

How to Distinguish Between Suicides and Accidental Deaths in Railway Infrastructure

Sasan Zarghooni-Hoffmann

Department of Safety, Economics and Planning, University of Stavanger, Norway. sasan.zarghooni-hoffmann@uis.no

Background: A key indicator in the safety management of railway infrastructure is the number of accidental deaths. One of the challenges associated with this indicator is the difficulty of excluding suicides. Railway-employed accident investigators do not have access to medical records or forensic evidence, and hence they typically rely on the conclusion from a police investigation to categorize a death as suicide. However, these investigations are sometimes inconclusive, are often slow, and are conducted on a case-by-case basis without reference to historical or national data. **Aim:** This study seeks to improve the classification of railway fatalities by identifying indicators that can aid in differentiating between suicides and accidental deaths, thereby enhancing the precision and timeliness of safety reporting. **Data and Method:** The analysis draws on data from a national railway incident report system containing case descriptions with witness accounts. A thematic analysis was conducted on 359 reports of suicides and attempted suicides over a 29-year period. **Results:** The study identifies two sets of behavioral indicators that may aid in differentiating suicides from accidental deaths—clear and ambiguous indicators. These indicators offer a more systematic and efficient approach to classification than current practices in European railways. **Implications:** The findings provide a practical guide for both accident and police investigators, enabling faster and more reliable categorization of railway fatalities. This contributes to improved data-driven safety management.

Keywords: Accident investigation, accident classification, suicide classification, behavioral indicators, accident investigation methods, railway safety systems, police investigation, psychological autopsy, forensics, suicide, rail fatalities, railway deaths.

1. Introduction: The problem of suicide classification

Accident investigation is a core element of railway safety management systems (EU, 2020). In most European countries, aggregated accident and incident data are used to set risk acceptance criteria and safety targets related to deaths, serious injuries, and extensive damages related to rolling stock, infrastructure, and the environment (ERA, 2023). However, European statistics on incidents that lead to human deaths and serious injuries have often “been dominated by suicides”, prompting the European Union Agency for Railways (ERA) to recommend a separation of suicides from accidental deaths; the purpose has been to strengthen reliability and facilitate a better calibration of safety levels (ERA, 2023, p. 8). Since the intentionality of suicides and accidental deaths are different, a correct classification of such incidents helps narrow down the range of appropriate safety measures.

Here, a railway suicide is defined as an intentional, self-inflicted injury using railway means, resulting in one’s own death. This definition includes, e.g., electrocution and placing oneself in the path of a train (Mishara & Bardon, 2016). At the same time, it excludes those who commit suicide on railway premises using methods unrelated to the railways (e.g., drug overdose) and those who may be killed as a result of someone else’s suicide attempt (e.g., intervening witnesses). This definition is in alignment both with ICD-11 and ERA criteria (ERA, 2023; WHO, 2022).

While a clear definition is helpful, it can be challenging to operationalize it as a guide in investigations. A central challenge in some cases is to determine whether the injury was intended or accidental. One of the methods recommended by ERA to classify such uncertain cases is to apply the ‘Ovenstone criteria’, a list of direct and indirect criteria which, each “on its own, may be treated as evidence of suspected suicide” (cf. ERA, 2023, pp. 20–21; Ovenstone, 1973, p. 16):

- (i) Presence of a suicide note
- (ii) Clear statement of suicidal intent
- (iii) Behavior that demonstrates suicidal intent
- (iv) Previous suicide attempts
- (v) Prolonged depression
- (vi) Emotional or coping instability

However, with the exception of the third criterion, accident investigators employed by infrastructure managers or railway undertakings (IM/RU) rarely have access to information related to these criteria. Individuals' personal circumstances are outside of their mandate. This is left to the police, which can spend more than a year to conclude on the cause of death (DNV-GL, 2015). Waiting for the police's conclusion can mean wasting valuable time for implementing safety measures, and the ambiguity of death cause combined with a managerial bias towards visible action can encourage the implementation of inappropriate measures. Hence, there is a need to strengthen the preliminary assessment of an unclassified fatality using the criterion available to IM/RU accident investigators: the behavior immediately preceding the death.

The impetus for this study came from an incident in the Norwegian railways that was investigated by the author. The objective evidence in the case indicated an accident, but information from outside the railway system suggested suicide. This ambiguity led to a realization that also raises an issue with the Ovenstone criteria: People with suicidal intentions may very well be victims of an accident, even on their way to commit suicide. In such cases, it would be fairer towards the victim and wiser from a safety management point of view to treat the incident as an accident rather than a suicide.

Research on railway suicides have traditionally focused on suicide prevention. One main emphasis has been the evaluation of preventive measures, such as physical barriers, lighting, presence of personnel, and automatic detection systems (Havârneanu et al., 2015; Topel, 2019). Another main emphasis has been to map epidemiological characteristics to address in the preventive measures, such as the behavior before and during the suicide attempt (Mishara & Bardon, 2016; Moritz et al., 2023; Read et al., 2025). Less attention has been dedicated to the investigative

issue of how to determine whether a death is accidental or intentional.

The aim of this study is to identify behavioral indicators that can aid in distinguishing between suicides and accidental deaths. For accident investigators, the value of such indicators is that they support more timely and reliable classifications while awaiting the formal conclusion of a police investigation. For police investigators, the value lies in an easily applicable overview of existing knowledge on railway suicides that can strengthen their investigations in the railway domain.

2. Theoretical background

Although railway suicide studies focus predominantly on suicide prevention, some of their findings may be useful in investigations. In a review of studies on behaviors immediately before suicide attempts, Mishara and Bardon (2016) systematize the acts as follows: lying on the tracks, standing or sitting in the tracks, walking along the tracks, and jumping in front of the train. These descriptions align to varying degrees with the third Ovenstone criterion, 'behavior that demonstrates suicidal intent'. The variety in degrees is due to the ambiguity of the intention or consciousness behind the behavior. For example, lying in the tracks could be due to intoxication, whereas jumping in front of a train in most cases does not leave any strong alternative explanation than suicide.

Some railway suicide studies quantify the prevalence of these suicide modalities. The numbers can be understood as the most common ways of committing railway suicide. Table 1 shows the relative frequency of such suicide modalities in Finland, Germany, and Sweden (Dinkel et al., 2011; Rådbo et al., 2005; Silla & Luoma, 2012). It is worth noting that each suicide is coded to one category only.

For investigative purposes, comparing a specific incident with the most prevalent modalities in such lists may strengthen the indication of suicidal intent, although a low prevalence should not automatically be taken as the opposite. A refinement of this approach is a comparison of the prevalence of a modality in suicides vs. accidents, especially if there is a strong difference in prevalence. For example, a calculation of the relative difference between suicide and accident attributions in Rådbo et al. (2005) shows that "lying/sitting on tracks" makes

the largest relative distinction; 51 cases were categorized as suicides, compared to one accident, and six unknown. Silla and Luoma (2012) found a similar pattern, with “lying, standing, sitting, crouching or kneeling on the track (waiting/loitering on the tracks)”, with 133 suicides compared to nine accidents and two unknowns. Such comparative quantifications of pre-incident behavior could offer some foundation upon which to strengthen accident investigators’ judgement of the intent of the deceased.

Table 1: Percentage of suicide behavior in three European countries

Behavior	FIN	GMY	SWE
Walks along tracks	6.9	34.5	47.4
Stands on tracks			
Lies on tracks	61.0	32.9	37.2
Sits in tracks			
Jumps in front of train	22.0	32.5	15.3
Runs in front of train			
Steps in front of train	9.2		
Is crossing the tracks	0.9		

Relative distribution of behavior immediately before a railway suicide in Finland (N=218), Germany (N=993), and Sweden (N=137), excl. incidents categorized as accidents or unknown.

Using CCTV recordings, some researchers have looked at behavioral indicators further back in time, with promising findings. For example, Mackenzie et al. (2018) discovered that some suicide attempters switch platforms and travel between stations, presumably to look for a quiet location or to gather courage. Moritz et al. (2023) found that suicide attempters carried luggage less often and used fewer objects (phones, cigarettes, food). Both studies found that suicide attempters spent longer time on the platforms, letting more trains pass by. Possible explanations are gathering courage and avoiding or shielding witnesses (Mackenzie et al., 2018). However, the studies differ in the degree to which suicide attempters interact with others; Mackenzie et al. (2018) found that the suicide attempters avoided contact with other people by looking down or away, whereas Moritz et al. (2023) found that they interacted more with others, compared to passengers.

One of the issues with the current research is that different behaviors are bundled into single, mutually exclusive categories—as demonstrated in Table 1. Also, studies aggregate their findings

differently, making comparisons more difficult. When determining suicidal intent, it can make a difference whether the person was sitting or lying, as the latter behavior is more ambiguous (see Section 5.1). Hence, accident investigators need a more granular categorization.

Since accident investigators do not have access to as much information as police investigators, there will often be a degree of uncertainty about suicidal intent. There is also uncertainty due to lack of knowledge about railway suicides in general. The confidence in the classification depends on several factors, which can be summed up through the strength-of-knowledge (SoK) concept in risk science (Aven & Thekdi, 2022):

- (i) The reasonability of the assumptions
- (ii) The amount and relevancy of data/information
- (iii) The degree of agreement among experts
- (iv) The degree to which the phenomena involved are understood and accurate models exist
- (v) The degree to which the knowledge has been thoroughly examined

These are intended to be used on future events, but they may just as well be used on past events, with the main difference being that the consequence is known; it is the attribution of intent that is uncertain. The focus of this study is to contribute empirically to SoK points (ii) and (iv): By investigating whether more insights can be drawn from existing data on railway fatalities, it seeks to strengthen the behavioral model that accident investigators can use to gather and analyze data.

3. Method

Data was retrieved from *Synergi*, the electronic incident reporting system of the Norwegian National Rail Administration since 1994, using a search query set up with assistance from a senior database specialist. The data consist of all *Synergi* records of railway fatalities or serious injuries classified as a suicide (attempt) following a

concluded police investigation^a (N = 359, spanning the years 1996–2025). These records contain textual descriptions of the incident, often including brief information from the train driver or other witnesses on behavior just before impact.

The cases were imported to a content analysis software (NVIVO) and analyzed thematically. Each case was read in full, and all behavioral descriptions were marked and later coded. Since a single report can contain descriptions of multiple behaviors, cases were coded with multiple codes. The coding followed a deductive-inductive approach. A top-down (deductive) coding was conducted based on the behaviors identified in the literature reviewed in Section 2. This choice was motivated by the principle of maintaining conceptual consistency in categorization. However, as previous studies have used varying and unclear delimitations, these categories were split up to improve the classification. With this increased precision, care was taken to code into these disaggregated categories only those behaviors that fit clearly. Whenever a behavioral description did not fit an existing category, or indicated a difference of nuance, a bottom-up (inductive) coding was done. This was motivated by the possibility afforded by the richness of the qualitative data to identify behaviors not previously discussed in the literature. Care was taken to keep the codes and subsequent themes observable and close to the data. Considering the fact that such incident reports very seldom give a full or clear description of all the relevant behavior, low-frequency codes were retained rather than to aggregate them into higher-level themes (see Vaismoradi et al., 2016). Thus, the thematic analysis is a variant of codebook thematic analysis expanded into a qualitative exploration, but without the heavily interpretive focus of reflexive thematic analysis (cf. Braun et al., 2019).

4. Results

The thematic analysis identified 15 observable behaviors. Out of 359 incident reports, 224 included at least one behavior, whereas 135 contained no behavioral description. The frequency of each behavior is shown in Table 2.

Table 2: Frequency of last-moment behaviors

Behavior	Freq.
Laying down	63
Sitting	17
Standing still	40
Hiding / not being noticed	16
Stepping calmly onto tracks	21
Walking along / between tracks	16
Running onto tracks	14
Jumping in front of train	55
Crossing tracks to reach train	2
Climbing masts	2
Last moment changing of mind	5
Facing the train	4
Facing away from train	5
Facing sideways	1
Hands (misc.)	4
No behavioral descriptions	135

No. of incidents where a specific behavior was noted. Some individual cases describe multiple behaviors. Total no. of incidents is 359.

The most frequently documented behaviors were laying down, jumping or throwing oneself in front of an oncoming train, and standing still on the tracks. Other frequent behaviors included stepping calmly onto the tracks, sitting in the tracks, walking in/along the tracks, and hiding near the tracks or under the train. Among the least frequent behaviors were some potentially high-value indicators, such as what the suicide attempters do with their hands, which way they face, and what appears to be suicide attempters changing their minds in favor of or against suicide moments before being hit by a train. Additionally, eight cases—not included in the table—contained circumstantial information. Five of these eight included information relevant to the Ovenstone criteria that that is normally unavailable to IM/RU accident investigators (e.g., suicide notes, previous suicide attempts).

5. Discussion

The results of the thematic analysis indicate that incident reports, while often shallow in their descriptions, contain a significantly wider range and nuance of behaviors than the categories common in railway suicide research. Some of this expanded range can be explained by the increased

^a A few older cases are known to have been categorized without police input.

granularity of categorization chosen for the present study, but a considerable share comes from behaviors not described in the reviewed literature. For the purposes of accident investigation, higher granularity provides a better foundation for developing a classification tool, since the subsets of behavior have different ambiguities in relation to suicidal intention.

5.1. Distinguishing between levels of ambiguity

Some behaviors have a clear link to suicidal intent whereas others may have competing plausible explanations, i.e., they are ambiguous in determining whether an injury was intended or not. To facilitate a reliable classification among investigators and across incidents, it can be helpful to separate behavioral indicators into two sets based on their ambiguity.

5.1.1. Clear indicators

From the readings of the dataset, jumping, standing still, and sitting are prevalent as well as unambiguous in their linkage to suicidal intent. Crossing one or more tracks to reach the point of death is also a strong indication of intent.

Changing one's mind the moment before impact includes both seemingly spontaneous suicides and last-moment regrets. In cases of last-moment regret, the definition provided in Section 1 brings some clarity to accident investigators: The person put themselves in a dangerous and non-accidental situation, and as such the incident should—viewed from a purely safety management perspective—be treated as a suicide.

Finally, a few cases contained information on which direction the deceased faced and what they did with their hands. This information was always detected in conjunction with other indicators and can serve to moderate the classification. For example, facing the train while walking towards the tracks is a strong indicator of suicidal intent, while facing sideways moving in the same manner opens the possibility for other explanations. There were fewer descriptions of hands and arms, but the ones that were recorded in the incident reports were clear indicators of suicidal intent, e.g., stretching out one's arms before impact.

5.1.2. Ambiguous indicators

Some of the indicators are ambiguous in terms of suicidal intent, particularly if they are the only behavioral description. While actively laying down on the tracks is a clear sign of suicidal intent, in most cases the person is already lying there passively when the train comes. Alternative explanations include intoxication and fainting. Silla and Luoma (2012) found that 48,9 % of railway suicide victims were intoxicated, compared to 68,6 % of victims of accidents. This distinction is important from a safety management perspective, for example if a train station is designed and used in such a way that intoxicated people have a disproportionately higher risk of accidentally falling onto the tracks, or if it is difficult for them to get back to safety due to height differences. The dataset used in the present study contains only one comment on intoxication.

Furthermore, in the dataset, climbing power masts was clearly associated with suicidal intent, but this clarity came from other contextual information. The direction of the indicator can be moderated by, e.g., the absence or presence of spray paint cans (vandalism) or camera footage (e.g., so-called 'TikTok challenges').

Other ambiguous indicators are walking along the tracks, stepping calmly onto the tracks, and crossing a single set of tracks, because these are difficult to distinguish from trespassing. Reasons for trespassing vary with location and season, due to, e.g., deep snow, fishing, and cabin usage, but also daily or weekly rhythms such as rush hour stress or weekend night shortcuts. Running onto the tracks can be due to an intention to reach a departing train or to get away from a perceived threat.

Another type of ambiguity arises from lack of observations. In most of the hiding cases, the suicide attempter was hiding until the train was visible and then moved quickly in front of it. These cases were unambiguous. However, there were also cases where a person was found dead without there being any observations of the suicidal act. While these cases were classified as suicides, there was more uncertainty connected to the classification in these cases. Presumably, hiding cases differ only in how long the suicide attempter succeeded in hiding, but in the absence of other means of determining last-moment

behavior, one cannot rule out the possibility of accidents or even homicide concealed as suicide.

Despite their ambiguous characteristics, the presence of such indicators can, in conjunction with other indicators or more contextual information, help in classification. Contextual information may also be based on data relevant to other Ovenstone criteria than the behavioral one discussed in this study. Five out of 359 cases contained data relevant to other Ovenstone criteria, e.g., suicide note or mental instability. The paucity of such data in the incident reporting system could be due to the perceived irrelevance for safety management, or other reasons, like respecting the integrity of the deceased. In any case, data related to such criteria lie outside the scope and mandate of accident investigators. They are helpful to register if one comes across them, but their inaccessibility and peripherality suggests that investigative efforts should be spent elsewhere.

5.2. Refining definitions

One important challenge to the use of behavioral indicators for classification of suicide intent is the lack of descriptive precision. On one hand, witnesses describe similar situations with different words. A prominent example is the lack of distinction between jumping and running, words that are used interchangeably—even within the same case—in the empirical material of this study. The same is found in railway suicide literature (see Dinkel et al., 2011; Rådbo et al., 2005; Silla & Luoma, 2012). Other examples include ‘taking a step’ vs. ‘jumping’. This can be ascribed to a colloquial rather than a scientific usage of terms and is an issue for reliability.

On the other hand, precise definitions meant for one context can cause ambiguity in other contexts. For example, walking along the track and walking between the rails are two different behaviors, but the data do not distinguish clearly between them. In Norwegian railway terminology, ‘in tracks’ is defined as within 2,5 meters from the nearest rail (NNRA, n.d.). However, from a non-railway perspective, the risk perception would be higher between the rails than right next to, because some do not realize how much wider a train is compared to the rails on which it travels. Hence, walking between the rails is a stronger indicator of suicidal intent than walking within 2,5 m from the nearest rail. The

technical terminology is unsuitable to capture this difference in perceived danger. This shows the importance of refining the definitions based on behavioral rather than legal or colloquial logics.

5.3. Strengthening data collection for short- and long-term benefit

An interesting finding is the lack of some behaviors identified in CCTV-driven research. The present dataset contains little or no descriptions of travel between stations, platform switching, contact between the suicide attempter and others, and loitering on the platforms (cf. Mackenzie et al., 2018; Moritz et al., 2023). This reflects the type of data recorded; most of the incident reports in the present dataset build on railway witnesses, who usually arrive seconds before the incident, and are to a very limited extent corroborated by cameras on the trains.

However, CCTV is not a magic bullet. In practice, the availability and quality of footage, and the static placement and angle of the cameras, restrict the usefulness of this source. There is still a need for a combination of sources. These include the involved railway employees (e.g., drivers, conductors), witnesses (e.g., passengers, other railway personnel), CCTV, and evidence on site (e.g., torn fences, foot tracks in snow)—sources that can capture different types of observations. If such behavior (or the lack thereof) has been observed and the data collected, it can aid accident investigators to categorize the specific incident correctly. It is worth noting that 37,6 % of the cases in this study did not have a behavioral description. Even if a specific railway suicide could not have been ably prevented, a description of the behavior can help determine other cases and thus serve to support accident investigators in the long run.

5.4. Methodological considerations

The indicators identified in this study are more granular than the categories common in suicide prevention research. The disaggregation follows directly observable behavioral differences. The question for the investigator then is whether a behavioral indicator is present or absent, which reduces the need for interpretation of the behavior and increases descriptive precision and reliability.

Furthermore, higher granularity facilitates the combination of multiple indicators without

forcing a choice, enabling a more precise and reliable characterization of each case. This simple binary distinction also increases the robustness of each indicator to variation in data completeness. When combined, indicators can also mitigate each other's ambiguities, thereby strengthening classification validity. This underscores the importance of adapting categories from suicide prevention research to investigative purposes.

These indicators contribute to strengthening interrater reliability between police and accident investigators because they are derived from real-life cases that have been categorized as suicide following a police investigation. However, police investigations also face uncertainties, and their conclusions on suicidal intent can be wrong. In the Norwegian context from which the data are drawn, police investigators are spread across the country with little contact with each other, and there are no dedicated suicide investigation units in the police. This limits organizational learning on railway suicide investigations. Yet, since the ERA guidelines define the police's judgement as the final classification, a faster and closer alignment between police and accident investigations represents a practical way to strengthen classification validity (ERA, 2023).

6. Limitations

There are two central limitations. The first is that the indicators should not be taken as a set of evidence for suicide. The data are inherently correlational and calibrated after a practice-based standard set by police investigators. However, conceptually, the behaviors fit—to varying degrees of ambiguity—with the Ovenstone criterion 'demonstration of suicidal intent'. This variety of ambiguity is addressed explicitly in the study's distinction between clear and ambiguous indicators, and it should also be considered in the investigation's account of the strength-of-knowledge or confidence assessment. The second limitation is that the study does not compare the indicators' performance on suicide vs. accident cases. Future studies on this distinction are expected to increase the diagnostic value of the behavioral indicators.

7. Conclusion: Ten recommendations for accident investigators

The findings from the present study lead to ten recommendations to accident investigators:

- (i) Combine multiple granular indicators rather than classifying the suicidal behavior into a single category.
- (ii) Distinguish consciously between clear and ambiguous indicators. Prioritize clearer indicators of suicidal intent, such as face direction and hand/arm movements, and the absence of common personal items such as luggage.
- (iii) Remember that multiple ambiguous indicators, when combined, may mitigate each other's ambiguity.
- (iv) Use CCTV to verify descriptions, especially when descriptions contain ambiguous terms.
- (v) Find out how long the person waited at the site and whether all trains in the repeating schedule cycle had passed.
- (vi) Use descriptive terms that stay close to observable behavior.
- (vii) Encourage witnesses to provide granular, low-interpretation descriptions.
- (viii) Record detailed behavioral descriptions for both accidents and suicides so models and indicators of railway suicide can be improved over time.
- (ix) Coordinate with other railway organizations in advance to improve the detail and precision of reports without adding unnecessary strain on train drivers.
- (x) To increase the confidence in the classification, meet with other accident investigators as soon as sufficient data are available to assess the evidence, and document both the justification and the strength-of-knowledge judgement.

The behavioral indicators presented here enable a structured and transparent preliminary assessment of suicidal intent. This pragmatic 'codebook-inspired' approach helps standardize investigations on railway suicides, while maintaining an openness to the richness in the residual material, which can benefit from a more reflexive thematic analysis (see Braun et al.,

2019). This will, in turn, improve the quality and timeliness of safety reporting in the railways.

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