

# RESTRAIL: Collaborative Project on REduction of Suicides and Trespasses on RAILway property

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## Abstract

RESTRAIL is a research project co-funded the European Commission which seeks to reduce the occurrence of suicides and trespass on railway property and the costly service disruption these events cause, by providing the rail industry with an analysis and identification of cost-effective prevention and mitigation measures. Through this application paper we aim to inform the end-users about the results of the completed work: data analysis on railway suicide and trespass, assessment of preventative and mitigation measures, and the development of a toolbox of best practices. These achievements are discussed in relation to the ongoing activities of the project (a set of pilot field tests which are aimed at evaluating the effectiveness of measures).

*Keywords:* safety; security; rail transport; mitigation measures; prevention suicides and trespasses; human fatalities.

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## Résumé

RESTRAIL est un projet de recherche cofinancé par la Commission Européenne, qui vise à réduire le nombre de suicides et d'intrusions sur les emprises ferroviaires ainsi que les perturbations de service coûteuses que provoquent ces accidents, en fournissant aux compagnies ferroviaires une liste et une analyse des mesures de prévention et d'atténuation les plus rentables. Cet article a pour but d'informer les utilisateurs finaux sur les résultats des travaux terminés: analyse des données suicides et intrusions, évaluation des mesures de prévention et d'atténuation et le développement d'une « boîte à outils » contenant les meilleures pratiques. Ces résultats sont mis en relation avec les travaux en cours (les essais sur le terrain qui permettront d'évaluer l'efficacité des mesures).

*Mots-clé:* sécurité; sûreté; transport ferroviaire; mesures d'atténuation; prévention des suicides et des intrusions; décès de personnes.

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## 1. Introduction

According to European Railway Agency data published in 2013, suicides represent more than two thirds of all fatalities and, together with the unauthorised person fatalities, constitute 88% of all fatalities occurring within the railway system. These figures are alarming for both governmental authorities and railway companies, for which a key objective has become to prevent suicides and trespassing accidents. The RESTRAIL project was selected in response to this growing cause of concern in the 4<sup>th</sup> transport call of Seventh Framework Programme (FP7 Programme, SST.2011.4.1-2.: Mitigation measures and good practice to reduce human fatalities and disruption of services resulting from suicides and trespassing on railway property). It is a 3-year project that started on the 1<sup>st</sup> October 2011 and is co-funded by the European Commission. It is coordinated by the International Union of Railways (UIC) and composed with 17 partners from 12 different countries (Belgium, Finland, France, Germany, Italy, Israel, the Netherlands, Poland, Spain, Sweden, Turkey and the United Kingdom). The project benefits from a multi-disciplinary expertise: rail companies as well as research centres and universities and manufacturers. The project tries to be as operational as possible, taking into account past and present experience in various European countries and their specific features, in particular sociological, public health, political and administrative aspects. The project will enhance the efficiency of the railway system by assisting it in responding to fatalities and trespassing accidents which jeopardise its reliability, punctuality and thus attractiveness to potential users.

The project consists of six work packages. The first work package (WP1) of the project aimed to collect and analyse data related to railway suicides and trespassing accidents. Work packages 2 and 3 assessed the measures targeted to reduce railway suicides (WP2) and trespassing accidents (WP3). Work package 4 (WP4) dealt with the mitigation of consequences by improving procedures and decision making. WP5, currently in progress, is concerned with the pilot field tests to evaluate selected measures. WP6 covers the dissemination and exploitation of results.

This application paper is user oriented and intends to inform the reader about the main results already achieved and to provide updates on the ongoing activities of the research project. The methods and main results of each work package are briefly presented in separate chapters in the following.

## 2. Data on the railway suicides and trespassing accidents (results of WP1)

The aim of work package 1 was to collect and analyse data related to railway suicides and trespassing accidents. The work resulted in (1) a description of the state-of-the-art based on a literature review, (2) up-to-date statistics on railway suicides and trespassing accidents compiled from different sources, (3) information on possible countermeasures to prevent railway suicides and trespassing accidents, (4) analysis of the consequences of railway suicides and trespassing accidents, and (5) data on the behaviour of victims prior to the incident.

The data were collected using forms or questionnaires that were completed by RESTRAIL partners, who typically acquired the requested data from documents or by interviewing national experts, and in some cases by organising workshops. In total, 14 countries provided data for WP1. The results of work package 1 provide valuable input to railway community since it is the first attempt to collect information on railway suicides and trespassers together, from a broad range of countries and data sources.

### 2.1. State-of-the-art

The literature review highlighted the main differences and similarities between railway suicides and trespassing events and discussed the preventive measures. These measures can be applied to both events or be specifically targeted to prevent either railway suicides or trespassing accidents.

There are two major international databases concerning railway suicides and trespassing accidents: the ERADIS database maintained by ERA and the UIC safety database. Based on the analysis of these two databases it was estimated that in 2010 the number of railway suicides in Europe was 2,854 and the number of fatalities resulting from trespassing accidents was 782.



According to a survey among RESTRAIL partners more than 40 different (partly overlapping) measures for the prevention of railway suicides and trespassing accidents have been implemented in EU Member States. Furthermore, several ideas on possible new measures were collected. The reported implemented measures concerned especially social measures targeting suicides (e.g. national and local prevention programmes, media guidelines), but also different kinds of behavioural measures (e.g. posters, information campaigns and education at schools), physical measures (e.g. fencing and landscaping) and technological measures (e.g. video surveillance). The information on countermeasures was forwarded to work packages 2 and 3 for further assessment.

The analysis of detailed incident data (provided by 12 countries) showed for example that (a) victims were predominantly males, both for suicides and trespassing accidents, (b) victims were typically between 20 and 59 years of age, (c) railway suicides and trespassing accidents seem to be fairly evenly distributed throughout the year, (d) all weekdays are represented quite evenly, and (e) suicides were almost always committed by persons alone, and even in trespassing accidents there was seldom more than one victim. Most of the received information concerned the age, gender, timing of events and locations whereas the least information was received concerning the access point, mental health and distance from incident location to home or to closest mental hospital.

## *2.2. Incident investigation*

Accident investigation practices and processes vary between countries. The Railway Safety Directive sets the minimum requirements for data collection, but does not regulate the investigation process otherwise. The classification on whether the case was a suicide or accident is most often made by the police or a coroner. The organisations involved in the investigation and their roles vary between countries. In most countries the police are responsible for at least of a part of the investigation. Infrastructure managers (IMs) and railway undertakings (RUs) or specific investigation bodies can do their own investigations.

Railway suicide and trespassing accidents have far reaching consequences for a wide range of actors and agencies within society: amongst them the victims and their families and close associates, train drivers and other witnesses, railway companies, emergency services and passengers. All countries have guidelines and procedures for managing the immediate consequences of railway suicide and trespassing accidents, and in some cases measures to mitigate the onset and development of post traumatic stress disorder amongst affected drivers. The most commonly collected data regarding impacts concerns damage to humans (number and type of victim and severity of injury) and delays (duration, frequency, number of trains). There are differences in how the financial costs of deaths and serious injuries are calculated in different countries. Average delays range from 45 minutes to 3 hours in different countries and cause considerable inconvenience to passengers as well as having significant operational and financial impacts for railways.

The behavioural data collection analysed material from existing documentation and company records and included four new studies which were conducted to collect behavioural data covering a combination of suicide and trespass context. Even though the conducted studies were exploratory and there is need for more data collection and analysis, the findings suggest that there are opportunities for prevention. The results suggest for example that the industry may need to consider how it can engage more effectively with external organisations and the public who are using the railway, in further efforts to understand and respond with empathy to these complex issues of railway suicides and trespass.

## *2.3. Recommendations*

Recommendations of work package 1 were made based on the identified opportunities for learning from these different data sources (e.g. about problems which have been identified through these data, practices for investigation and analysis, and options for prevention) and based on the detailed review of the gaps in the current knowledge base (e.g. about victims, locations of incidents, contributory factors, behaviours, consequences of



incidents, uniformity in investigation processes). The recommendations and the more detailed descriptions of actions related to each recommendation are listed in Table 1.

Table 1. Recommendations of work package 1.

Recommendation	Detailed description of actions
Additional data collection	<ul style="list-style-type: none"><li>• Establishment of European database for detailed incident data from national sources</li><li>• Development of European wide guidelines for collection of detailed incident data</li><li>• Systematic collection of data on frequency of trespassing</li><li>• Raising awareness in the railway companies on the importance of collecting data on railway suicides and trespassing accidents to be used as a basis for their decision making</li></ul>
Additional analysis	<ul style="list-style-type: none"><li>• Making the assessment of effectiveness a regular element in all plans concerning the implementation of preventative measures</li><li>• Developing common methods for the determination of factors contributing to individual trespassing accidents</li><li>• Considering in-depth case studies of limited number of suicides and/or trespassing accidents, to gain knowledge of specific features of incidents that are not included in the routine collection of detailed incident data</li><li>• Analysing behaviour in accidental and suicide events from larger samples of pre-existing documents or other sources of data to have better understanding of behaviours that indicate risk of subsequent incidents</li></ul>
Better access to information	<ul style="list-style-type: none"><li>• Enabling and facilitating access to relevant databases, for researchers but also for the general public</li><li>• Making the results of studies on railway suicides and trespassing accidents available to the interested parties more widely, especially to those working in the railway sector</li><li>• Promotion of publication of results from studies and experiments in scientific publications, even if the results are not as positive as expected</li></ul>
Encouraged cooperation between organisations	<ul style="list-style-type: none"><li>• Cooperation between organisations involved in investigations of railway suicides and trespassing accidents to enable exchange of documented information on the incident</li></ul>

### 3. Assessment of measures targeted to reduce railway suicides and trespasses (results of WP2 and WP3)

The two work packages WP2 & WP3 were dedicated to analysing the best practices (technological and non-technological) and identifying, when possible, cost-efficient measures to prevent respectively suicide (WP2) and trespassing (WP3) accidents or incidents. The main tasks focused on the assessment of identified countermeasures (technical and soft) for preventing suicide and trespasses, taking into account the research findings and good practices IMs and RUs. Attention was given to the development of new approaches of soft measures to avoid suicide and trespassing accidents.

The process has been successful in discriminating differences between different types of measures and a shorter list of more promising preventative measures for suicide and trespass have been identified. These measures were considered suitable for more in-depth testing in RESTRAIL. Some of the selected measures are currently being tested in a set of pilot field studies carried out in WP5. The detailed information that has been collected during WP2 and WP3 is a useful resource and is being used as a basis for some initial guidance for implementation of the measures. It is anticipated that this information will be developed with partners during the field testing stage of the project, to produce a robust set of guidance that will be available to railway organisations at the conclusion of the project.

#### 3.1. Development of a method for the evaluation of measures

An initial set of 83 preventive measures to reduce the occurrence of suicide or trespassing, either used already or proposed by project partners, national IMs and RUs, has been grouped into 38 families of measures in which the modes of action for incidents and accidents are similar, using a safety barrier model. Since overlapping exists



between preventive measures against suicide and trespassing, a model has been proposed to take into account shared and specific suicide and trespassing characteristics. The model also makes it possible to visualise how each stage of the suicide or trespassing processes can be linked to certain families of measures.

Several criteria were chosen for the evaluation procedure: (1) durability of effects, (2) costs and benefits (based on expert judgment and not on calculation of the C/B ratio), (3) integration with other policy measures, (4) impact on railway operations, (5) impact on people and jobs, (6) technological issues, (7) environment, (8) acceptance, and (9) transferability issues.

### 3.2. Assessment of suitable measures (technical and soft)

The objectives of the work conducted were to assess preventive measures identified from WP1 taking into account the experience of IMs, RUs and other users. Since measures geared towards preventing suicide cannot always be clearly distinguished from those aimed at preventing trespassing, and as those measures were reviewed and assessed using the same process, experts and criteria, the decision was taken to combine the output into a joint deliverable referring to the prevention of both suicides and trespassing accidents.

The assessment process took into account factors and information that could impact the success of measures if they were applied in different European environments, and drew conclusions on a list of measures defined as recommended and promising. The 38 families of measures were assessed by a group comprising 21 members of WP2, WP3 and external IMs. Each family of measures was assessed separately for suicide and for trespassing. A set of available data was used for the preliminary classification that allowed sector experts in a second phase to assess the principles for classifying measures as “Recommended” or “Promising”, i.e. effective, cost-effective, and free of shortcomings. Three main sources of information were used: the preferences of IMs and RUs; estimates of impact at European level; weighted and individual scores according to 11 criteria representing implementation practicalities for each family of measures.

Table 2. Preventative measures against railway suicide and/or trespass.

Family of measures	Classification for suicide	Classification for trespass
1. Targeted campaigns (including shock campaigns)	Recommended	Promising
2. Fences and barriers at specific parts of stations	Recommended	Recommended
3. Fences and barriers at locations outside stations where people take shortcuts	Recommended	Recommended
4. Surveillance to deter based on patrols	Promising	Promising
5. Mass media campaigns	Promising	Promising
6. Risk assessment (e.g. of stations, special circumstances, risk groups etc.)	Promising	Promising
7. Monitoring and learning from research and best practice	Promising	Promising
8. Collaboration between organisations and agencies	Promising	Promising
9. Surveillance and light to influence behaviour	Recommended	-
10. Detection system combined with sound warnings	Recommended	-
11. Increased visibility by lighting at railway crossings, tunnels and hotspots	Promising	-
12. Increasing visibility through removal of vegetation	Promising	-
13. Surveillance based on local intelligence (e.g. from police, health authorities)	Promising	-
14. Media Guidelines	Promising	-
15. Emergency information at stations (signs, posters, information on screens etc.)	Promising	-
16. Societal collaboration to prevent railway suicide and trespassing accidents	Promising	-
17. Emergency button at unstaffed stations	Promising	-
18. Training of staff - Gatekeeper training	Promising	-
19. Education and prevention in schools and outside of school	-	Recommended
20. Warning signs and posters to address trespassing	-	Recommended
21. Prohibited access signs	-	Promising
22. Training of staff - General Awareness Rising	-	Promising

The assessment procedure resulted in a set of recommended and promising measures as well as an outline of the factors affecting successful implementation of the measures. In addition, implementation issues connected to the



“Recommended” or “Promising” measures were also considered. The method has demonstrated the capacity to support the analysis and selection of measures: 8 families for suicide and trespass, 10 families for the prevention of suicide and 4 families of measures against trespass (see Table 2).

### 3.3. *New approach of soft measures for the prevention of suicides*

Among the whole set of preventative measures, special attention was given to the “soft” measures against suicide and trespass. These are influential, social, or psychological measures dedicated to influence the actors’ knowledge and attitudes and to deter risky behaviours by calling for more socially-responsible actions or for voluntary decisions to comply with the safety rules.

Soft measures against railway suicide include the design and placement of signage and posters in a railway environment, advertising crisis hotlines, mass media campaigns and media guidelines or local prevention campaigns, intervention at schools and provision of educational materials, briefing of station staff or security personnel, announcement in trains and at stations, gatekeeper programmes and hotspot analysis and education.

The analyses show that several soft measures against railway suicides are implemented in European countries and worldwide. Soft measures are often a part of a more general suicide prevention measure.

In order to assess information on existing and emerging soft measures against railway suicides in Europe and worldwide and their degree of implementation, a survey was designed and conducted among RESTRAIL partners. Surveys were also conducted with Bahnhofs Mission, German train drivers union, and among Spanish engine drivers.

The analysis showed that:

- *Awareness rising programmes* are implemented in five European countries media approaches in six.
- *Help lines* are offered and operated in many countries, but only in five countries is the information about the hotline displayed in a railway environment.
- *Poster campaigns* were also launched in five countries.
- *Suicide hotspots* have been officially identified in nine of the countries but only five report that actions have been taken at the identified sites.
- Ten countries have *special announcement* to passengers waiting on stations and in trains and even though all countries avoid using the word “suicide”.
- *Gatekeeper programme* is yet only implemented in Great Britain but several different European countries are planning on setting up gatekeeper programmes for frontline staff.

### 3.4. *New approach of soft measures for the prevention of trespassing*

In order to analyse the development of new approaches to soft measures against trespassing, two complementary approaches were used: (1) quantitative criteria to distinguish the new measures from mainstream approaches in the current literature and (2) qualitative criteria to define innovative approaches from the viewpoint of railway safety experts who participated in several focus groups in Spain, France, and Turkey. The main results suggest that effective interventions which emerge as ‘innovative’ are based on integrative approaches to soft measures.

- *New approaches to education.* Risk awareness should be raised at locations close to the tracks such as bars, taverns, nightclubs, sport centres or arenas, bicycle paths, shopping centres, cinemas, new residential areas, or squatter camps on vacant land. Education should be also targeted towards urban planners and community representatives. Lastly, education campaigns should not be conducted in isolation, and should be reinforced by punitive measures.
- *Innovative collaboration between institutions and agencies.* A joint work is needed within communities, between IMs and RUs on one hand, and urban planners, local authorities, municipalities, etc. on the other.



However, railway companies could look for new collaboration partners such as chambers of commerce, local stores, unions, media, youth, city planners, transportation engineers, manufacturers, and bystanders.

- *'Soft' approaches to physical barriers.* Fences may in fact be used as psychological deterrents rather than simply physical barriers, indicating the boundary of an area with restricted admission. It has been suggested that smearing the bars of fences with heavy grease as a further means to reinforce their deterrent effect on behaviour.
- *Training railway staff to dissuade certain groups of trespassers.* This measure depends heavily on each country's specific context. For example, in France new approaches to training are not necessary, but in Spain there is demand for training maintenance personnel in order to develop their skills in detecting and warning trespassers. Similarly, in Turkey the staff need emergency situation and anger management as well as communication training, to help them manage difficult situations with third parties.

#### **4. Mitigation of consequences by improving procedures and decision making (results of WP4)**

Another objective of RESTRAIL is to develop methods and technological tools that can be integrated with existing procedures and technologies in order to achieve the most effective and cost-efficient means of mitigating the potential impact of suicides and trespasses on railway infrastructures.

The first part of work package 4 identifies numerous interfaces to and between IMs, RUs and police forces involved in managing suicide or fatal trespassing incidents. Clearly, in order to mitigate the consequences of such incidents, system shut down time must be minimised. Therefore, the added value of these deliverables comprises soft and hard products, which aim to improve the full range of operational and technical arrangements that enable this objective to be met whilst enabling the responding organisations to meet their legal responsibilities.

The operational arrangements, represented by the information reference source will support the stakeholders as they assimilate the identified methods, tools, procedures and managerial models in order to reduce the shut down time associated to suicides and trespassing incidents.

The technological deliverables - information, situation management and decision support platform, and the line restoration model are meant to improve the situational picture of the incident, the information collection and dissemination tools, the management of the business processes related to the incident response and decision making processes of the involved IM and RU; between them and the first responders, primarily the police; contractors and other RUs.

##### *4.1. Consequences mitigation information reference source*

This deliverable focuses on the "procedural" aspects associated with mitigating the consequences of attempted suicides, also suicide and trespassing incidents with casualties. It enables the development of a functional information reference source for IMs, RUs, police (state, municipal and railway), fire services and other first responders, regulatory and investigation bodies, which supports response management and consequences mitigation actions, particularly with respect to the shut-down time of railway operation.

The reference source covers the following topics as displayed in Figure 1:

- Incident response arrangements of IM, RU, the police, the fire brigade, emergency medical services (EMS) and others.
- Information management and lines of communication among responding bodies and with decision makers, with emphasis on information sharing and coordination.
- Decision making processes for traffic restoration, including aspects relating to prior agreements among the responders, awareness of rail arrangements, managers' competence and training in handling incidents and decision making on- and off-site.



- Conclusion and recommendations: a summary of the practices associated with the procedural aspects of handling suicide and trespassing incidents with casualties and their impact, and how these might be improved to minimise their impact on rail operations.

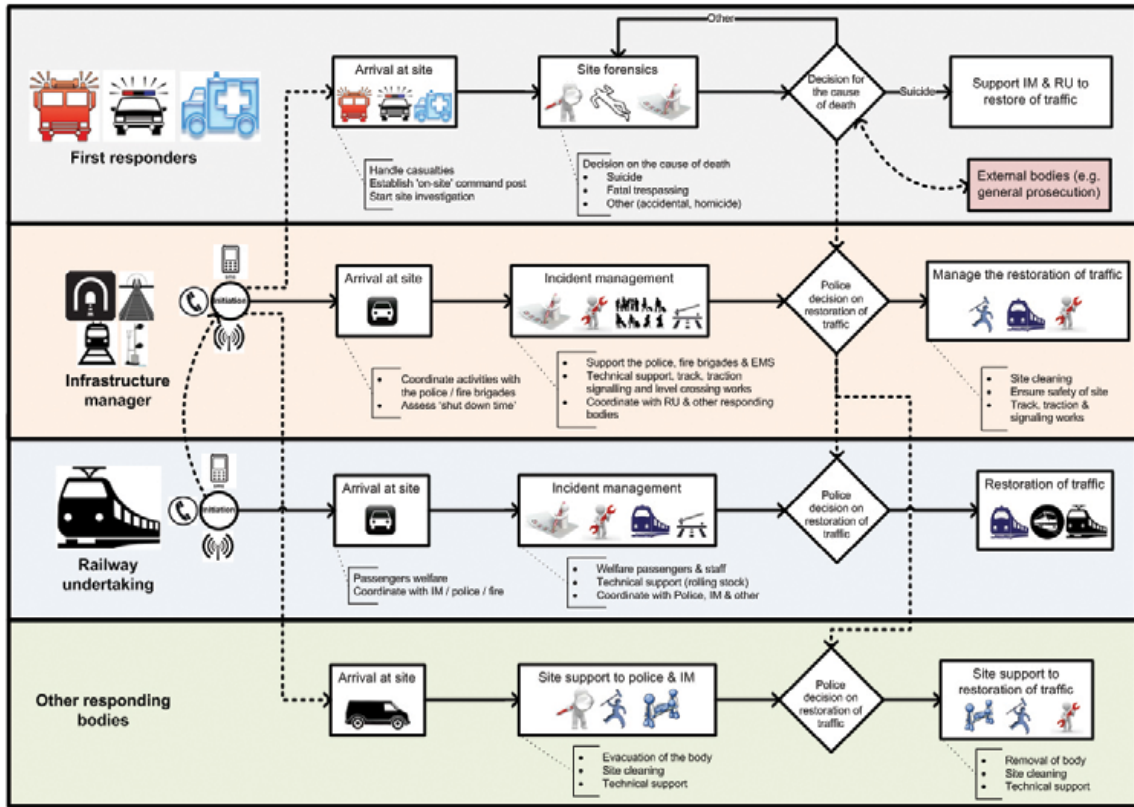


Fig. 1. Incident response responsibilities and arrangements.

#### 4.2. Information, situation management and decision support platform

Information sharing platforms and effective lines of communication between responding bodies are essential for effective and coordinated incident management. As shown in Figure 2, data shared in real time includes geo-data on the incident location and track access points; information on the site of the incident and on possible involvement of third parties, on train data recording and essential actions as part of the response – safety, assistance to passengers, evacuation.



Fig. 2. Data shared in real time within the platform.





This deliverable includes the technical specification and prototype of the situation management system, intended to assist IMs and RUs to achieve the above goals, improve coordination among first responders and help reduce system shut-down time due to incidents with casualties. The system should include:

- *Full customisation*: Easy-to-use and customise-planning tools and menu-driven operations, and a Business Process Manager (BPM) workflow/rule correlation engine. The business rules, as a set of workflows, will automate the appropriate incident management response.
- *Hierarchical solution* multiple layers, which may consist of multiple sites. Each site will be capable of monitoring and managing its own local facility and incidents, systems and client views. Access to higher layers will require authorisation.
- *Effective and coordinated incident handling via incident execution*: pre-planned incident response workflows will be activated automatically by a time schedule or a sensor alert, or manually by control room operators or field personnel. Incidents can be manually categorised, to present operators with an incident task checklist enabling adaptation to evolving situations.
- *Intuitive multi-layered Geographical Information System (GIS)-based display with dynamic updating* to support effective monitoring, decision making and interaction using an IM / RU's existing GIS infrastructure and supporting GIS standards, such as Open Geospatial Consortium (OGC) and proprietary formats (e.g. ESRI, Google, and etc.).
- *Unified management of all IM and RU video systems*: public video IP feeds, station, way-side and on train forward facing CCTV. The single video matrix relevant to the incident will be automatically displayed, and may be shared among RU and IM. Operators will be able to manipulate cameras as required, to optimise incident handling.
- *Incident assessment*: time-coded playback of incident handling for debriefing to support improving incident response and for evidential purposes.
- *Reporting/custom reporting*: automated and fully customisable.

#### *4.3. Improving situational picture and communication between control centres – The line restoration model*

The Restoration Model was developed to reduce the line operation restoration time following suicide and trespassing incidents. The Model receives information concerning the incident and its handling from the Situation Management System, and uses it to forecast the restoration time. By providing IMs and RUs with accurate as possible information, it allows them to prepare and take necessary action to resume operation without unnecessary delay, as soon as the incident is resolved. The Model's forecasts are of great value to the IMs and RUs, as they allow them to optimise the rescheduling of regional and long distance rail traffic, and also improve passenger service by providing passengers with information that allows them to decide whether to use alternative routes and/or modes of transport.

### **5. Providing guidance material through the RESTRAIL Toolbox (results of WP5 and WP6)**

The RESTRAIL Toolbox was designed to help railway undertakings (RUs) and infrastructure managers (IMs) in three ways: (1) lead decision-makers through the process of selecting from the range of preventative and mitigation measures, (2) provide more detailed guidance on the implementation of those measures and (3) provide a framework for collecting and structuring information in order to feed an accessible and documented database on measures implementation and efficiency across the rail community and beyond.

This is an open-access tool available online and in paper format. The first part provides general guidance as a multistep approach for helping and structuring the analysis of a problematic situation. This part of the toolbox may provide a general methodology for the inexperienced end-users who deal with a suicide or trespassing problem. For the experienced end-users, it can be simply used as a checklist in the problem-solving process. The second part includes the specific guidance which concerns details about the implementation of preventative measures. It provides the end-user with a wide list of measures, implementation tips, examples, empirical evidence for effectiveness and other useful details which may be important during the implementation phase. The third part of the Toolbox is about post incident response mitigation action plan. It follows the same structure as the previous ones and contains a set of measures covering post incident consequence mitigation measures.



The RESTRAIL WP5 partners have selected several measures to be implemented and developed a series of field pilot tests in different European locations (e.g., Finland, Germany, Spain, Sweden, Turkey, and UK) in order to provide additional empirical evidence for effectiveness. The Toolbox includes the key-information and recommendations produced in the context of RESTRAIL.

## 6. Conclusions

In summary, the reader may note that the project has covered at least five relevant issues which aid the prevention and mitigation practice: (1) collating details across a wide range of countries of what is happening in terms of prevention, data on incidents and processes for investigation and the management of incidents, etc.; (2) developing and using methodology (e.g., for the evaluation of preventative measures); (3) providing recommendations for further examination of selected preventative measures; (4) looking for additional empirical support for a set of selected measures; and (5) providing guidance materials and best practices to help IMs and RUs implement measures more effectively according to their specific needs and mitigate the consequences.

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