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Designing the common occurrences and taxonomy for COR

COMMON OCCURRENCE REPORTING PROGRAMME

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2. DEFINITIONS AND ABBREVIATIONS

2.1. Standard Terms and Abbreviations

The general terms and abbreviations used in the present document can be found in a standard dictionary. Furthermore, a glossary of railway terms that focuses primarily on safety and interoperability terminology, but also on other areas that the Agency can use in its day-to-day activities as well as in its Workgroups for the development of future publications, is available on the Agency website.

2.2. Specific Terms and Abbreviations

Table 1: Table of Terms

Term	*Definition*
Agency	The European Union Agency for Railways such as established by the Regulation (EC) No 2016/796 of the European Parliament and of the Council of 11 May 2016
Information	Data endowed with meaning and purpose. It is interfered from data and deemed useful.
Occurrence	Occurrence means any safety-related event which endangers or which, if not corrected or addressed, could endanger a train or any rolling stock, its passengers, staff or any other person, and includes in particular an accident and incident.
Risk	Means the frequency of occurrence of accidents and incidents resulting in harm (caused by a hazard) and the degree of severity of that harm[1].
Reporting taxonomy	Scheme which defines the composition structure of a data report where each component is described by an independent data flow definition.
Safety	Freedom from unacceptable risk of harm. (CSM risk assessment) Freedom from unacceptable risk.
Taxonomy	Taxonomy refers to classification according to presumed natural relationships among types and their subtypes.

[1] EC Regulation No. 402/2013 - Common safety method for risk evaluation and assessment

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Table 2: Table of Abbreviations

Abbreviation	*Meaning*
COR	Common Occurrence Reporting
NIB	National Investigation Body
NSA	National safety authority
RU	Railway Undertaking
IM	Infrastructure Manager
NOR	National Occurrence Reporting
RSD	Railway Safety Directive
SMS	Safety Management System
CSI	Common safety indicators
CSM	Common safety method
ERAIL	European railway accident information links
RID	Règlement concernant le transport international ferroviaire des marchandises dangereuses
TDG WG	Transport of Dangerous Goods working group
CSM Revision WP on Assessment & Supervision	Revision of the Common Safety Methods on Conformity Assessment and Common Safety Method on Supervision working party

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3. Purpose of the document

The purpose of this document is to present updated Agency work on developing a set of common safety occurrences and taxonomy (characteristics of occurrences) after first written consultation with stakeholders as a part of the Common Occurrence Reporting Programme[2].

This document contains a proposed structure and content for a set of common rail occurrences and taxonomy. **It is not proposed that the annexes to this document are adopted in full initially as a European Occurrence Reporting system.** The further outcomes of the work planned as part of the COR project will help to determine the scale, phasing and cost to benefit ratio of such a European system. In other words, we have attempted to provide a full picture of what occurrence reporting might look like, but recognize that we will likely need to begin on a much more limited scale. This will of course impact on the likely benefits of such a system.

It is important to note that there will be further opportunities to refine this work, and build agreed occurrences, taxonomy, definitions and guidance, as the project develops:

- **In particular, in 2017, the Agency will develop and consult upon a comprehensive proposal for European COR, according to the Project Plan supported by the impact assessment which will be accompanied by necessary cost-benefit analysis;**
- **In time, if a decision is taken by the Commission to issue a mandate for legislation, considerable work will be needed, working with stakeholders, to develop, and agree as far as possible, a recommendation, according to the Agency normal working procedures.**

4. Scope and objectives

This document incorporates consultation responses on the methodology and assumptions and proposals from the stakeholders ((NSAs, NIBs, Ministry, Railway sector organisations (CER, UNIFE, UIC, RSSB, ATOC) and University (Huddersfield)) following first consultation on the methodology and assumptions used by the Agency to prepare the first proposal of a common occurrence reporting structure.

The objective is to document the methodology used and to provide stakeholders with the explanations and motivations behind this updated proposal.

5. Background

As further explained in the Project Plan, learning from occurrences is vital for both the railway sector and railway authorities and it supports a risk-based approach to safety. The specific objectives we have identified for the collection and analysis of safety management data are:

- Supporting convergence through improvement of Member States safety performance across all significant and non-significant accident categories, to achieve current EU average;
- Improved understanding and management of the risks of significant and catastrophic accidents in all Member States.

Greater convergence through improvement of European Member states safety performance would both achieve the vision of world leaders in rail safety, as well as facilitating a reduction in national safety regulatory barriers to an open market for goods and services. Thankfully, low frequency/high consequence occurrences,

[2] COR project plan

such as major train accidents, are rare occurrences at a national level. It is quite possible that a Member State will not experience any in a given year. However, these events have a heavy impact on the public reputation of rail businesses as well as the evident human tragedy. For rare occurrences, such as major train accidents, it can be beneficial to look at the risk at an EU rather than national level as it is only at an EU level that there are sufficient accidents to understand the underlying risk. Therefore the objective is to better understand the risk of such occurrences. Thus, there is the need of data, which could be only available at EU level, not national (local) level. Moreover, pooling broader safety data can be helpful in risk assessment activity and support EU level policy decisions. High level statistics, and good intelligent benchmarking of key outcomes, can support such policy decisions.

Thus, new and improved methods of monitoring and managing the risks of these types of accidents are needed in order to prevent them. To understand the risks of these events, analysis and monitoring of the causes and possible consequences of these events is required. Moreover, collection and monitoring of such occurrences can help to predict, prevent and target activity toward areas of greatest risk.

To enable effective sharing and analysis of safety occurrences reported within EU, a proposal for a common occurrence categorisation and taxonomy is needed to support reporting and analysis of safety management data. The aim is to improve trends in raw data sets and feed risk modelling techniques as well as to help different railway organisations (Agency, NSAs, NIBs, RUs, IMs, etc.) to fulfil their roles determined by EU legislation[3]. The intention is not to replace or assume responsibility for the tasks set out in the legislation. Clearly, the information needs of each actor, according to their defined roles and responsibilities, are different. However, one of the aim of the COR project is to create one single tool both for railway operators and for authorities, to support them in fulfilling various legal obligations. Thus, it is important to identify the categorisation of occurrences and their reportable thresholds, map consequences and causes in order to associate them with occurrences, determine the taxonomy of information needed for each report to support analysis and modelling of the risks.

The Agency has learned that occurrence reporting is widespread across MSs[4] and at different levels. Many MSs have developed their own reporting systems. In many cases, national legislation defines the list of reportable occurrences and the attributes to be reported. In order to build on existing good practices, as well as avoid any unnecessary costs, these national systems have to be carefully considered when preparing a common European structure for reporting of occurrences taking into account roles and responsibilities of different railway actors which are determined in the RSD and CSMs (a dedicated paper on roles, responsibilities and governance will be elaborated by the Agency). A review of these national practices has been carried out in 2015 by an external consultant with the view to identify common categorisations and practices (DNV GL study).

The DNV GL study showed, that many MSs NOR systems include reportable occurrences not only for serious accidents, but also for minor accidents, incidents and near-misses. This was advocated as a means for measuring underlying safety risk and as a leading indicator of potential accidents. It is possible to have empirical links between near misses, incidents, minor accidents and serious accidents. However, these relationships only exist if the same cause is applicable to both the incident and the accident: for example the number of broken rails not resulting in an accident may be an indicator of derailment risk. Thus, to improve efficient learning and early identification of arising and recurring safety issues in the EU railway system, it is

[3] Review of legislation related to COR

[4] Assessment of Existing National Occurrence Reporting Regimes and Systems

important to include reporting on incidents (precursors to accidents) that result in either no or minor consequences. Databases of such occurrences also represent a valuable source of information for the efficacy of standards such as the Technical Specification for Interoperability (TSIs).

Finally, during first consultation, although not strictly related to this paper, stakeholders raised the issue of a duplication of systems at national and EU level, double reporting or damage to well establish national systems. This is clearly something we will need to consider very carefully as part of the planned Impact Assessment in 2017 and we have asked stakeholders for a detailed list of quantitative and qualitative data to support this. However, it is worth noting that the previous experience of the Agency in creating an interface between national databases and European systems has shown that many technical and organisational issues can arise and lead to very time consuming and costly solutions (e.g. vehicles registers). The main issue is the different architectures of the national systems which makes the connection of all the Member States extremely complicated and unreliable. Nevertheless, stakeholders were invited to propose possibilities on how an EU COR system could work with national systems during consultation on the COR phasing[5] paper. It is clear that, whatever the structure of EU data sharing and the specific supporting data flows and access rules, a clear standardised set of data points and definitions will be needed to create a reliable and useful data set.

6. Methodology

6.1. Introduction

There are several possible approaches for designing a set of common occurrences and reporting taxonomy. A top down approach is one in which the objectives drives the structure and the users agree on the taxonomy. This creates good alignment between the taxonomy/database and the objectives for it, but can be expensive in that previously uncollected data may be needed. In a bottom up approach, the currently used reporting structures are considered and their synthesis leads to a common basis. This is inexpensive as data is already collected but provides potentially poor alignment to any objective. A hybrid approach to designing a common reporting structure has been advocated by the consultant (DNV GL).

In this exercise, the Agency first took the top-down approach, and designed the occurrence structure from a theoretical perspective[6]. Then, all available international and national practices were reviewed, seeking the best practice and fit across those systems. Clearly, during implementation of the future COR system, occurrence structure and taxonomy could be changed from lessons learned and from the experience of the users and the Agency. Thus, there should be established clear change control procedure taking into account cost-benefit analysis of proposed changes.

6.2. Top-down approach application

The intention behind a top-down approach is to develop a set of occurrences and taxonomy that supports the identified objective – in this case, better management of the risks of the CSI accident categories and catastrophic accidents in particular. Furthermore it allows to harmonise accident and incident reporting for EU level assessment to help inform EU policy, compare EU Member states and identify best practices, identify EU level common causes for accidents/incidents. Thus, following steps were considered and taken when deriving the occurrence categorisation and taxonomy:

[5] Phasing the COR SMD

[6] http://www.era.europa.eu/Document-Register/Pages/Prospective-Study-into-Harmonized-Train-Accident-Precursors-Analysis-and-Management.aspx

1. the categorisation and definition of occurrences (thresholds);

2. the fault trees and consequence mapping associated with these occurrences;

3. limitations and assumptions made to create the fault trees;

4. the taxonomy of information needed for each report of an occurrence to support analysis and modelling of the risks;

5. identification of possible causes of the occurrences.

6.3. Bottom-up approach application

The intention behind a bottom-up approach is to maximise the alignment between a Common European system and existing national and other systems. To do this, current practices of EU and non-EU Member states NOR systems (Table 3) as well as other available sources (including additional sources proposed during consultation process) were assessed and reviewed in order to identify differences and commonalities between these systems and to establish and propose a "best-fit" for occurrence categorisation and taxonomy across those systems.

Table 3: Practices considered under bottom-up approach

Practice	*Description and reasoning for inclusion, where relevant*
CSIs (Annex I)	*Occurrences defined in Annex I and its appendix and further explanatory notes available in ERA guidance on CSI data reporting. These are already mandatory reportable occurrences and reporting of them is widespread across Europe.*
ERAIL-INV	*Categorisation and taxonomy jointly developed by NIB network and the Agency for registering the NIB investigation reports in ERAIL database.*
TRL study	*Prospective study into common reporting of accident precursors carried out in 2013.*
DNV GL COR study	*Dedicated study into national OR practices and Proposal for Common Occurrence Reporting Regimes and Systems Including Taxonomy[7] carried out in 2015.*
UIC Safety database[8]	*Categorisation and taxonomy developed by UIC members and used for reporting railway accidents into common safety database.*
International practices	*Well-established occurrence reporting schemes from outside of Europe (USA, CAN, AUS, and NZL).*
National practices	*We considered those national systems that were available to us and contained a well-described (established) categorisation/taxonomy.*
Support Study for Human Factors Integration – Human Functions in European Railways[9]	*Human Support study for Factors Integration - Final reports of the study on Human Functions in European Railways carried out by the Centre for Rail Human Factors, University of Nottingham.*

[7] Proposal for Common Occurrence Reporting Regimes and Systems Including Taxonomy
[8] http://safetydb.uic.org/
[9] http://www.era.europa.eu/Document-Register/Pages/Study-Human-Factors-Integration.aspx

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Practice	*Description and reasoning for inclusion, where relevant*
Regulation on rail transport statistics	*Regulation (EC) No 91/2003 of the European Parliament and of the Council of 16 December 202 on rail transport statistics, Annex H STATISTICS ON ACCIDENTS*

7. Proposal

7.1. Occurrence categorisation

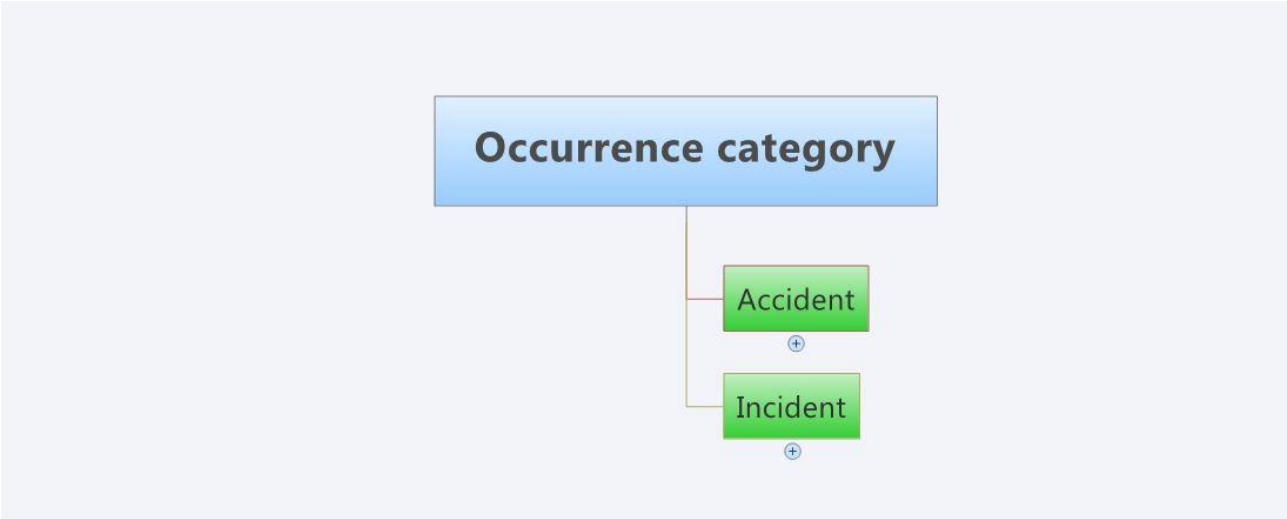

Figure 1 – Occurrence categorisation

Annex I sets out the complete set of occurrences which were identified using both the top down and bottom up approaches. This is the updated proposal after consultation with stakeholders on the first[11] Agency proposal of the list of occurrences which could eventually be reported in the COR. **However, this is not the final Agency proposal. As it was mentioned before the final proposal will be delivered next year with the supporting impact assessment and consulted with all relevant stakeholders**.

The occurrences are organised into categories according to revised RSD[12] (**accidents, incidents**) and especially taking into account Annex I. During consultation process, most of the stakeholders were in favour of grouping occurrences according to the CSIs structure. Thus, the Agency updated the first proposal taking into account the view of the stakeholders. Following the revised RSD and CSI structure (All CSI indicators for accidents and incidents were retained as part of the set of occurrences), main type of occurrences were identified.

Furthermore, incidents type occurrences (precursors of the accidents from train operations, vehicle technical failures and failures of fixed installations) were developed and updated accordingly taking into account comments received during consultation. The updated proposal is considering higher level reportable occurrences, thus the list of possible reportable occurrences is decreased.

[10] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02003R0091-20090420&qid=1476954334883&from=LT
[11] Designing the common occurrences and taxonomy for COR
[12] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1464339024282&uri=CELEX:32016L0798

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For some occurrences sub-type level was developed in order to precise the occurrence more accurately with possibility to improve risk analysis and consequently to improve decision making. The proposal for a common set of precursors developed by a consultant in 2013 (TRL study[13]), stemming from a set of common fault trees, was the basis for development of reportable incidents and near misses.

In the future, the intention is that the proposed EU occurrence reporting will incorporate reporting CSIs to the Agency. In this case, no double reporting from NSAs would be required, it will be possible to extract CSI data from the COR future system. Furthermore, possible migration from NIB ERAIL system to COR system to support NIB reporting to the Agency or provide the link to NIB report of investigated occurrences will be considered as well as an option in the final proposal and consultations with the NIBs. The next deliverable of the COR project – paper on roles, responsibilities and governance, will define how this reportable occurrences could help different stakeholders to fulfil their roles and how they could use the data of the future COR system for which purposes and actions.

The list of developed and updated occurrences after first consultation with stakeholders is provided in Annex I.

[13] Prospective Study into Harmonized Train Accident Precursors Analysis and Management

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7.2. Occurrence taxonomy

Figure 2 – Occurrence taxonomy

The aim of the development of occurrence taxonomy is to identify all relevant information and possible data attributes for each occurrence. Detailed taxonomy of the occurrence helps to identify and understand background, context as well as consequences and causes of the occurrence. This supports greater analysis of the data and, ultimately, understanding of the risks being managed.

Also, it should be noted that depending on the occurrence not all taxonomy information will be relevant and should be reported. For example, if there is a track buckle, no information regarding rolling stock will be submitted because it was not relevant to the occurrence. It was assumed that depending on the occurrence category different and only relevant taxonomy information to the occurrence should be submitted. So, in some cases some parts of the taxonomy would be non-relevant and in some cases it could be not mandatory to fill them or if the information is not available for primary notification, it could be updated in the final notification. The Agency does not have any intention to create any unnecessary burdens on reporters, understanding that this would undermine use of the system. Furthermore, the Agency recognise that future COR system IT tool user interface should be developed as easy to use and intuitive in order to ease and encourage its use. It is clear, that when reporting in future COR IT system the reporting rules could suggest a primary component (occurrence) and then any relevant objects (person, train, track etc.) for that occurrence appear in the data flow to add to the event depending on the occurrence. The level of detail required would be proportionate to the occurrence to ensure the taxonomy is limited to essential and mandatory fields. This process has to be followed in the new system design and build. Furthermore, clear governance (reporting rules) allows for easy and consistent input. **According to project plan, the Agency will develop future IT specification in 2018 and all stakeholders suggestions and views will be appreciated.**

The approach during the taxonomy development was to as far as possible identify and establish predefined taxonomy fields rather than free text description. The reason for this is both to support multilingual reporting, as well as to reduce the resource needed to analyse and classify reports after they are submitted. Also this will help in the future COR system to search and sort data with the search engine according to the user needs. During consultation process, most stakeholders suggested that hybrid approach regarding free text and predefined taxonomy is the right way forward. Fixed taxonomy should be developed as much as possible with the possibility to report free text in some cases and taking into consideration the issues of the languages. The Agency is in favour to develop predefined taxonomy with the possibility to report free text. Thus, the Agency will consider multilingual reporting in the future COR system during development of the specification for the IT tool. However, during consultation on the Safety Alerts IT tool, strong support from various stakeholders were given for reporting free text in English only, in order for other parties be able to understand the safety alert and provided information (free text). Nevertheless, there could be the option which will consider translation of predefined text (taxonomy) in all MSs Languages and obligation to report free text only in English.

The following parts of future COR system occurrence taxonomy were considered:

- **Reference number and reporting entity**

Each occurrence should have reference number in the future COR system. Reference number will give the possibility to identify each occurrence separately, support search engine and editing/amending information of the occurrence, contact reporter of the occurrence if necessary and also help to manage double reporting. Thus, it was considered, that the future IT system will automatically create this number for each reportable occurrence. Moreover, it is important to identify the reporter of the occurrence to allow traceability and further analysis of the risks associated with the event. Also, it allows users to approach the reporter if further information is needed. During the development the considered approach was, that the reporters will be the

organisations (e.g. NSAs, RUs/IMs, etc.). It could be possible that different staff members of the company could report different occurrences, or one dedicated staff member would report all the occurrences depending on the company's own organizational rules and taking into account future COR system governance procedures. Moreover, future rules on COR governance should clarify who, when and what to report and to whom, to prevent double reports on the same occurrence from different parties e.g. RUs and IMs report the same accident. Furthermore, reporting entity or the individuals and companies involved in the occurrence could be confidential and not all future COR users will have access to see who was involved in the occurrence. So, this information will not be revealed to other competing parties (e.g. RUs). Next paper on roles, responsibilities, governance and confidentiality will tackle this issue.

- **Occurrence notification status**

It is likely that immediately after the occurrence and therefore at the time of the initial notification, the reporter does not have all the information relating to the occurrence. Thus, there should be the possibility to update or edit/amend the notification. When all the required occurrence taxonomy is submitted, the report can be classified as the final notification of the occurrence. For example the consequences of an occurrence resulting in serious injury may not be known fully for some time as an individual's medical treatment is ongoing, or causes of an accident may require investigation. For this reason occurrence reporting requires an investment in the ongoing management of the report itself and completing an occurrence report may not be seen as a one off event. Indeed several of the mandatory occurrence reporting schemes examined require an occurrence to be reported within specific times such as soon as possible, 72 hours or once per day/week. The accident investigation for a serious accident may take up to a year to complete and as such the occurrence report will need to be updated over the course of the year. Moreover, future COR system governance (reporting rules) should define in advance minimum information for each time-step of notifications and different notification times for different types of occurrences (accidents/incidents) which should be agreed with all relevant parties. Last but not least, there should be distinction between immediate report of an occurrence to respective NSA/NIB and providing data of the occurrence to the COR system. This should be taken into consideration during final proposal of the future COR system next year.

- **Occurrence identification**

This attribute describes the date, time, location of the occurrence and involved railway undertaking and infrastructure manager. It is important to know when and where the occurrence happened in order to be able to track it and look for possible trends for risk modelling purposes (e.g. black spots) and to identify which relevant actors (RU/IM) were involved in the occurrence. Different NOR use different location reporting rules, thus future COR IT system should consider the possibility to mark the occurrence on the map to help the reporter and to ensure quality of the reporting location. Furthermore, reporting rules established by the users and the Agency should agree on common position how to report location to ensure data quality. To this aim, future possible interaction of COR with the register of infrastructure (RINF) could facilitate reporting and help to ensure consistency of location reporting as the RINF already provides a common geographical and technical description of railway lines.

- **Occurrence category**

Reporter should report the occurrence (what happened) and define the severity of the occurrence, which should be defined by the consequences of the occurrence. In the future, when an accident will be reported through COR, it will be possible to identify automatically the accident type (serious, significant, and non-significant) when the consequences of the accident are known and reported. Furthermore, one of the future

add-on of the COR system could be reporting not only to real consequences but also potential consequences e.g. with near-misses, in order to understand the risk associated with the occurrence.

- **Occurrence description**

As it was mentioned before, the Agency is in favour to have predefined taxonomy. However, it is important to capture as much rich information about the event as possible, perhaps for only a subset of significant events. This is why, separate free text field with the text occurrence description could be used in the future COR system. Text records add depth to the occurrence reporting and supports text-based risk analysis and advanced cognitive analysis. Moreover, free text reporting can help to explain and give more knowledge of the local system as well or to help to explain complex and sometime rare phenomena or if something unusual or not defined by the taxonomy will happen. Nevertheless, future COR system needs to consider reporting rules, taking into account the needs of the different actors as well as multilingual reporting with the possibility to report free text only in English to support other parties be able to understand the free text or automatic translation tools could be implemented if available.

- **Rolling stock, signalling system characteristics, transport of dangerous goods, environmental relevant factor**

Information related to the type of rolling stock involved, signalling system, helps to define the occurrence background and could improve better risk modelling and possibility to establish new trends. For example a correlation could be identified between derailments and types or formations of trains etc. Similarly, environmental factors could also be correlated to particular risks, or causes or preconditions for the occurrence. For example, a road vehicle driver could have difficulty seeing the warnings of a level crossing because of the fog or sun or etc. Moreover, to be consistent with RSD and RID, information regarding occurrences involving transport of dangerous goods should be also provided. However, there is separate Agency work stream on transport of dangerous goods (TDG WG) and outcomes of this work stream could be incorporated in the future COR system.

- **Occurrence consequences and causes**

Occurrence consequences and causes are detailed in the next paragraphs [7.3, 7.47.4].

- **Associated occurrences/chain of events**

Taking into account the revised RSD and CSI approach and consultation of the stakeholders, within the chain of occurrences the Agency proposes that each occurrence shall be reported under the type of the primary occurrence, even if the consequences of the secondary occurrence are more severe (e.g. a derailment followed by a fire). Moreover, all identified incidents are to be reported, both those resulting and those not resulting in accidents. Nevertheless, occurrence taxonomy part is developed to allow the possibility to associate other occurrences to the main occurrences in such cases as well. This approach also gives the possibility to track trends in occurrence categories as well as to better understand them in relation to more significant consequences and causes. It should be possible to do analysis on every stage in the chain of events e.g. how many collisions with rail vehicles resulted in derailments and vice versa. In addition, during consultation process, most stakeholders issued an opinion, that they would like to have the option to report whole chain of events. The Agency will consider to have the possibility to report the whole chain of event during the development of the future COR IT tool.

- **Shunting/maintenance operations, actions/measures taken, link to NIB report/additional relevant information/documents**

Some of the stakeholders raised following issues:

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a) Shunting/maintenance operations

Several stakeholders proposed that the scope has to consider shunting/maintenance operations as well. This is why, new taxonomy field to report occurrences during shunting/maintenance operations is proposed. However, this option could be used as one of phasing options of future COR system[14] or maybe on voluntary basis only. Nevertheless, more data could provide additional benefits for COR future system users for basic analysis and risk assessment activities.

b) Actions/measures taken after an occurrence

Several stakeholders proposed, that there should be also possibility to report what kind of actions/measures were taken after an occurrence (follow-up). This could support learning from others as well as learning across borders for the same type of occurrences and causes, although clearly, RUs, IMs and ECMs will need to take risk-based measures according to their own operations and context. This could be considered voluntary/mandatory as a functionality of the future COR system from the beginning or as an add-on later according to user needs.

c) Link to NIB investigation report with the future COR system

The aim of the COR project is to create one tool for operational and regulatory authorities (including NIBs) in order to have one common EU COR system. Nevertheless, at the moment there is a dedicated tool for NIB investigation reporting (ERAIL), as well as national systems that support NIBs in their role in real time. The Agency will consider NIB needs during paper on roles, responsibilities and governance. Thus, at least the investigation report of NIB could be linked or available in the future COR system.

d) Additional relevant information/documents

Also, some of the stakeholders expressed the view that it should be possible to upload additional information or documentation regarding the occurrence if relevant and available (e.g. photos).

Developed and updated taxonomy of the occurrence (without consequences and causes section) after first consultation with stakeholders is provided in Annex II.

[14] Phasing the COR SMD

7.3. Occurrence consequences

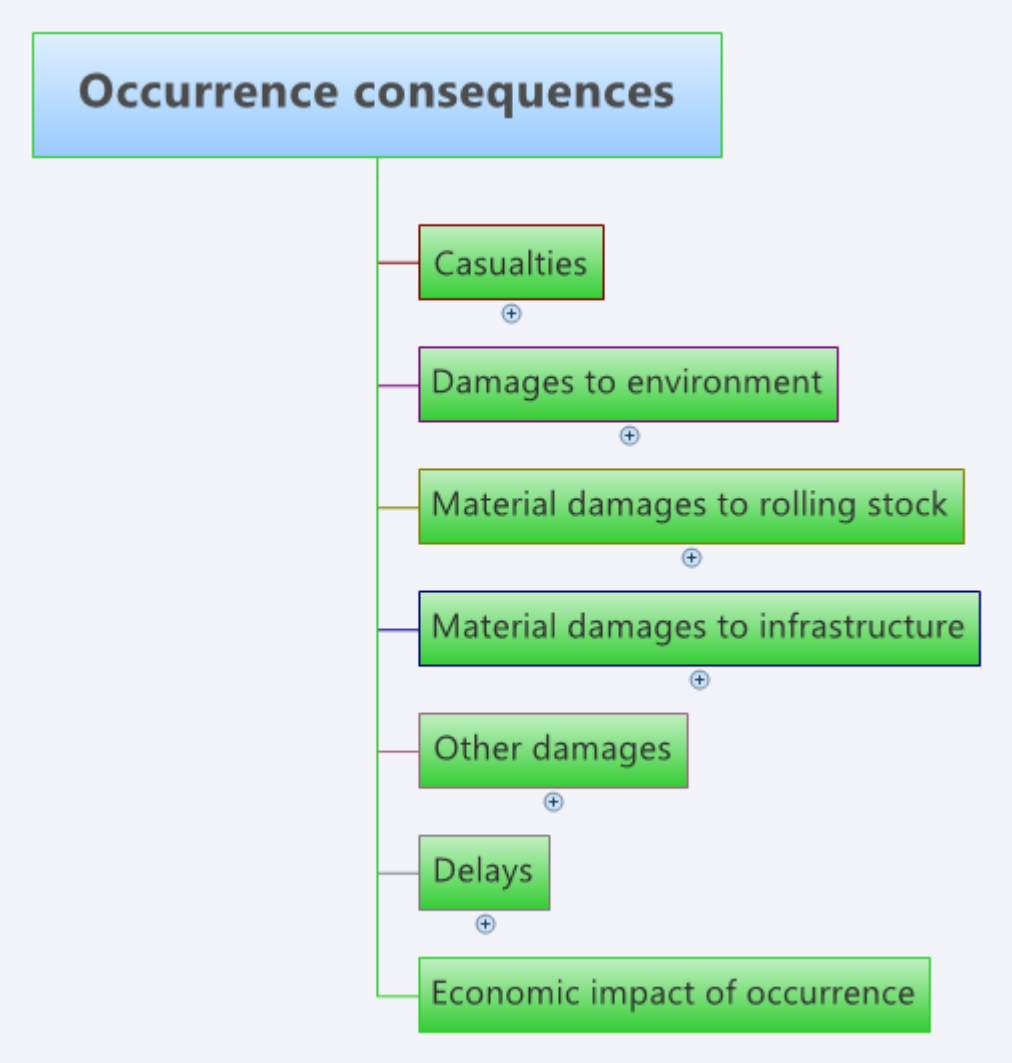

Figure 3 – Occurrence consequences

Occurrence consequences were developed in order to build a better understanding of the risks associated with those occurrences. It is intended that this information will support future work to develop risk models for the rail sector, and in the meantime, support risk assessments carried out as part of the SMS or CSM Risk Assessment. At the level of authorities, both national and European, this information could be both used for statistical purposes regarding measurement of safety levels (as for CSIs and CSTs today) as well as for better risk targeting and prioritisation. Thus, this information is important to the companies (RU/IM) as well as regulatory authorities (NSA/NIB).

Consequences information for the occurrence is especially valuable for NIBs, supporting prioritisation and decisions about which occurrences to investigate[15]. NIBs may investigate those accidents and incidents which under slightly different conditions might have led to serious accidents, including technical failures of the

[15] RSD and http://www.era.europa.eu/Document-Register/Documents/Guidance-decision-to-investigate-accidents-and-incidents-en.pdf

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structural subsystems or of interoperability constituents of the Union rail system. In making this decision NIBs should take into account the seriousness of the accident or incident, whether it forms part of a series of accidents or incidents relevant to the system as a whole and occurrence impact on railway safety.

Also, using the CSI methodology for impact of delays, the system could automatically count costs of the delays. As it was mentioned before in the future, careful reporting of the accident consequences will allow automatic classification of the accident type. For example, if reporter will report derailment with 5 fatalities consequences, system automatically could determine that it is serious accident. If reporter will repot level crossing accident with 1 fatality, system automatically would classify the accident as significant and etc. In addition, the next ad-on could consider probable consequences reporting i.e. in case of near-misses. For example, if the train almost hit the trespasser, the potential consequence could be reported as 1 fatality/injury and etc.

Taxonomy for occurrence consequences were developed on the CSI basis and no further comments were made during consultation approach. We therefore conclude that the proposal has broad support and is therefore stable, subject to the wider impact assessment to be carried out next year.

The detailed developed and updated taxonomy of occurrence consequences after first consultation with stakeholders is provided at Annex III.

7.4. Occurrence causes

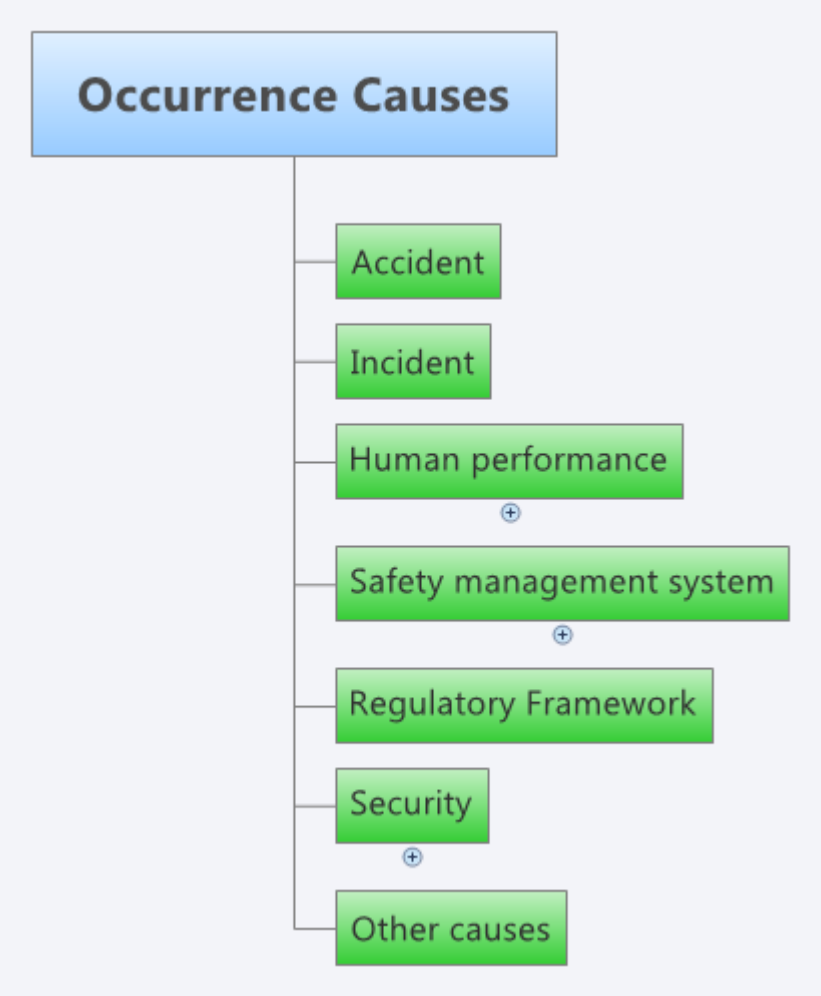

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Figure 4 – Occurrence causes

Investigation and reporting of causes of an occurrence helps to build and improve a risk modelling approach to safety management. This approach support better, more thorough learning from accidents and incidents, and in particular, helps to establish and improve better risk mitigation measures. According to fault trees of main accidents (TRL study), incidents could be identified as causes for accidents. For example, derailment (accident) could be caused by a track buckle (incident, technical failure of fixed installation).

Many causes or incidents (precursors to occurrences) are valuable occurrences in themselves and should be reported, collected and analysed accordingly. This will help to build a more predictive approach to risk management. For example, if track buckles are collected only when they result in a derailment, we will have a limited understanding of the trends and associated risk of track buckles. It would be extremely useful to understand how many track buckles are detected during inspection, maintenance or other data collection (driver reports) that do not result in derailments. For this reason, track buckles and other incidents may be collected as both causes and occurrences. Clearly, a proportionate and reasonable approach to the resource burden of collecting this information will need to be taken, although it is noted that the CSM Monitoring already imposes a clear obligation to collect much of the data that would be relevant for this purpose.

Causes could also be related to human performance (see paragraph 7.5) or security events. In addition, possibility to report suicides is proposed to report under human performance. Reporting suicides is important in determination of the Common safety targets and National risk value for different categories, because the suicides and trespasser accidents have different causes. Therefore, different actions has to be taken in order to prevent this type of accidents. It is already nowadays legal obligation to report suicides (Recast of the Railway safety directive, Annex I).

Building on the learning from NIB investigation reports, it is clear that the causes for accidents and incidents often relate to weaknesses or failures of the SMS and / or the regulatory framework or its application. Building a greater understanding of the whole system and the contribution of systemic elements to the risk profile is essential in developing strong safety management systems and the right cultures across European railways. This information will also help to drive NSA supervision planning, to ensure NSAs are targeting their resource toward oversight of safety management. References used as inputs to this part of the proposal include ongoing work on the revision of CSMs on conformity assessment. It should be noted, that causes of occurrences could be understood and linked to the SMS.

Detailed developed and updated proposal after first consultation with stakeholders of occurrence causes is provided in Annex IV.

7.5. Human performance

Understanding railway operations as a technical, social and organisational system is reliant on analysis of the role of humans within that system. Any future common occurrence reporting regime will therefore need to include these aspects. Eventually, the aim is not only to ask for a reporting of occurrences from a purely technical point of view, but also to capture the human functions and behaviours that are involved, in particular with a view to addressing human performances across the railway system in a consistent manner.

Regarding this proposal of an occurrence categorisation and its supporting taxonomy, a first step for the integration of the human performance into the reportable occurrences is proposed through the integration of some aspects of human performances as part of the potential causes of occurrences. The objective of this

is to help capture the underlying reasons that should drive safety from a human performance point of view. Nevertheless, the Agency acknowledges that this approach of human performance aspects into the taxonomy has its limits as human performances should not only be considered in terms of causes, but also in understanding how to improve risk management, through understanding and maximising the potential for the humans in the system to provide safety barriers and mitigate consequences. This proposal is done on the basis of the outcomes of the study done by TRL on train accident precursors.

The proposal in this document should be seen as a very first step, reflecting the most basic understanding of how to capture the positive and negative capabilities of the humans in the system. During consultation on the first occurrence categorisation and taxonomy proposal, most of the stakeholders agreed, that human performance has to be integrated in the COR project. Furthermore, the Agency received several contributions from the stakeholders (NSA Finland, RSSB, UNIFE, NIB IT, NIB ES, etc.) with some additional proposals how to implement human performance in the future COR system. Thus, a proposal for reporting human factors was added to the proposed taxonomy. However, a phased approach to capturing human performance would be appreciated by the stakeholders (start small, expand later). Identification of the positive human actions could be additional part of the future COR, but may be difficult to achieve within a new reporting system. The Agency appreciates proposals from the stakeholders how to better integrate human performance in the taxonomy. Nevertheless, the Agency will analyse and investigate how proposed taxonomy could be updated taking into account:

- Introduction of a new taxonomy field inside the occurrence structure in order to report the human functions involved in an occurrence (accordingly to the Support Study for Human Factors Integration – Human Functions in European Railways[16])
- Integration of human performance causes as occurrences as such, or as explanatory factors (following the example of aviation sector);
- Development of an approach to integrate “positive human performances”, aiming to identify the human actions that positively help to mitigate hazards during operation (inspired again by the aviation sector and NOR in Finland);

The Agency intends to continue to explore further all possible approaches in order to support final proposal of the Agency next year.

7.6. Occurrence definitions

Some of the occurrence definitions were developed and clarified where the plain meaning was not clear and where the COR team were able to find definitions and support in reference material. RSD Annex I[17] was used as a priority, but also other practices and sources were analysed. For example “Failure” means “defect, construction non-conformities, malfunctions or any other irregularity that endangers, or has the potential to endanger, the safety of railway operations”. Moreover, thresholds were also defined by the definitions e.g. serious, significant, non-significant accident.

All stakeholders were supporting the view that definitions for each occurrence and taxonomy item has to be developed and agreed. The Agency recognise that clear and agreed definitions for occurrences, causes and consequences are essential and can take considerable work to refine. Poorly understood or accepted definitions will weaken support for the entire COR system. Unfortunately, the complexity of achieving this

[16] http://www.era.europa.eu/Document-Register/Pages/Study-Human-Factors-Integration.aspx
[17] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1463999880385&uri=CELEX:02004L0049-20140730

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agreement is multiplied at a European level and it must be accepted that we are unlikely to ever achieve unanimity across the various practices within EU rail operations. Ultimately, if the Agency receives a mandate to develop legislation for COR, a working group will be created to develop detailed definitions which could be directly applicable to all Members states (in case of CSM) or, eventually, by amending RSD Annex I. The agreed definitions would need to be comprehensive and ensure all Member states have aligned their definitions and they are clear on what is being asked to report in order to support data quality.

Furthermore, there should be user guidance to help reporters as well. When the future COR IT tool will be developed, the Agency will also elaborate all necessary procedures and guidelines for the users.

The updated developed proposal after first consultation with stakeholders for occurrence definitions is provided in the Annex V.

7.7. Limitations of the proposal

This updated proposal is a result of internal Agency work carried out by the COR team according to the COR project plan with the input of different stakeholders after first consultation. It should be noted that the Agency does not have direct access to all MSs NOR systems. Thus, it was not possible to include these other systems as part of the in-depth analysis carried out. As was mentioned before, the proposal was developed using sources mentioned in the paragraph [6] and stakeholders contributions during consultation process. Thus, the Agency appreciated constructive contributions to the proposal as part of the workshop and written consultation exercise. The Agency did not investigate how historical data can be cared for future COR system, but this could be done during designing final COR future IT system. Furthermore, this updated proposal relied only on consultation on first Agency proposal on occurrence categorisation and taxonomy, but not for other COR deliverables, on which consultation is ongoing (papers on legislation and phasing). Nevertheless, new inputs from the stakeholders will be considered during final proposal next years. Some of the topics during consultation mentioned by stakeholders (NSAs needs, confidentiality, governance, phasing and etc.) are not in the scope of this paper and were not detailed, but served as an input for other deliverables. It should be mentioned that COR project does not consider occurrences in metro, tram networks. Finally, dangerous goods impact is proposed according to the CSIs, but this section will be updated according to Agency TDG WG deliverables and outcomes.

8. Consultation process

The first paper "Designing the common occurrences and taxonomy for COR" of the COR Project was elaborated by the Agency and provided for comments to various stakeholders (railway operational actors and authorities) from 23th of May 2016 till 15th of July 2016. In addition, dedicated workshop was organised by the Agency in Valenciennes on 2nd and 3rd of June 2016.
During consultation period 18 different organisations (NSAs, NIBs, Ministry, Railway sector organisations (CER, UNIFE, UIC, RSSB, ATOC) and University (Huddersfield)) provided 166 comments for above mentioned paper.

Most comments received during consultation for the "Designing the common occurrences and taxonomy for COR" paper were not directly related to the above mentioned paper. However, they were related to the other important topics of COR project, which will be tackled by the Agency accordingly to COR Project plan. In addition, some stakeholders provided not only comments, but also proposals and suggestions how to

improve the Agency first proposal on occurrences list and taxonomy for COR. The Agency provided written responses to all consultation responses and these are published and available[18].

The Agency appreciates all received comments and proposals from various railway stakeholders. This consultation provided general view to the Agency of stakeholders expectations and raised questions/issues which should be tackled by the Agency during further implementation of the COR Project. The Agency recognises the stakeholders' perception and support and is looking forward for fruitful cooperation for next consultations on the next COR project papers.

In the first consultation paper, Agency raised 8 main questions to stakeholders regarding the Agency first proposal on occurrences list and taxonomy for COR. Following table provides most common stakeholders view and response of the Agency.

Table 4: Consultation overview

Question raised in the paper	Stakeholders view	Agency view
1. Approach regarding reportable occurrences: Should we focus on thorough analysis of more serious incidents, or collect precursors to these accidents and incidents, even where no serious incident or accident occurs? A wider scope would support better, more predictive trend analysis and risk modelling.	Stakeholders view split in two options: *a) Shared view on the need to start with a collection of some occurrences but not all of them: step by step approach towards a comprehensive approach at the end (phased approach). Different stakeholders proposed to begin at first from CSIs, and develop more precursors from there.* *b) Implement Annex I (proposed occurrences list) from the beginning. This was justified by some NOR systems, which are collecting these occurrences already or by the needs of relevant actors.*	The Agency first proposal shows vision of the Agency for COR. However, the Agency acknowledges the need to have the phased approach for the future COR system. This issue was to some extent addressed in the COR paper on phasing (consultation September 2016 to November 2016, workshop October 2016) and will also be considered as part of the system proposal and impact assessment next year. Furthermore, it should be noted, that if we agree on only very limited set of occurrences, this will affect the available benefits of the system because the ability to analyse and draw conclusions on the data will also be limited. The intention is to define the best compromise considering the final objective of a COR regime.
2. Categorisation of occurrences: methodology, completeness, relevance, content. How to better guarantee	Some of the stakeholders proposed amendments and suggestions on the	Suggestions which will be taken into account or further explored are noted in the

[18] https://extranet.era.europa.eu/safety/COR/Deliverables/Forms/AllItems.aspx

completeness and relevance of the occurrences? Is something missing? What should be the initial / target scope for European COR?	categorisation of the occurrences e.g. To classify occurrences in RSD structure (accidents, incidents, near-misses) and etc.	individual consultation responses, which could be accessible in the Agency COR extranet webpage.
3. Grouping of occurrences: following CSIs structure (by accident / incident types) or following operational activities in which these occurrence could be identified and reported?	Most of the stakeholders are in favour of grouping occurrences according to the CSIs structure.	The Agency will update the first proposal taking into account the view of the stakeholders.
4. Should the occurrence with most serious consequence be reported or the first occurrence in a chain of events?	Different stakeholders supported different options: either to report the occurrence with most serious consequence or the first occurrence in a chain of events. Furthermore, most stakeholders would like to have the option to report whole chain of events.	The Agency will propose to stick with CSIs approach, which is in the legislation already. Thus, each occurrence shall be reported under the type of the primary (first) occurrence, even if the consequences of the secondary occurrence are more severe (e.g. a derailment followed by a fire). In addition, the Agency will explore possibilities during the development of the future COR IT tool to have the possibility to report the whole chain of events.
5. Taxonomy for causes and consequences: Level of detail? Completeness of the proposal? Free text vs pre-determined taxonomy? Inclusion of contextual/environmental description and security: Level of detail?	All stakeholders agreed with the taxonomy for consequences. Taxonomy for causes should be updated with some proposed amendments. Furthermore, it is suggested also to phase the level of detail of the causation. In addition, some of the stakeholders would prefer have some proposed technical occurrences (vehicles or fixed installations) in the causes section rather than in the occurrence category section. Hybrid approach regarding free text and predefined	The Agency will keep taxonomy for consequences unchanged from the first proposal. Taxonomy for causes will be updated in the second paper, because of the changed structure of the Annex I (some of the events will be moved to causes). Nevertheless, it is important to note, that the final aim of the Agency is also to collect some precursors to accidents as reportable occurrences (i.e. list of events that must be reported, whether they are at the end of the chain of events or not). Thus, it may

	taxonomy is the right way to go forward. Fixed taxonomy should be developed as much as possible with the possibility to report free text in some cases and taking into consideration the issues of the languages. It is necessary to define the concept of "Security" in relation to railway safety. A distinction of IT and physical security should be defined and security events should not be collected as the occurrences (reduced taxonomy). Security area could be seen as a cause for accident (e.g. derailment because of the act of vandalism (stones on the rail)). Security events should be collected if there is a clear benefit for the stakeholders.	not be very important whether they will be in the occurrence list or in the causes section. The Agency is in favour to develop predefined taxonomy with the possibility to report free text, perhaps for only a subset of significant events. Thus, the Agency will consider multilingual reporting in the future COR system during development of the specification for the IT tool. However, during consultation on the Safety Alerts IT tool, strong support from various stakeholders were given for reporting in English only, in order for other parties be able to understand the safety alert and provided information. Nevertheless, there could be the option which will consider translation of predefined text (taxonomy) in all MSs languages and obligation to report free text only in English. The Agency will not exclude security causes from the proposal, because they could be the cause of the occurrences and the data could support better management of these risks (e.g. derailment because of the act of vandalism).
6. Integration of human performance in the taxonomy: Relevance of the current proposal? How to go further? How can we incorporate the science of human functions in order to better target the	Most of the stakeholders agree, that human performance has to be integrated in the COR project. Thus, most of the stakeholders were in favour of the proposal	The Agency appreciates proposals from the stakeholders how to better integrate human performance in the taxonomy. Nevertheless, the

role of human performance? Identification of positive human actions?	by the Agency. However, some of the stakeholders also proposed some suggestions regarding human performance taxonomy. A phased approach to capturing human performance would be appreciated by the stakeholders (start small, expand later). Identification of the positive human actions could be additional part of the future COR, but definitely not the priority at the moment.	Agency will analyse and investigate how proposed taxonomy could be updated.
7. Data dictionary – Establishing a definition for each occurrence: Relevance of current proposal? How to achieve a common understanding across Europe?	All stakeholders were supporting the view, that definitions for each occurrence and taxonomy item has to be developed and agreed. Furthermore, there should be user guidance to help the reporters as well.	The Agency agrees with the stakeholders view. Final proposal of the Agency for COR will contain some supporting definitions. After the future COR IT tool will be developed, the Agency will also elaborate all necessary procedures and guidelines for the users. Ultimately, if the Agency receives a mandate to develop legislation for COR, a working group will be created to develop detailed definitions. Before that, the Agency will explore the possibility for virtual collaboration, using a "wiki" approach to sharing and updating definitions.
8. SMS and regulatory factors as causes: the level of detail? Relevance of current proposal?	SMS and regulatory factors causes could be seen as core interest for sector and regulatory actors. These causes should be considered as high-level (not very deep/detailed). Sharing information on the SMS requires the presence of a data protection policy. Furthermore, some of the stakeholders pointed out, that all the occurrences have direct	The Agency will keep the SMS and regulatory factors as a proposed taxonomy part. Proposal will be established on the developments of the CSM CA WG. The Agency recognise, that all occurrences are related for part of the SMS. However, the Agency aim is to allow for reporters to report not one cause, but all related causes

	or indirect cause of the SMS. Thus, it must be clarified when and how to report SMS causes.	to the occurrence in order to have all necessary and comprehensive information of the occurrence. Furthermore, different investigations (internal or NIB), can reveal different causes of the occurrence.

Furthermore, some common additional questions were raised during consultation period by the stakeholders related to phasing of the COR, roles & governance and legislation, access, use of data and confidentiality issues, just culture and liability. This important topics will have dedicated papers and will be consulted with all stakeholders during workshops and written consultation process. Please refer to the project plan for exact dates. Furthermore, COR IT specification development is foreseen in 2018 as a final proposal together with the accompanied impact assessment in 2017.

9. Next steps

This is the updated proposal developed by the COR project team. It should be noted that other deliverables of COR project could influence COR taxonomy and occurrence categorisation final proposal as well as results from other Agency working parties (TDG WG, CSM CA revision WG, etc.). Any inputs and more details are welcomed by the Agency to assist the COR project final proposal. The COR project plan sets out in detail the other planned work packages, as well as the timing and content of an overall review, followed by a comprehensive proposal for a European COR system, in 2017, together with the supported impact assessment. All stakeholders will be invite to provide their comments and contributions. In time, if a decision is taken by the Commission to issue a mandate for legislation, considerable work will be needed, working with stakeholders, to develop, and agree as far as possible, a recommendation, according to the Agency normal working procedures.

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ANNEX I – Occurrence categorisation

- Occurrence category
  - Accident
    - Collision
      - Collision of train with rail vehicle
        - Front to front
        - Front to end
        - Side
      - Collision of train with obstacle within the clearance gauge
        - With objects fixed on or near the track
          - With buffer stops
          - With (part of) infrastructure (equipment) within clearance gauge
          - With other fixed objects
        - With objects temporarily present on or near the track
          - With animals (excluding birds)
          - With rocks
          - With landslides
          - With trees
          - With lost parts of railway vehicles
          - With lost or displaced loads
          - With vehicles and machines or equipment for track maintenance
          - With road vehicles
          - With other temporarily present objects
        - With overhead contact lines
    - Derailment of train
    - Level crossing accident
      - With one or more crossing vehicles
      - With crossing users (e.g. pedestrians)
      - With other objects temporarily present on or near the track if lost by a crossing vehicle or user
    - Accident to persons involving rolling stock in motion
      - Person hit by a railway vehicle (or by an object attached to, or that has become detached from, the vehicle)
      - Person fall from railway vehicle
      - Person fall or are hit by loose objects when travelling on board vehicles
    - Fire in rolling stock
      - Fire in rolling stock
      - Explosion in rolling stock
    - Other (accident)
      - Electrocution

- Other

Incident

- Train operations failure
  - Signal passed at danger when passing a danger point
  - Signal passed at danger without passing a danger point
  - Runaway train
  - Wrong routing
  - Train over-speeding
  - Loading irregularity
    - Overweight
    - Oversized loading
    - Imbalanced loading
    - Insecure loading
    - Open door
  - Train composition failure
  - Train available for boarding or alignment outside platform
  - Other (train operations failures)
- Technical failure of vehicles
  - Broken wheel on rolling stock in service
  - Broken axle on rolling stock in service
  - Wrong-side signalling (vehicle) failure
  - Braking system failure
  - Losing of vehicle parts
  - Traction motor failure (electrical)
  - Diesel engine failure
  - Hot axle box
  - Coupling failure
  - Doors failure
  - Suspension system failure
  - Other (technical failures of vehicles)
- Technical failure of fixed installations
  - Broken rail
  - Track buckle and other track misalignment
  - Wrong-side signalling (infrastructure) failure
  - Switch and crossing failure
  - Failure of the level crossing equipment
  - Disorder of earthworks/embankment failure
  - Structures failure
    - Tunnel failure
    - Viaduct failure
    - Culvert failures

- Rail bridge structural failure
- Over line bridge (e.g. pedestrian) failure
- Station structure failure
- Platform failure
- Power supply equipment failure
- Train detection equipment failure
- Overhead contact line failure
- Fire of fixed installation
- Other (technical failures of fixed installations)

Near miss

- With rail vehicle
- With road vehicle
- With person
  - Passenger
  - Employee or contractor

ANNEX II – Occurrence taxonomy

Occurrence taxonomy

- Occurrence reference number
- Reporting entity
  - Company reference number
  - Reporter reference number
- Occurrence notification status
  - Initial notification
  - Interim notification (updated)
  - Final notification
- Occurrence identification
  - Date
  - Local Time
  - Location
    - Country
    - Location type
      - Inter-station/open line
      - Station
      - Other type (e.g. siding)
    - Location details
      - Switches and Crossings
      - Level-crossing
        - Passive level crossing
        - Active Level-crossing
          - Manual

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- Automatic with user-side warning
- Automatic with user-side protection
- Rail-side protected
- Bridge/Viaduct
- Tunnel
- Other
- Number of tracks
  - Single track
  - Double track
  - Multiple track
- Km/mile number
- RUs involved
- IM involved

Occurrence category

- Accident
  - Serious accident
  - Significant accident
  - Non-significant accident
- Incident

Occurrence description (free text)

Rolling stock characteristics

- Train type
  - Freight train
  - Passenger train
    - High-speed train
    - Conventional train
  - Engineering train\Maintenance rolling stock
- Composition
  - Locomotive
    - Diesel
    - Electric
    - Hybrid
  - DMU
  - EMU
  - Wagons
  - Coaches

Transport of dangerous goods

- Yes
  - Dangerous goods are released
    - Yes

- No
  - No
- Signalling system characteristics
  - ERTMS
  - Lineside signalling
  - Cab signalling
  - Other
- Environmental relevant factor
  - Meteorology/Weather
    - Fog
    - Flooding
    - Frost
    - Ice
    - High winds
    - Storm
    - Snow
    - Heat
    - Other
  - Landslide
  - Rock/stone fall
  - Earthquake
  - Vegetation
  - Light conditions
  - Other
- Associated occurrences\Chain of events
  - Occurrence category
- Occurrence consequences
- Occurrence causes
- Shunting/Maintenance operations
- Actions/Measures taken (free text)
- Link to NIB report (if relevant)
- Additional relevant information/documents/pictures

ANNEX III – Occurrence consequences

- Occurrence consequences
  - Casualties
    - Passenger
      - Deaths
      - Serious injuries
      - Minor injuries
    - Employee or contractor

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- Deaths
- Serious injuries
- Minor injuries
- Level crossing user
  - Deaths
  - Serious injuries
  - Minor injuries
- Trespasser
  - Deaths
  - Serious injuries
  - Minor injuries
- Other person at a platform
  - Deaths
  - Serious injuries
  - Minor injuries
- Other person not at a platform
  - Deaths
  - Serious injuries
  - Minor injuries

Damages to environment

- Yes
  - Costs
  - Description (free text)
- No

Material damages to rolling stock

- Yes
  - Costs
  - Description (free text)
- No

Material damages to infrastructure

- Yes
  - Costs
  - Description (free text)
- No

Other damages

- Yes
  - Type
    - Structures/Buildings
    - Objects
    - Cargo
    - Other
  - Description (free text)

- Costs
  - No
- Delays
  - Passenger train
    - Number of trains
    - Number of total minutes
  - Freight train
    - Number of trains
    - Number of total minutes
  - Overall
    - Number of trains
    - Number of total minutes
- Economic impact of occurrence

ANNEX IV – Occurrence causes

- Occurrence Causes
  - Accident
  - Incident
  - Human performance
    - Human behaviour
      - Suicide
        - Suicide
        - Attempted suicide (serious injury)
        - Attempted suicide (minor injury)
      - Passenger behaviour
        - Accidental\Unintended actions
        - Deliberate\Intended actions
      - Employee or contractor behaviour
        - Train driver behaviour
          - Accidental actions
          - Deliberate actions
        - Train crew behaviour
          - Accidental actions
          - Deliberate actions
        - Traffic operating and signalling staff behaviour
          - Accidental actions
          - Deliberate actions
        - Maintenance (vehicle) staff behaviour
          - Accidental actions
          - Deliberate actions
        - Maintenance (fixed installations) staff behaviour

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- Accidental actions
- Deliberate actions
- Shunters behaviour
  - Accidental actions
  - Deliberate actions
- Loader staff behaviour
  - Accidental actions
  - Deliberate actions
- Other staff behaviour
  - Accidental actions
  - Deliberate actions
- Level crossing user behaviour
  - Accidental actions
  - Deliberate actions
- Trespasser behaviour
  - Accidental actions
  - Deliberate actions
- Other person at a platform behaviour
  - Accidental actions
  - Deliberate actions
- Other person not at a platform behaviour
  - Accidental actions
  - Deliberate actions

Human factors

- Communication
- Practices and Processes
- Information
- Equipment
- Knowledge, Skills and Experience
- Supervision and Management
- Work Environment
- Teamwork
- Personal
- Workload

Safety management system

Leadership

- Leadership and commitment
- Safety policy
- Organisational roles, responsibilities and authorities
- Involvement of staff and other parties

Planning

- Actions to address risks

- Safety objectives and planning
- Support
  - Resources
  - Competence
  - Leadership and commitment
  - Safety policy
  - Organisational roles, responsibilities and authorities
  - Involvement of staff and other parties
  - Planning
    - Actions to address risks
    - Safety objectives and planning
  - Support
    - Resources
    - Competence
    - Leadership and commitment
    - Safety policy
    - Organisational roles, responsibilities and authorities
    - Involvement of staff and other parties
    - Planning
      - Actions to address risks
      - Safety objectives and planning
    - Awareness
    - Information and communication
    - Documented information
  - Awareness
  - Information and communication
  - Documented information
- Operation
  - Operational planning and control
  - Asset management
  - Contractors, partners and suppliers
  - Management of change
  - Emergency management
- Performance evaluation
  - Monitoring
  - Internal auditing
  - Management review
- Improvement
  - Learning from accidents and incidents
  - Continual improvement

Regulatory Framework

Security
- Terrorism
- Assault
- Theft
- Arson
- Vandalism
- Cyber attack
- Other (security causes)

Other causes
- Design of vehicle
- Design of fixed infrastructure
- Other

ANNEX V – Definitions

Definitions from the occurrence category

‘accident’ means an unwanted or unintended sudden event or a specific chain of such events which have harmful consequences; accidents are divided into the following categories: collisions; derailments; level crossing accidents; accidents to persons involving rolling stock in motion; fires and others;

‘collision of train with rail vehicle’ means a front to front, front to end or a side collision between a part of a train and a part of another train or rail vehicle, or with shunting rolling stock;

‘collision of train with obstacle within the clearance gauge’ means a collision between a part of a train and objects fixed or temporarily present on or near the track (except at level crossings if lost by a crossing vehicle or user), including collision with overhead contact lines;

‘derailment of train’ means any case in which at least one wheel of a train leaves the rails;

‘level crossing accident’ means any accident at level crossings involving at least one railway vehicle and one or more crossing vehicles, other crossing users such as pedestrians or other objects temporarily present on or near the track if lost by a crossing vehicle or user;

‘accident to persons involving rolling stock in motion’ means accidents to one or more persons who are either hit by a railway vehicle or by an object attached to, or that has become detached from, the vehicle, this includes persons who fall from railway vehicles as well as persons who fall or are hit by loose objects when travelling on board vehicles;

‘fire in rolling stock’ means a fire that occurs in a railway vehicle (including its load) when it is running between the departure station and the destination, including when stopped at the departure station, the destination or intermediate stops, as well as during re-marshalling operations;

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‘explosion in rolling stock’ means an explosion that occurs in a railway vehicle (including its load) when it is running between the departure station and the destination, including when stopped at the departure station, the destination or intermediate stops, as well as during re-marshalling operations;

‘other (accident)’ means any accident other than a collision of train with rail vehicle, collision of train with obstacle within the clearance gauge, derailment of train, level crossing accident, an accident to person involving rolling stock in motion or a fire in rolling stock;

'Electrocution' - Pathological consequences caused in a human body by the passage of an electric current; or 'Electrocution' - The injury or killing of someone by a sudden discharge of electricity through a part of the body.

‘incident’ means any occurrence, other than an accident or serious accident, affecting the safety of railway operations;

‘Failure’ means defect, construction non-conformities, malfunctions or any other irregularity that endangers, or has the potential to endanger, the safety of railway operations.

‘Signal Passed at Danger when passing a danger point’ means any occasion when any part of a train proceeds beyond its authorised movement and travels beyond the danger point;

‘Signal Passed at Danger without passing a danger point’ means any occasion when any part of a train proceeds beyond its authorised movement but does not travel beyond the danger point.

Unauthorised movement means to pass:
— a trackside colour light signal or semaphore at danger, or an order to STOP where a train protection system (TPS) is not operational,
— the end of a safety-related movement authority provided in a TPS,
— a point communicated by verbal or written authorisation laid down in regulations,
— stop boards (buffer stops are not included) or hand signals.
Any case in which a vehicle without any traction unit attached or a train that is unattended runs away past a signal at danger is not included. Any case in which, for any reason, the signal is not turned to danger in time to allow the driver to stop the train before the signal is not included.

‘Runaway train’ - Train movement on tracks out of the control of train operators or The uncontrolled movement of an unattended train or item of rolling stock that endangers or has the potential to endanger the safety of railway operations.

‘Wrong routing’ - Signaller behaviour results in the wrong route being set for a train.

‘Loading irregularity’ - Any situation where the load endangers or has the potential to endanger the safety of railway operations.

‘Train over-speeding’ - Any situation when the train exceeds allowed speed limit.

‘Train composition failure’ - Train composition failure which leads to non-compliance with allocated path.

‘Train available for boarding or alignment outside platform’ - Train doors are open for boarding or alignment while it is outside the platform.

‘Broken wheel on rolling stock in service’ - A break affecting the wheel and creating a risk of accident.

‘Broken axle on rolling stock in service’ - A break affecting the axle and creating a risk of accident.

‘Wrong side signalling (vehicle) failure’ means any technical failure of a signalling system to rolling stock, resulting in signalling information less restrictive than that demanded;

‘Braking system failure’ - failure of the vehicle braking system.

‘Losing of vehicle parts’ - Any unintentional separation of any vehicle part.

‘Hot axle box’ - Any deterioration of an axle box bearing of a vehicle, detected either by on-board equipment or by trackside equipment.

‘Broken rail’ - Any rail which is separated in two or more pieces, or any rail from which a piece of metal becomes detached, causing a gap of more than 50 mm in length and more than 10 mm in depth on the running surface.

‘Track buckle or other track misalignment’ means any fault related to the continuum and the geometry of track, requiring track to be placed out of service or immediate restriction of permitted speed;

‘Wrong side signalling (infrastructure) failure’ means any technical failure of a signalling system to infrastructure, resulting in signalling information less restrictive than that demanded;

‘Near-miss’ - any occurrence where the driver of a moving train takes emergency action, or would have if there was sufficient time, to avoid impact with a person, vehicle or other obstruction and no collision occurred. Emergency action includes continuous audible warning and/or brake application.

Definitions from the taxonomy

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

‘significant accident’ means any accident involving at least one rail vehicle in motion, resulting in at least one killed or seriously injured person, or in significant damage to stock, track, other installations or environment, or extensive disruptions to traffic, excluding accidents in workshops, warehouses and depots;

‘Significant damage to stock, track, other installations or environment’ means damage that is equivalent to EUR 150 000 or more;

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‘non-significant accident’ means any accident involving at least one rail vehicle in motion, resulting in at least one minor injured person, or in any damage (less than 150 000 EUR) to stock, track, other installations or environment, or any disruptions to traffic (less than 6 hours), excluding accidents in workshops, warehouses and depots;

‘Extensive disruptions to traffic’ means that train services on a main railway line are suspended for six hours or more;

‘non-significant accident’ means any accident involving at least one rail vehicle in motion, resulting in at least one minor injured person, or in any damage (less than 150 000 EUR) to stock, track, other installations or environment, or any disruptions to traffic (less than 6 hours), excluding accidents in workshops, warehouses and depots;

‘train’ means one or more railway vehicles hauled by one or more locomotives or railcars, or one railcar travelling alone, running under a given number or specific designation from an initial fixed point to a terminal fixed point, including a light engine, i.e. a locomotive travelling on its own,;

‘Passenger’ means any person, excluding a member of the train crew, who makes a trip by rail, including a passenger trying to embark onto or disembark from a moving train for accident statistics only;

‘employee or contractor’ means any person whose employment is in connection with a railway and is at work at the time of the accident, including the staff of contractors, self-employed contractors, the crew of the train and persons handling rolling stock and infrastructure installations;

‘Level crossing user’ means any person using a level crossing to cross the railway line by any means of transport or by foot;

‘Trespasser’ means any person present on railway premises where such presence is forbidden, with the exception of a level crossing user;

‘other person at a platform’ means any person at a railway platform who is not defined as ‘passenger’, ‘employee or contractor’, ‘level crossing user’, ‘other person not at a platform’ or ‘trespasser’;

‘other person not at a platform’ means any person not at a railway platform who is not defined as ‘passenger’, ‘employee or contractor’, ‘level crossing user’, ‘other person at a platform’ or ‘trespasser’;

‘Death (killed person)’ means any person killed immediately or dying within 30 days as a result of an accident, excluding any suicide;

‘Serious injury (seriously injured person)’ means any person injured who was hospitalised for more than 24 hours as a result of an accident, excluding any attempted suicide.

‘Minor injury’ - means any person injured who was hospitalised for lee than 24 hours as a result of an accident, excluding any attempted suicide.

‘Occurrence involving the transport of dangerous goods’ means any accident or incident that is subject to reporting in accordance with RID (1)/ADR Section 1.8.5;

‘Dangerous goods’ means those substances and articles the carriage of which is prohibited by RID, or authorised only under the conditions prescribed therein.

‘Suicide’ means an act to deliberately injure oneself resulting in death, as recorded and classified by the competent national authority;

‘Attempted suicide’ means an act to deliberately injure oneself resulting in serious injury.

‘Cost of damage to environment’ means costs that are to be met by Railway Undertakings and Infrastructure Managers, appraised on the basis of their experience, in order to restore the damaged area to its state before the railway accident.

‘Cost of material damage to rolling stock or infrastructure’ means the cost of providing new rolling stock or infrastructure, with the same functionalities and technical parameters as that damaged beyond repair, and the cost of restoring repairable rolling stock or infrastructure to its state before the accident, to be estimated by Railway Undertakings and Infrastructure Managers on the basis of their experience, including also costs related to the leasing of rolling stock, as a consequence of non-availability due to damaged vehicles.

‘Cost of delays as a consequence of accidents’ means the monetary value of delays incurred by users of rail transport (passengers and freight customers) as a consequence of accidents, calculated by the CSI model.

‘Level crossing’ means any level intersection between a road or passage and a railway, as recognised by the infrastructure manager and open to public or private users. Passages between platforms within stations are excluded, as well as passages over tracks for the sole use of employees.

‘Road’ means, for the purpose of railway accident statistics, any public or private road, street or highway, including adjacent footpaths and bicycle lanes.

‘Passage’ means any route, other than a road, provided for the passage of people, animals, vehicles or machinery.

‘Passive level crossing’ means a level crossing without any form of warning system or protection activated when it is unsafe for the user to traverse the crossing.

‘active level crossing’ means a level crossing where the crossing users are protected from or warned of the approaching train by devices activated when it is unsafe for the user to traverse the crossing.

Protection by the use of physical devices includes: half or full barriers gates.

Warning by the use of fixed equipment at level crossings: visible devices: lights, audible devices: bells, horns, klaxons, etc.

Active level crossings are classified as:

(a) Manual: a level crossing where user-side protection or warning is manually activated by a railway employee.
(b) Automatic with user-side warning: a level crossing where user-side warning is activated by the approaching train.
(c) Automatic with user-side protection: a level crossing where user-side protection is activated by the approaching train. This shall include a level crossing with both user-side protection and warning.
(d) Rail-side protected: a level crossing where a signal or other train protection system permits a train to proceed once the level crossing is fully user-side protected and is free from incursion.