail elsewhere. This argument applied to suicide is that if a potential suicide victim is unable to commit suicide on one day or at a particular location due to the application of a mitigation (for example fencing preventing access to the track) they will simply try again the next day or in a different location. In other words the value invested in the mitigation does not prevent the suicide casualty it merely diverts it elsewhere. On the basis of this argument a VPC approach is not appropriate.

However, this argument is not reflective of what is known regarding suicide. At the first suicide workshop held by the Agency it was stated that 90% of those individuals attempting to commit suicide but for whatever reason are prevented from doing so subsequently die of natural causes<sup>32</sup>. For the rest of their life no repeat attempt is made. This is backed up by other observations regarding suicide prevention measures. Matsubayashi et al<sup>33</sup> describe the use of blue light systems at stations in Japan. These are applied to make the station area brightly illuminated at night and so dissuade potential suicide victims, who it is believed prefer a secluded environment in which to prepare for the act of suicide. It was initially considered that installing such a system at one station would simply move the problem to nearby stations only a few km away. However, no evidence of this was found. Further evidence to support this is found in the replacement of coal gas with natural gas in domestic use in England and Wales and its effect on suicide rates<sup>34</sup>. Coal gas contains carbon monoxide and is toxic unlike natural gas. The move from coal gas to natural gas was associated with a reduction in suicide in England and Wales indicating that removing one possible means of committing suicide did not simply result in potential suicide victims switching to alternative means.

This strongly suggests that a VPC approach can be legitimately applied to suicide as it is to safety accidents. In a railway context the existing values published in the CSI guidance are therefore considered appropriate.

## 4.2 The Railway Specific Impacts of a Suicide or Attempted Suicide on Railway Premises

### 4.2.1 Introduction

The impact of a suicide or attempted suicide on railway premises can have widely varying impacts depending on the nature of the suicide and its location on the national network. At the second Workshop on suicide on railway premises (28<sup>th</sup> October 2015) Deutsche Bahn<sup>35</sup> presented the consequences of a single suicide event in a tunnel in 2015. In addition to the tragic loss of the victim and the trauma

<sup>32</sup> See also Suicide on Railway Networks: Epidemiology, Risk Factors and Prevention, K Krysinska and D de Leo, Australian and New Zealand Journal of Psychiatry, 2008, 42, pp763-771

<sup>33</sup> Does the Installation of Blue Lights on train platforms Shift Suicide to Another Station? Evidence from Japan, T Matsubayashi, Y Sawada, M Ueda, Journal of Affective Disorders, 2014, 169, pp57-60

<sup>34</sup> Quoted in Suicidal Acts on Metro Systems; An International Perspective, I O'Donnell and R D T Farmer, Acta Psychiatry Scand, 1991, 86, pp60-63

<sup>35</sup> [Workshop on reporting and preventing suicides on railway premises](#) Hosted by European Railway Agency, 28<sup>th</sup> October 2015, presentation by Eckhard Huwald, Deutsche Bahn

experienced by the train driver<sup>36</sup> this resulted in traffic disruption to the high speed line of 9 hours duration. Some of the adverse impacts of this were:

- The 350 passengers on the high speed train involved had to be evacuated in the tunnel to another train following damage to that train
- Delay to the replacement train was 135 minutes
- Ten other high speed trains were delayed totalling 334 minutes of delay
- Two other long distance trains were delayed totalling 677 minutes as they missed their allotted train path at key junctions
- Thirty four freight trains were delayed totalling 1720 minutes delay.

The costs of this delay are not trivial to calculate. In the presentation Deutsche Bahn estimated that it took one whole day to evaluate the cost for only one of the delayed trains (not the one directly involved in the incident). This train had 250 passengers and was delayed by 77 minutes. In addition to the direct costs some of the consequential costs were calculated as:

- Repayments to passengers under their passenger rights €8,500
- Costs due to connecting trains being missed due to delay:
  - Taxis €10,500
  - Hotel rooms €1,200
  - Additional time costs for the train staff €700
  - Additional time costs for station staff €400
  - Additional time cost for maintainers with reduced access to the line for maintenance €800

As can be seen from this example of a single delayed train the impact of a railway suicide is widespread across a network. The Deutsche Bahn presentation, in its discussion of this, highlighted that an average cost for the impact of a railway suicide can hide wide variations with the impact being relatively minimal on a lightly used rural line, but considerable at key infrastructure locations such as tunnels. It should be noted that the impact of the loss of the victim and the impact to the train driver is however, similar in both instances.

Given the time taken to calculate the costs for one train it is clearly not possible to do this for all trains delayed due to suicide on railway premises in the EU, Norway and Switzerland. The conclusion of the Deutsche Bahn presenter was that assessing the costs using a value of Euros per minute delay is reasonably practicable and this is the approach that has been taken below.

#### 4.2.2 Methodology for Sampling Data

In order to derive the railway specific direct and indirect costs for railway suicide a survey of Infrastructure Managers and Railway Undertaking was made (see Task 1 Report "Assessment of Existing National Occurrence Reporting Regimes and Systems"). The questions and methodology to support this were discussed and agreed with the Agency. It was trialled with an Infrastructure Manager and revised following comments relating to clarity and understanding and ability to complete, and then circulated electronically to the Infrastructure Managers representatives sitting on the European Railway Infrastructure Managers Safety Working Group by the Agency on 6<sup>th</sup> May with a requested deadline of 14<sup>th</sup> June. Reminders were given before the deadline. The survey of Railway Undertakings was similarly developed and circulated to the Community of European Railways for distribution amongst its members.

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<sup>36</sup> At the same workshop a separate presentation was made by the Gewerkschaft Deutscher Lokomotivführer on the impact of a suicide on railway premises on the train driver and impacts experienced by the driver.

This survey was augmented with data found in academic and railway literature and where relevant with analogy to incidents such as cable theft which produce similar indirect, secondary and intangible costs. The types of cost data that have been sought through the survey and literature are detailed in Table 12 below.

**Table 12 – The Direct, Indirect, Secondary and Intangible Costs Associated with a Railway Suicide**

Cost Category	Description
General Costs	Loss to society of the victim
Railway Specific Costs	
Direct Costs	Damage to the railway vehicles and infrastructure as a result of the suicide or attempted suicide
Indirect Costs	Costs to the IM or RU as a result of train cancellation or delay
	Loss of economic potential due to passenger delay
Secondary Costs	Suppressed demand due to delay or cancellation of services
Intangible Cost	Trauma to the train driver
	Trauma to those attending the scene

The survey of infrastructure managers was distributed by the Agency to the European Railway Infrastructure Managers. Whilst a response from all EIM members was desirable and hoped for a target list was agreed with the Agency based on the results of the first survey. These were:

- Network Rail (UK)
- Trafikverket (Sweden)
- PLP (Poland)
- Refer (Portugal)

These were selected to provide a geographical spread across the EU, a balance between large and small countries and a balance in the sophistication of their occurrence reporting systems reporting systems. All of these organisations were able to provide a response.

In addition two further infrastructure managers who are members of CER were identified:

- OBB (Austria)
- OSE (Greece)

They were identified based on the same criteria as above in that they provide further geographical diversity, further diversity in regard to size of country and further diversity as regards their occurrence reporting systems. Again a response was received from both, noting that the response from OSE was provided after direct telephone contact with the Greek NSA and OSE.

In addition to the targeted Infrastructure Managers further responses were received from:

- Belgium (Infrabel)

- Czech Republic (SZDC)
- Denmark (Banedanmark)
- Finland (Finnish Transport Agency)
- France (SNCF and RFF)
- Germany (Deutsche Bahn)
- Italy (RFI)
- Netherlands (Prorail)
- Norway (JBV)
- Slovak Republic (Zeleznice Slovenskej Republiky)

The number of suicides on railway premises in the EU, Norway, Switzerland and the Channel Tunnel was that shown in the ERAIL database for 2014 for which there were 3077 suicides on railway premises, shown in Table 13 below:

**Table 13 – The Number of Suicides on Railway Premises per Member State in 2014 as recorded in the ERAIL Database**

Member State	Railway Suicides 2014
Austria	92
Belgium	97
Bulgaria	29
Croatia	28
Cyprus	0
Czech Republic	279
Denmark	21
Estonia	5
Finland	64
France	298
Germany	781
Greece	4
Hungary	79
Ireland	5
Italy	143
Latvia	6
Lithuania	6
Luxembourg	6
Malta	0
Netherlands	220
Norway	15
Poland	71
Portugal	44

<b>Member State</b>	<b>Railway Suicides 2014</b>
Romania	80
Slovakia	44
Slovenia	18
Spain	139
Sweden	77
Switzerland	139
United Kingdom	287
Channel Tunnel	0

The study additionally extended to assessing the costs of attempted suicide. 2014 was the first year in which attempted suicide data is available in the ERAIL database, but this is only for ten Member States. The proportion of attempted suicides to suicides resulting in a fatality varies greatly amongst the ten Member States averaging 7.6%. Other estimates of the number of attempted suicides have been made in the literature and have been summarised by the RESTRAIL project<sup>37</sup>. This found the following estimates of fatality arising from a suicide attempt:

Four studies citing 90% fatality rate for mainline railway

Seven studies, Metro and Underground railways, 42-66% fatality rate

One study 94% fatality rate on mainline open line and 83.8% in mainline station areas

One study 88% fatality rate for trespassers

The conclusion is that suicide attempts on railway premises result most frequently in a fatality, but that this is dependent on the nature of the network concerned. The more stations a network has and the more the network resembles a metro operation the higher the fatality rate might be expected to be. The figures may also be subject to underreporting as those attempting suicide may not reveal their intention afterwards. In the absence of definitive data this study has assumed that 15% of all suicide attempts on a railway do not result in a fatality, which has been used as the basis of the number of attempted suicides.

Railway economic data was sourced from the Implementation Guidance for CSIs<sup>38</sup> and general economic data such as GDP per capita and inflation rates were sourced from Eurostat.

### 4.2.3 Direct Costs

#### Damage to the train and infrastructure

In a majority of suicides there is little damage to the train and infrastructure. Exceptions do occur particularly in situations involving driving a vehicle onto a level crossing. In this case significant damage can occur to the train and infrastructure and in at least one instance caused additional injuries and casualties to the train driver and passengers on the train. However, in this case it may be possible to recover the costs from the motor insurer.

Estimates of the equipment cost can be derived from figures available in Belgium<sup>39</sup> in which the impact of the 282 suicides between 2006 and 2008 is quoted as being 750 hours of train delays and 300,000

<sup>37</sup> "Data concerning railway suicides and trespassing accidents", deliverable D1.1, RESTRAIL project, 7<sup>th</sup> January 2013

<sup>38</sup> Implementation Guidance for CSIs, Annex 1 of Directive 2004/49/EC as Amended by Directive 2014/88/EU, European Railway Agency ERA-GUI-02-2015

Euro of direct cost (equipment cost and cost of train delay compensation). Once the cost of train delay (see below) is subtracted an estimate of the equipment cost per suicide can be applied and assumed applicable across the EU. The survey of infrastructure managers and railway undertaking revealed that no other precise data is available in this area.

Based upon the number of suicides recorded in the ERAIL database for 2014 the annual Direct Costs of suicide on railway premises in terms of physical damage to the train or infrastructure is:

- Suicides on railway premises is €3.76 million
- Attempted suicides on railway premises €660,000

#### 4.2.4 Indirect Costs

##### Economic Loss to Society

This is the economic loss arising from train delay due to suicide. This has been calculated using the CSI guidance which provides a cost for each minute of delay of a business or leisure passenger which can be used to estimate the consequential loss to society. The number of trains impacted by such delays and the value of a delay minute has been estimated by a survey of the literature and from the survey of infrastructure managers and railway undertakings. From these surveys it is clear that data is not consistently or uniformly collected. The information that has been provided has been assumed to be applicable across the EU although noting that wide variations can exist from the impact of a suicide event on railway premises depending on the location (plain line, tunnel etc.) and the features on the line (lightly used rural versus high speed mainline).

##### Indirect Costs - Delay to Train Services

A suicide event on a railway is associated with the closure of the line and suspension of train services for a period whilst the victim is treated by the emergency services or recovered from the scene and the police investigate possible criminality. The direct cost attributable to this is the cost that the Infrastructure Manager bears in terms of having to compensate a Railway Undertaking for delay. The number of trains impacted by such delays and the value of a delay minute were subject of the survey of Infrastructure Managers. This revealed that many infrastructure managers do not compensate Railway Undertakings for delay and where they do the value of the compensation is not readily available.

In the event that an Infrastructure Manager is not subject to a regime that compensates a Railway Undertaking for a delay due to suicide then the direct cost will be zero. In this event the CSI guidance provides a cost for each minute of delay of a business or leisure passenger which can be used to estimate the consequential loss to society and the direct costs incurred of train services being unavailable for a period. This is the approach that has been taken in the study.

It is worth noting that compensatory arrangements between infrastructure managers and railway undertakings can mean that the consequences of a suicide on railway premises are positive for a railway undertaking. If such a regime exists consideration should be given to the exact level of compensation provided and whether this may influence behaviour. The impact of suppressed demand, that such compensation is designed in part to address has been separately addressed below.

This analysis indicates that there were over 5 million delay minutes due to suicide on railway premises in 2014. The indirect costs are estimated as:

- Suicides on railway premises is €87.44 million
- Attempted suicides on railway premises €15.43 million

<sup>39</sup> Railway Suicide in Belgium 1998-2009 K Andriesssen and K Krysinska, Crisis, 2012, Vol33 (1), pp39-45

## 4.2.5 Secondary Costs

### Supressed Demand

The intangible cost considered is the cost of rail journeys not undertaken. There is no direct evidence that the incidence of suicide on railways is a determinant of whether someone wishing to travel will choose not to travel by rail rather than any other mode or indeed choose not to travel at all. However, it is known from passenger research that rail punctuality is the biggest driver of overall passenger satisfaction<sup>40</sup>. In the instance of cable theft the number of passenger journeys not taken in Great Britain in a year due to suppressed demand arising from delay due to cable theft was estimated at 500,000. It can be assumed that similar delay due to suicide results in similar forgone passenger journeys and by comparing the total delay due to suicide in Member State to the total delay from cable theft (assuming that the Great Britain estimate applies across the EU) then an assessment of the foregone demand can be made.

This has been monetised by assuming that the financial loss from each journey not taken is €10. This is believed to be conservative as it can be assumed that as no additional staff, infrastructure or trains are required then the marginal loss is the full ticket price. However, as many of the most popular rail corridors in the EU are close to capacity this cannot be assumed as additional capacity may be needed to absorb this demand and hence a reduced value of €10 has been used.

This analysis estimates that 7 million railway journeys were not made in 2014 because of the impact of suicide on railway premises, resulting in the following cost estimates:

- Suicides on railway premises €61.66 million
- Attempted suicides on railway premises €10.88 million

## 4.2.6 Intangible Costs

### Trauma to the train driver

The majority of suicides on a railway involve persons being hit by a train. As such each suicide is associated with trauma for the train driver who most usually witnesses the event and despite the application of the emergency brake and sounding of the horn is generally powerless to prevent the event. The CSI guidance issued by the Agency provides a value for a casualty prevented and equivalents for serious and slight injuries. The Rail Safety and Standard Board<sup>41</sup> has undertaken research into this area to determine the equivalence of how many serious injuries equate to a fatality and how many slight injuries equate to a serious, and in this way permit different accident consequences to be compared. This system equates Class 1 trauma from witnessing a fatality to 1/200<sup>th</sup> that of the fatality. This ratio has then been used to calculate the equivalent value for preventing trauma to the train driver. In calculating an overall cost of suicide it has been assumed that there is one such trauma event per suicide.

This trauma from witnessing the act of suicide can also extend to other groups. For example if the suicide occurs in a station then potentially those waiting on the station platform or station staff may well witness the event. Little precise data has been found on this to date and hence it has not been included in the analysis of cost at this stage.

The number of train drivers traumatised in 2014 is estimated at over 3,000, leading to the following costs:

<sup>40</sup> Evidence presented to the House of Commons Transport Committee hearing on Cable Theft on Railways; [www.publications.parliament.uk/pa/cm201012/cmselect/cmtran/1609/160905.htm](http://www.publications.parliament.uk/pa/cm201012/cmselect/cmtran/1609/160905.htm)

<sup>41</sup> Annual Safety Performance Report, Rail Safety and Standards Board, <http://www.rssb.co.uk/Library/risk-analysis-and-safety-reporting/2014-07-aspr-2013-14-full-report.pdf>

- Suicides on railway premises €34.55 million
- Attempted suicide on railway premises €6.1 million

#### Trauma to others attending the scene

Police, medical services (ambulance staff), funeral undertakers and railway personnel will all have to attend the scene. In the RSSB classification this is regarded as a Class 2 trauma. A Class 2 trauma is considered as being 1/1000<sup>th</sup> of the equivalent of a fatality. This has then been used to calculate the equivalent value for preventing trauma to those attending the scene of a suicide. In calculating the overall cost of suicide it has been assumed that five persons are so traumatised per suicide event leading to the following cost estimates:

- Suicides on railway premises €41.47 million
- Attempted suicides on railway premises €7.32 million

### 4.2.7 Railway Specific Costs from Suicide on Railway Premises

The total railway specific costs for suicide on railway premises for 2014 based on the sections above are:

- Suicide on Railway premises € 229 million
- Attempted suicide on railway premises € 40 million

The total railway cost of all suicide events is thus € 270 million.

### 4.2.8 Cost to Society of Suicide on Railway Premises in the EU

The single largest impact of a suicide is the tragic loss of the victim. This was discussed at the beginning of section 4 and it was determined that a Value for Preventing a Casualty (VPC) approach can be taken in regard to assessing the loss to society of the victim. Similarly for attempted suicide it can be assumed that the result is a major injury. Following the guidance from the Agency on the use of Common Safety Indicators the VPC values quoted in the guidance for both a fatality and a major injury were updated to 2014 figures using the GDP per capita figures available from Eurostat. The number of railway suicides was provided from the E-Rail database (CSI N07) for 2014 leading to the following annual EU wide cost estimates:

- Suicide on railway premises €6.9 billion
- Attempted suicide on railway premises €165.6 million

### 4.2.9 Total Impact of Suicide on Railway Premises

The overall costs of suicide on railway premises in 2014 have been estimated at:

#### Railway specific costs

- Suicide on railway premises €229 million
- Attempted suicide on railway premises €40 million

#### Cost to Society

- Suicide on railway premises €6.9 billion
- Attempted suicide on railway premises €165.6 million

Thus the total costs of all the components above amount to:

- € 7.1 billion

## 4.3 Discussion

In conventional terms a VPC figure would be used to support an argument to invest in a mitigation to prevent the casualty. The survey of infrastructure managers sought information on the programmes of mitigation being employed in the Member States. Most of the mitigations being considered comprise of preventative measures such as fencing and posters offering counselling and support together with training in suicide prevention for rail staff. Table 14 below provides an overview of the responses received:

**Table 14 – The Infrastructure Managers and Railway Undertakings responding to the Survey Questions on Whether a VPC Approach is used and if a Suicide Prevention Programme is in Place**

IM or RU	Is a VPC applied to suicide victims?	Suicide prevention programme in place?
IM	Yes – same value as other fatalities	No
IM	No	No
IM	No	Yes - €1million per annum
IM	No	No
IM	No	Yes
IM	No	No
IM	No	Yes - €3.4 million per annum
IM	Yes – same value as other fatalities	Yes - €10-20 million per annum
IM	No	Yes
IM	No	No
IM	Yes – same value as other fatalities	Yes
IM	No	Yes
IM	No	No
RU	No	No
RU	No	No

As can be seen above three infrastructure managers report currently using a VPC approach towards suicide victims and approximately half of respondents report a suicide prevention programme in place. This would indicate considerable opportunity to both extend the use of a VPC approach to better capture the true costs of suicide on railway premises and to develop comprehensive suicide prevention programmes in response.

## **4.4 Conclusion**

The cost of suicide and attempted suicide on railway premises in the EU, Norway and Switzerland in 2014 has been estimated at €7.1 billion of which €270 million is a railway specific cost that is in addition to the costs had the suicide been attempted at a different location.

Approximately half of the infrastructure managers surveyed had a suicide prevention programme and three were employing a VPC approach.

## **5 RECOMMENDATIONS**

### **5.1 EU-Level Measures**

The current reporting arrangements for suicide on railway premises have been shown to be robust at the level of the individual suicide victim, but overall are complicated, with several databases in existence which all record slightly different information to varying definitions around the same central event. There is no obvious advantage to the creation of an additional database at an EU level that is specific to suicide on railway premises, as this would only serve to increase the burden of reporting and potentially add to the confusion.

What would be of benefit is to simplify and harmonise the existing reporting arrangements so that they are clearer and more transparent. In particular the following recommendations relevant to the EU level are derived from the discussions in section 2:

- 1) The ERAIL and EDMD should be harmonised in terms of the definitions of a suicide on railway premises. In particular the X81 code in the ICD-10 should be amended so that it is railway specific "Intentional self-harm by jumping or lying before a moving object on a railway" and a new code created for "Intentional self-harm by jumping or lying before a moving object not on a railway". While it is understood that the ERA/ EU do not control the EDMD, they are in a position to liaise and discuss ways forward with the WHO.
- 2) The ERAIL database reporting requirements should be aligned to the reality of the time it takes for a verdict of suicide to be made rather than the nominal annual reporting today.
- 3) The guidance that is used by the police or others as regards determining if a fatality is a suicide on railway premises or an accident to a trespasser should be consistent in the Member State and preferably consistent at an EU level. Further liaison between the Agency and Railpol is recommended.

Once these steps have been undertaken it may then be beneficial to establish an EU-wide database of suicide on railway premises. Until then any such database would merely record the inconsistencies inherent in the current reporting arrangements. In addition to these recommendations relating to reporting three additional recommendations are made for EU level initiatives:

- 4) Given that the normaliser proposed in this report addresses all the identified important external influencing factors, allowing the management of railway suicide to be better understood, it is recommended that the Agency replaces its existing normaliser.
- 5) The Agency should encourage railway actors in the EU to adopt the VPC approach when making risk management decisions, including the prevention of suicides on railway premises. This should lead to the true costs of suicide being brought into investment decisions.
- 6) Significant differences exist between the best and worst performing Member States in terms of normalised data on suicide on railway premises. A programme of research should be instigated at EU level to understand the causes of this and whether practice from better performing Member States can be usefully transferred.

## **5.2 Additional Actions at Member State Level**

The following actions have been developed from a consideration of the normalised statistics and financial impact of suicide on railway premises.

- 1) All actors in the determination of a suicide (Infrastructure Manager, NSA, NIB, Police, Medical Services, and Coroner) should cooperate and instigate a process of data sharing so that a common single source of the "truth" is available for the prevention of suicide at a national level. This does not have to be publically available or contain personal details but should allow certain basic facts to be made readily available such as the number of suicides on railway premises in a country.
- 2) All Infrastructure Managers should establish a suicide prevention programme in proportion to the substantial financial impact that suicide on railway premises represents.
- 3) This suicide prevention programme should extend as a multi-agency approach to all those with an ability to decrease the current levels of suicide on railway premises; as a minimum this should include the infrastructure manager, the railway undertaking, and the police from the Member State.
- 4) The suicide prevention programme should engage with any national suicide prevention programme and if none exists it should encourage its Member State to establish one.
- 5) A VPC approach should be adopted by all railway actors as a means of assessing the financial impact of suicide on railway premises and determining what a proportionate response should be in terms of the funding of a suicide prevention programme.

## **6 CONCLUSION**

The objectives for the suicide reporting element of the study were to determine the means by which railway suicides are reported, what is the real impact of suicide events on railways in the EU and whether there is a need for any action at the EU level. Specifically the Agency wishes to understand what the cost impact of suicide is at an EU and national level and, in order to facilitate comparison between differing Member States, understand what a suitable normaliser for railway suicide might be.

The conclusions are that:

- The reporting of suicide on railway premises is complex involving multiple actors, decision points and databases. Opportunity exists to harmonise the collection of data so that it is consistent between the databases and within and between Member States.
- Reporting of suicide at railway premises is heavily dependent upon the criteria applied by the national police force. A brief survey of Railpol, Italian, Netherlands and British Police has revealed that there is limited guidance available in this regard.
- A multi-agency approach to the prevention of suicide at railway premises should be adopted involving the infrastructure manager, the railway undertaking, and the police from the Member State to cooperate in sharing data and preventing suicide at railway premises.
- The annual cost of suicide at railway premises in the EU, Norway and Switzerland is very considerable, estimated at €7.1 billion per annum. Currently a minority of infrastructure managers apply a value for preventing a casualty approach to assessing the financial impact of suicide on railway premises and only a half of those responding to the survey had a suicide prevention programme. There is thus a far greater justifiable spend that can be applied to preventing suicide on EU railways and a suicide prevention programme managed through a multi-agency approach, as above, is recommended.
- A suitable normaliser for comparing railway suicides between Member States is the proportion of all suicides that occur on the railway normalised by log (train km). This proposed normaliser is statistically significantly different from the currently used normaliser of train km. The proposed normaliser reveals significant differences in the relative performance of Member States which can be used to share best practice and direct the justifiable expenditure identified above. Further studies into the causes of these differences could be usefully undertaken.

## **APPENDIX 1 NOTES FROM THE 1<sup>ST</sup> WORKSHOP ON THE REPORTING OF SUICIDE ON RAILWAY PREMISES**

**5<sup>th</sup> February 2015**

The workshop was opened by the Agency who welcomed all attendees. The workshop was placed in the context of suicides on railway premises representing broadly 70% of all railway fatalities and acknowledged the work of the Restrail project that further data and analysis of this data was needed to understand the issue and determine how to influence it.

The first presentation provided an introduction to the need for further data. The statistics held by the European Detailed Mortality Database for railway suicide and those held in ERADIS show evident differences in the classification of a fatality between suicide (intentional) and accidental death. Further there was variation in the number of accidental deaths, intentional deaths and undetermined deaths between roughly similar countries, even when differences in population were accounted for. It was unclear whether this represented differences in the reporting system used between the countries or inherent differences in the approaches to managing and reducing the number of fatalities. Hence, the desire by the agency for a study to explore the issue of suicide reporting in the EU, Norway and Switzerland. Accurate data is a first step in understanding the nature and extent of the problem.

The first step in the study to explore suicide reporting was a short survey which had been circulated by the Agency to the NSAs. This survey was presented with an encouragement to the NSA representatives present to please respond. Comments made by the workshop were that:

Other databases and reporting systems are held by the police and emergency services which often contain valuable information.

In one Member State 5% of fatalities are to non-nationals who are not recorded as they are not contained in the national registry of population.

It can often take up to a year for a fatality to be classified as a suicide or an accident. As data for ERADIS is collected annually this can result in a number of fatalities not being classified at the time of reporting and hence there is a need to revise the data at a later date.

Until such time as a final formal decision is made regarding accidental or intentional death then the databases of the IM, NSA, and NIB may all hold different data on the same event. It was suggested that a first step in reporting would be to treat accidental and intentional deaths as equivalent for safety reports in the first instance.

Presentations were then made on the Swedish, British and Lithuanian systems for suicide reporting in their respective countries. This highlighted the role of the police or prosecutor and the judiciary (coroner) in investigating and classifying a fatality as accidental or intentional and the timescale over which this occurred. This could take between 6 months and three years. In the UK the Ovenstone criteria were applied during this period to classify the fatality with some success as few classifications were subsequently changed as a result of a coroner's verdict.

The Ovenstone criteria are already recommended in the "IMPLEMENTATION GUIDANCE FOR CSIs, ANNEX 1 OF DIRECTIVE 2004/49/ECAS AMENDED BY DIRECTIVE 2009/149/EC". It was recommended that the use of these together with the data held by the national police and emergency services would form a suitable basis for a second survey of those organisations holding data.

The workshop finished with a consideration of the use of normalisers for suicide reporting and an initial assessment of the impact of suicide on railway premises at an EU level.

Normalisers for the reported data are intended to facilitate comparison between different Member States with different sizes and types of railway. Little information was currently available in this area. Normalisers explored included overall population of a Member State, underlying rate of suicide and frequency of train service. It was stated that the incidence of suicide varied by region within several countries and that normalisation at a regional level as opposed to a national one may be more beneficial. Overall it was felt that little normalisation of the data is undertaken at present by the workshop attendees and that in terms of evaluating the effectiveness of any suicide reduction measure it would be preferable to use changes in trend rates (e.g. suicide rates rising in the overall population but falling for those areas employing the reduction method) rather than absolute numbers.

The impact of suicide on railway premises was explored in terms of the loss of the individual, trauma to railway staff and delay to the railway. The workshop considered it appropriate to employ the use of a Value per Life Saved figure as described in "IMPLEMENTATION GUIDANCE FOR CSIs, ANNEX 1 OF DIRECTIVE 2004/49/EC AS AMENDED BY DIRECTIVE 2009/149/EC". All available evidence was that an individual saved from committing suicide does not then seek to commit suicide a second time (figures of over 90% of all potential victims prevented from committing suicide die of old age). As an approximate figure it was calculated that the annual cost of suicide on railway premises in the EU Norway and Switzerland was approximately €5 billion. Further work in the study would seek to determine a more precise estimate.

The meeting finished by the Agency thanking all for attending and for the valuable exchange of information.





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