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Final Report	
Prevention and mitigation of freight train derailments at short and medium terms	
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Amendment record

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0.1	21.12.11	All	1st version of the draft report	ER, SK
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1.0	10.02.12	Relevant sections only	Consideration of comments received from the consultation of representative associations Consideration of comments concerning the use of DNV's results by the Agency	ER, HL, SB, BL

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EXECUTIVE SUMMARY

Following a joint position of the Railway Interoperability and Safety Committee (RISC) and of the Inland Transport of Dangerous Goods Committee (ITDGC) stated in November 2009, the Agency was mandated by the European Commission to report on potential efficient actions to further prevent or mitigate the risks related to the freight train derailments at EU level.

After an extensive review of the existing measures for preventing or mitigating this risk in EU, the Agency has assessed the possibilities for further reducing the derailment risks at EU level.

The Agency considered that it was particularly important not to draw any conclusions which would recommend un-balanced new requirements to the railway freight transport in order not to shift un-controlled risks to the road mode. Therefore, the Agency carefully considered the current risk levels resulting from the railway freight transport in comparison with the road mode, including the risks relating to the transport of dangerous goods.

The Agency also considered the potential influence of the long term objectives expressed for the railway transport in the White Paper concerning the development of a Single European Transport Area.

As a result, the Agency believes that the most important actions for reducing the freight train derailment risks today, at EU level, are the following:

- To improve the implementation of safety management systems under the responsibility of the Infrastructure Managers and the Railway Undertakings.
- To improve the implementation of maintenance systems for freight wagons under the responsibility of the Entities in Charge of Maintenance.

There is no need to amend the current EU legislation for implementing these actions as the corresponding basic requirements have already been introduced in the EU legislation. However the Agency assessed that a better implementation of the current requirements by the responsible actors would significantly reduce the risks of freight train derailments, including the risks related to the transport of dangerous goods.

It is often a common reflex to try to reduce risks with technical measures (e.g. new safety device, new product design…) while the basics of the safety management systems may not be fulfilled. This phenomenon should be avoided. Instead, it is the objective of safety management systems to identify the priority measures for safety improvements and developments at company level, such measures not necessarily corresponding to the adoption of a new technical measure.

Nevertheless, some technical measures have been assessed as efficient safety improvements at EU level, at short and medium term, as follows:

- The use of Wheel Load Detectors & Wheel Impact Load Detectors for preventing the derailment causes in relation with wheel defects and with incorrect loading, over-loadings and skew loadings,

- The use of Bearing Acoustic Monitoring for preventing bearing failures at an early stage,
- The use of Bogie Hunting Detectors for preventing the derailment causes related to underperforming bogies,
- The increased use of polyamide roller cages instead of brass roller cages for reducing number of axles ruptures due to hot boxes.

An important point needs to be clear at this stage. The technical measures listed above are some possible efficient improvements achievable in addition to existing measures. It does not mean that the measures already applied today are useless, on contrary they are contributing to the current level of safety. For example, the use of hot axle box detectors already contributes significantly to the prevention of derailments in the current railway system. This is the reason why a new measure consisting to use even more hot axle box detectors at EU level is not assessed as the best achievable improvement, hot axle box detectors being already extensively used in EU for achieving the current safety level.

Another point needs also to be clarified concerning the current implementation of the EVIC measure (European Visual Inspection Catalogue) by the sector. The Agency has assessed that the EVIC measure is far less efficient than the most promising improvements for reducing the risk of freight train derailments. Therefore the Agency recommends the sector to re-consider its strategy for reducing the freight train derailments risks in the light of the finding reported in the present report.

Nevertheless, the Agency considers that there is no reason to make one or another of the technical measures assessed in the present report mandatory at EU level. This is justified as follows:

- It might be an unbalanced action towards the railway freight transport if we compare the level of safety achieved by the railway transport mode in comparison with the road transport mode,
- The present report did not assess country specific or company specific improvements, therefore the Agency can only draw conclusions on EU harmonised measures,
- If one of the measures listed above is already extensively applied in a country or by a company, the remaining room for improvement would be very low in this country or for this company,
- The fact that the measures listed above have been assessed as cost-effective at EU level should be sufficient incentive for the concerned actors for evaluating their own potential safety improvements in using one or another of these measures, if it is relevant in their context.
- The measures listed above should be considered at company level, together with any other potential measures which would be identified as the most efficient one through the correct implementation of the safety management system. In other words the correct use of safety management systems must target the most efficient risk reduction measures for each given Infrastructure Managers and Railway Undertakings under their respective responsibilities.

Concerning the question of the potential use of the derailment detection in the EU railway system, the Agency reiterates its recommendation issued in 2009. The derailment detection should not be introduced in RID. This recommendation is reinforced today at least for the two following reasons:

- The present reports shows that there are other measures (organisational, operational and technical) immediately applicable which are more effective and more efficient for reducing the risks of freight train derailments at EU level, including the risks related to the transport of dangerous goods,
- It would be a discriminating action to make the derailment detection mandatory at EU level, while other technical measures currently existing on the market are assessed as being more efficient for reducing the risk related to the transport of dangerous goods, and for reducing the risks related to the railway freight transport in general.

In addition the Agency would like to points out that dangerous goods wagons non-equipped with derailment detection should not be prevented to operate in countries which would recommend its use.

Finally, opportunities for the long term, have been identified for further reducing the occurrence of freight train derailments which also could help to achieve the railway objectives set out in the White Paper concerning the development of a Single European Transport Area.

These measures are not practicable today but some of them are already considered or should be considered in research projects. In this field the Agency recommends to further study and develop the identified measures in the relevant forum and to monitor the progress achieved within 3-5 years.

The development of the above conclusions have been supported by a detailed assessment of potential risk reduction measures carried out in the Study mandated by the Agency to Det Norske Veritas Ltd. (DNV) from which the reports have been made publicly available on the Agency web-site.

The Agency reviewed the findings reported by DNV and drawn its own conclusions taking into account the potential developments of the EU legislation and other additional information. In particular, the Agency took into account the available results from the Task Force on freight wagon maintenance established after the Viareggio accident.

During the whole process of development of the Agency’s conclusions the Agency took great care of surveying all the interested parties through collections of relevant information and also offered regular information to these parties, in particular in organising two dedicated workshops in May and September 2011, as well as in regularly reporting information on the work progress in relevant meetings.

Doing so, the Agency regularly received comments from interested parties during the process of development of the present report which contributed to draw well-informed conclusions.

1. INTRODUCTION

By end 2009, The European Railway Agency (the Agency) has been mandated by the European Commission to study the possibilities for efficiently reducing the risks related to the freight train derailments in EU.

This mandate was based on the Joint decision of the Railway Interoperability and Safety Committee and of the Committee on Inland Transport of Dangerous Goods.

In particular the Agency was requested to study all possible preventing measures which would lead to a more efficient risk reduction than the mitigation of derailments based on the immediate detection of occurred derailments.

The Agency was also requested to further study specific issues concerning the derailment detection in addition to the impact assessment and the recommendation addressed by the Agency to the European Commission in May 2009.

Due to the amount of the work to be carried out for studying all potential preventing measures, the Agency mandated Det Norske Veritas Ltd, as the results of an open European tendering procedure, for establishing a list of the possibly most efficient risk reduction measures at EU level. The Agency requested DNV to applied well recognised methods on risk analysis, risk assessment and cost-benefit analysis for assessing all the measures. As a result, DNV proposed a list of promising measures which were considered as an input to the Agency assessment reported in the present document. Other inputs were also considered as they have an influence at short, medium or longer terms on the risk reduction of freight train derailments.

In summary, the main inputs of the present report are the following:

- the current EU railway legislation, and the objectives set out by the European Commission in the White Paper on Transport,
- the relevant statistics on railway accidents, including a comparison with the road transport,
- the findings reported in the DNV's study,
- the comments received by the Agency on the DNV's study,
- the current results of the Agency Task Force on Wagon Maintenance, and,
- the comments received by the Agency from representative European associations on the draft version of the present report (see section 3.3. to be completed)

The present document reports the Agency's findings, comments and conclusions, taking into consideration the inputs listed above and their possible influence on the further actions for reducing the freight train derailment risks, at short and medium term.

Finally the Agency recommends actions which should be considered for the short and medium term and lists some opportunities which are currently examined or which should be examined in the longer term.

2. MANDATE AND PROCEDURE

2.1 Mandate

Following the joint position of the Railway Interoperability and Safety Committee (RISC) and of the Inland Transport of Dangerous Goods Committee (ITDGC), the Agency has received the mandate from the European Commission [9] to undertake the following tasks:

- Task 1:
  "*Study on derailment preventive measures (which would lead to better impact assessment results)*"[1].
- Task 2:
  "*Study on the impact of false alarms and the level of reliability that should be imposed for the derailment detection device (DDD)*".
- Task 3:
  "*Market research on products that meet the DDD provision in its current version (and/or in the version modified)*".
- Task 4:
  "*Study on the impact of automatic braking in tunnels/bridges*".
- Task 5:
  "*Additionally, the TSIs need to be revised in order to include the technical requirements of such devices*[2]*… …and the corresponding conformity assessment/verification procedures*".

In response to this request, the Agency has prepared the present report which contains an analysis of potentially efficient[3] measures for preventing freight train derailments in EU and a specific analysis of the derailment detection issues.

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[1] The text in brackets means: preventive measures which would lead to better impact assessment results than the derailment detectors (DDD) studied by the Agency in its 2009 impact assessment [11]

[2] 'such devices' means either a derailment detection of the same type than the 'DDD' studied by the Agency in 2009 or other types of derailment detections.

[3] In the context of the present report the following definitions apply:

Effectiveness means the extent to which options/measures achieve the objectives of a proposal.

Efficiency means the extent to which objectives can be achieved with options/measures for a given level of resources/at least cost (cost-effectiveness).

In its conclusion, the present report provides recommendations to the European Commission for efficient measures reducing the freight train derailment risks at short and medium terms. It is also suggested to further assess some measures which might be efficient at longer term.

2.2 Development process of the present report

Tasks 1 and 3:

Considering the amount of work for assessing all potential measure preventing the freight train derailment risks the Agency decided to organise the performance of the tasks with the support of a consultant.

After an open procedure [24], the Agency contracted a study with Det Norske Veritas Ltd (DNV) which provided support to the performance of the tasks 1 and 3 listed in the previous section.

As a results DNV delivered to the Agency a comprehensive assessment of potential prevention measures and established a list of the most efficient ones, including a comparison with the efficiency of the mitigation measure based on the derailment detection.

DNV reported the study findings in reports [25, 26, 27, 28, 29, 30, 31, 32, 33, 34] made publicly accessible on the Agency's website at the following address: http://www.era.europa.eu/Document-Register/Pages/Freight-train-derailments-relevant-documents.aspx.

The study reports contain the following information:

- Part A – Master report, [25]: Providing an overview of the collection of all relevant information necessary for the assessment of the risk reduction measures, sub-divided in the following specific reports,
    - A1 report [26]: Existing measures,
    - A2 report [27]: Markets for technical measures,
    - A3 report [28]: Functional and performance assessment,
    - A4 report [29]: New technologies and approaches.
- Part B – Master report, [30]: Providing an overview of the assessment of the potential risk reduction measures, including a ranking of the most efficient improvements achievable at short and medium term, sub-divided in the following specific reports,
    - B1 report [31]: Derailment risk models,
    - B2 report [32]: Risk model and potential effectiveness of measures, with its annex [33] on the analysis of derailment accidents,
    - B3 report [34]: Top ten ranking of safety measures.

Tasks 2 and 4:

Tasks 2 and 4 were performed by the Agency in parallel to the work performed by DNV.

Then findings resulting from tasks 1 to 4 have been analysed by the Agency and considered further as detailed inputs for the present Agency's report.

Task 5:

During the development of the present report, and after having considered all the available inputs, the Agency concluded that a mitigation measure based on derailment detectors currently existing on the market would not be efficient compared to the other studied options for reducing derailment risks at EU level.

Therefore the Agency considered that the task 5, focussing on the amendment of TSI in a view of integrating derailment detectors in the EU legislation was no longer relevant anymore.

Other inputs to the present report:

In addition to the work carried out in the above mentioned tasks, the relevant results from the **Agency Task Force on freight wagon maintenance**, covering specifically the maintenance issues of freight wagon axles, have also been considered by the Agency as an input to the present report. See section 4.4.

From all these inputs, and from information on the **past, current and future situation of freight train derailments in EU** described in section 4.1, the Agency has assessed the most cost-effective measures for reducing the risks of freight train derailments, in the short and medium term, taking also into account the foreseeable long term situation of railway freight transport.

Final version of the present report:

A draft version of the present report has been published for consultation and the Agency has considered the received comments for finalising the present report. The results of the consultation are summarized in section 3.3. In parallel the received comments have been forwarded to the European Commission for information.

In conclusion, the present report contains recommendations to the European Commission for efficiently reducing the freight train derailment risks in the short and medium term.

3. INVOLVEMENT OF INTERESTED PARTIES

The Agency considered from the beginning that it was crucial to perform a well-informed impact assessment and therefore to use all the possible ways to collect as much as possible robust information from the concerned parties.

The present section describes how the interested parties in the reduction of freight train derailment have been informed and involved during the performance of the present impact assessment.

3.1 Surveys

A large part of the resources offered to DNV for contributing to tasks 1 and 3 were allocated to an extensive collection of information that is relevant for the present impact assessment.

In particular, the DNV part 'A' study had the objective of identifying all prevention and mitigation measures that exist today or could be implemented within short or medium term.

For gathering this information DNV surveyed concerned parties. Information was received from the following States and organisations:

- Railway undertakings from 13 EU MS, and from Norway, Switzerland and USA,
- Infrastructure Managers from 15 EU MS, and from Norway, Switzerland and USA,
- 12 suppliers on 31 technological products used for preventing or mitigating derailments,
- CER, UIP and UNIFE,
- Research organisations and internet, as well as DNV's team knowledge.

As a result, DNV delivered the four following reports on collected data:

- A1 report [26]: Existing measures
- A2 report [27]: Markets for technical measures
- A3 report [28]: Functional and performance assessment
- A4 report [29]: New technologies and approaches

A master 'A' report [25], giving an overview of information collected in A1 to A4 reports has also been delivered to the Agency. All these reports are accessible to the following link:
http://www.era.europa.eu/Document-Register/Pages/Freight-train-derailments-relevant-documents.aspx

Ultimately, the A1, A2 and A3 reports were submitted to the review of independent experts. This review confirmed that the information collected by DNV were sufficiently exhaustive to valuably undertake the part B of the study.

3.2 Workshops

In order to regularly inform all interested parties on the DNV study on freight train derailments, the European Commission, in collaboration with the Agency organised two workshops in Lille, on the 6th of May 2011 and on the 29th of September 2011.

The first workshop was devoted to present the intermediate results obtained by DNV on part A of the study. The second workshop was focused on part B.

The following parties were invited to attend to the two workshops:

- MS representatives of EU Railway Interoperability and Safety Committee (RISC),
- MS representatives of EU Regulatory Committee on Inland Transport of Dangerous Goods (TDGC),
- National Safety Authorities,
- National Investigation Bodies,
- Railway Undertakings, Infrastructure Managers,
- Industry and Railway sector associations (including CEFIC, CER, EIM, ERFA, UIC, UIP, UIRR, UNIFE…)
- RID Committee of Experts on carriage of dangerous goods by rail.

Each workshop allowed valuable discussion with the audience (50 to 70 participants).

During these workshops DNV presented their findings and the audience was invited to discuss the results as well as to reports any comments or questions to the Agency.

The comments received by the Agency as a result of the workshop are presented in section 4.3.2. The Agency reports its views, where appropriate, in the following sections.

3.3 Informal consultation on the present report

In addition to the involvement of external parties during the process of development of the present report, the Agency offered representative European associations the opportunity to provide their comments on the draft version of the present report.

The draft version of the present report was sent to the following parties on the 20/01/2012: CER, EIM, ERFA, UIC, UIP, UIRR and UNIFE. This consultation finished on the 06/02/2012.

The Agency received comments from CER and UIRR which globally support the Agency's conclusions. Some detailed comments, which do not affect the Agency's conclusions, have also been transmitted to the Agency. The other consulted associations did not provided any comments, therefore the Agency has considered that they have, in principle, given their assent to the Agency's conclusions.

The Agency has addressed the final version of the report to the European Commission on the 17/02/2012.

3.4 Consultation of the EU Member States

As initially planned in 2009, it is foreseen that the European Commission will consult the EU Member States, on the basis of the present report, with the objective to update the EU position on the derailment detection.

4. INPUT INFORMATION TO THE IMPACT ASSESSMENT

4.1 (Latest) Evolution of freight train derailment risks

In 2009 [11] the Agency analysed both the amount of derailments (passenger and freight trains) reported by the Member States to Eurostat in 2006 in order to estimate the number of significant freight train derailments per year. As a reference for its impact assessment the Agency considered there were 300 significant freight train derailments per year based on 2006 Eurostat reporting. In addition, a survey of past freight train derailments in the EU, dedicated to better estimate the consequences of derailments (fatalities, track damages, wagon damages and accident costs), allowed the Agency to further estimate that the above mentioned 300 significant derailments corresponded to 50% of 600 derailments occurring per year in EU, half part of them being less than significant. In other terms only half of 600 derailments were reported to Eurostat in accordance with the applicable reporting (significance) criteria[4].

To date, we note an important decrease in derailments (both passenger and freight trains) reported by EU Member States for years 2007, 2008 and 2009. On this basis, if we consider the same approach than for the 2009 Agency's impact assessment [11] where only the data for the year 2006 were available, we should take in the present impact assessment a reference number of 78 instead of 300 significant freight train derailments.

	2006	**2007**	**2008**	**2009**	**2010**	**2011**
Significant derailments : Passenger + Freight						
Derailments of both passenger and freight trains Eurostat (EU-27)	**549**	452	247	141		
Derailments of both passenger and freight trains CSI (EU-27+NO+CT)	477	346	319	177		
Significant freight train derailments						
Assumption in ERA IA 2009 [11] (55% of all derailments reported in Eurostat are assumed to be significant freight train derailments)	**300**	*249*	*136*	*78*		

However, the numbers of derailments reported in 2009 (and 2008 to a lesser extent) should be treated with caution (grey cells). Effectively, in 2007, the threshold for reporting accidents changed: the threshold of EUR

[4] Eurostat reporting threshold fixed at 50,000 euros of damages.

50,000 of damage increased to EUR 150,000 in line with the UIC recommendation. As a consequence, the number of derailments reported to Eurostat in 2008 and 2009 reduced considerably.

Similarly, a more stringent definition of a significant accident was introduced by the Railway Safety Directive (2004/49/EC) and the Directive 2009/149/EC has been gradually put in place by several Member States since 2006, leading to the distortion of the picture depicted by the reported figures.

In this regard, several countries used to report shunting movements, most of them being not reported any more in Eurostat or in the CSIs as the cost of damages is often amounting to less than the applicable 150,000 euros reporting threshold.

Beside the changes in reporting requirements, it should be noted that the EU aggregate available at the Agency is strongly influenced by the high figures reported by Poland and France, accounting together for more than half of all derailments in the EU. These numbers are very high when compared with figures in countries with comparable train-km performance such as Germany, UK or Italy and suffers from important fluctuations over time. Reflecting the Agency's position Eurostat advised us that "More particularly, the EU aggregate is especially influenced by the Polish figures, accounting for 40-45% of the total number of derailments observed at EU level. Poland has reported a significant decrease over the 2007-2009 periods, and this had consequently a significant impact at total EU level."

And Poland advised us that "…the improvement was illusionary. The explanation is the change of derailment categories (according to current regulations)."

This issue was considered by the Agency and discussed with DNV in order to keep the possibility for comparing the results reported in the Agency's impact assessments, in 2009 and in the present one, as well as with the results reported by DNV.

Therefore the reference number of freight train derailments, used as an input for estimating the impacts of derailments, their costs, and the potential for risk reduction, has been fixed at 500 for the present impact assessment. The Agency advised DNV to use a reference value of 500 derailments per year as an input to their risk assessment and cost/benefit analysis.

Reference year	**2009** Assumption in 2009 ERA's Impact assessment report [11]		**2011** **Assumption for DNV study and for the present ERA Impact Assessment - 2011**	
	Less than significant	More than significant	Less than significant	More than significant
Reference number of freight train derailments considered in the risk assessment model for EU 25	300	300		
Total	600			

Reference number of freight train derailments considered in the risk assessment model for EU 25			204	296
Total			500	

Nearly half of the (500) reference freight train derailments are considered to be less than significant according to the old Eurostat definition (50,000 euros threshold). This is reflected by the results provided in B2 report [32] which estimated at 204 (non-significant) derailments that are detected and brought to a safe stop within the 500 derailment reference number.

The Agency received a comment from CER stating that this reference value would be too high and would not reflect the actual level of freight train derailments in EU. A detailed answer too this comment is provided in section 4.3.3.2.

In principle the Agency agrees that the trend is likely to be a reduction of freight train derailments; however the reference number of derailments used in the risk assessment model must neither be compared with the Eurostat data nor with the CSI's data as they do not use the same reporting definition.

Also the Agency preferred to adopt a conservative approach, i.e. possibly overestimating the impacts of freight train derailments in EU.

However, even if the actual number of derailments would be lower than the reference number considered in the DNV study and in the present impact assessment, the Agency has taken into account the potential impacts of this issue on the interpretation of the DNV's study results as follows:

- The ranking of the measures is not affected, both in terms of fatality reduction and of cost-effectiveness.
- The cost-effectiveness of all the measures assessed by DNV might be lower than the estimated one. This is explained by the fact that if the actual number of derailment is lower than the one assumed, then there is less benefits for putting in place risk reduction measures.

The Agency takes into account these potential effects when interpreting and using the results reported by DNV in the present impact assessment.

4.2 Current situation of freight train derailment risk

Railway freight accidents and freight train derailments statistics

According to Eurostat data, 2,601 railway accidents (including both passengers and freight trains) occurred in EU-25 in 2009 [46]. As shown in Figure 1, the derailments of both passenger and freight trains represented 5.4% of reported accidents in 2009.

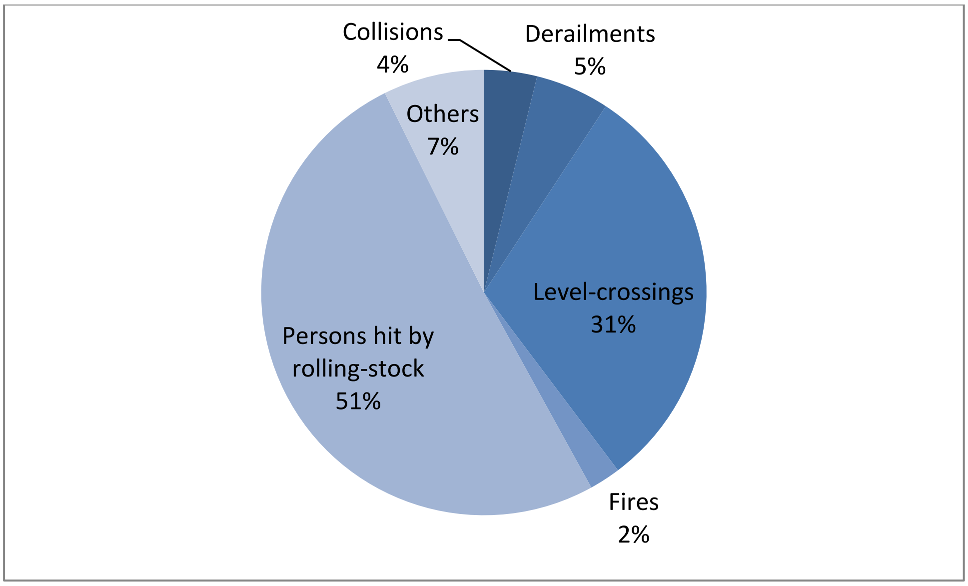


Figure 1: Breakdown of railways accidents in EU-25 per type of accident in 2009

Unfortunately the Eurostat database does not allow the separation of the statistics for freight trains from passenger transport. Therefore an assumption on the breakdown of freight train accidents must be introduced here. Using an analysis of past derailments the Agency established in [11] that around 65% of all derailments are freight train derailments. This assumption was also used by DNV in [30] and is used in the present report.

Under this assumption the present analysis leads to the conclusion that, even if we include in the statistics the fatalities resulting from freight train catastrophic derailments (Viareggio), the **yearly average number of fatalities resulting from freight train derailments in EU-25 amounted to 3.9 fatalities per year in the period 1980-2009.**

It must be noticed that this figure has significantly increased in 2009 due to the inclusion of victims resulting from the Viareggio accident. Over the period 1990-2005 the yearly average number of fatalities resulting from all accidents involving dangerous goods trains is estimated at 1.7 fatalities per year. Moreover, according to the accidents recorded in the ERA Archive database [35, 47] only few railway accidents resulted in a release of the dangerous substance carried.

Nevertheless, in order to be conservative, the present impact assessment assumes a yearly average number of fatalities resulting from freight train derailments of 3.9 fatalities, composed as follows:

- 3.7 fatalities per year due to the impact of dangerous goods involvement (95%).
- 0.2 fatalities per year due the (mechanical) impact of derailments without involvement of a dangerous goods substance (5%).

Comparison of railway transport safety with road transport[5]

As a comparison it is interesting to be aware of the human risk levels in the road transport (EU-25), as follows:

- Road accident fatalities amounted to 31,103 in 2009 [40] - substantially higher number than railway accidents which amount to 1,250 fatalities in 2009 [41],

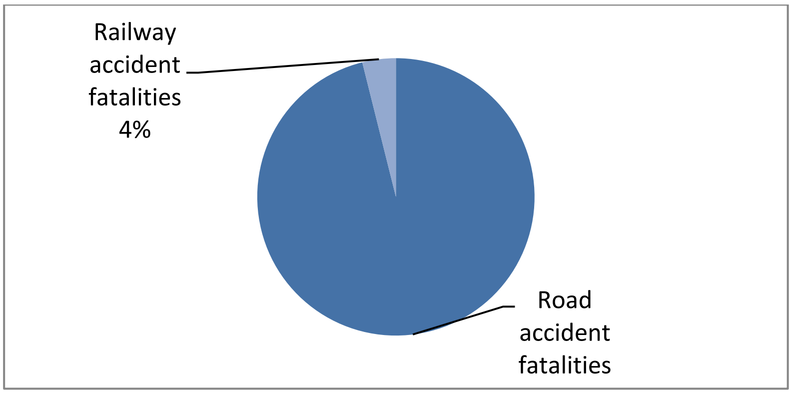


Figure 2: Fatalities in road transport and rail transport EU-25 in 2009

Within this overall picture the comparison of safety in freight transport by road and freight transport by rail shows the following statistics:

- Road fatalities in accidents involving heavy goods vehicles (HGVs > 3.5 ton) are estimated as 5,322 in 2008 from data reported in [42][6] and [45]. One can estimate that at least one third of them could be directly related to the truck behaviour (problem on the truck or driver behaviour).
- In comparison, the comparable number of fatalities in freight train accidents amounts in average to 10 per year for the period 1990-2009.

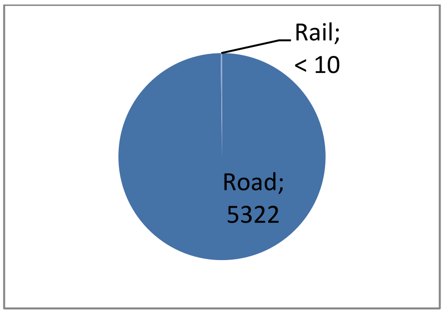
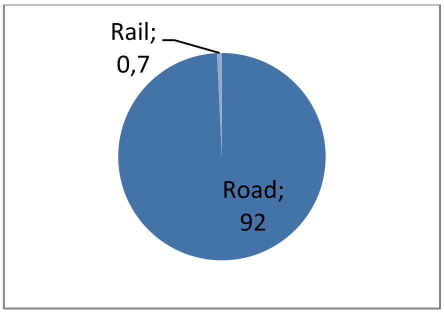


Figure 3: Number of fatalities due to road and rail freight transport – EU-25

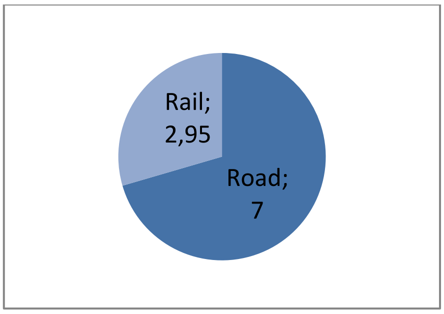
[5] The comparison between modes based on data reported in 2009, is also valid in general as the general conclusions are unchanged when using available data from 1990 to 2009.

[6] Estimate of fatalities number in EU-25 based on data reported for EU-23.

- Road fatalities from accidents involving heavy good vehicles transporting dangerous goods can be estimated from [43][7] and [44] as amounting to at least 80-100 fatalities per year,
- Road fatalities from accidents involving heavy good vehicles in which the transported dangerous good substance is involved is estimated from [43][8] and [44] to amount to at least 6-10 fatalities per year.



A) Fatalities due to mechanical impacts



B) Fatalities due to the involvement of the substance

Figure 4: Estimates of the yearly average number of fatalities in road and rail transport of dangerous goods – EU-25

In comparison the rail mode represents a lower risk level for EU citizens than the road mode for carrying dangerous goods.

This situation is confirmed if we consider the rate of fatalities per million tons kilometres of dangerous goods transported. One can derive from the same set of data that the dangerous goods freight risk is estimated to 1.2 10^{-3} fatalities per million tons kilometres for the road mode and to 0.05 10^{-3} fatalities per million tons kilometres for the rail mode, i.e. the railway dangerous goods transport is estimated to be 24 times safer than the road transport of dangerous goods.

There is also another important difference between road and railways concerning the transport of dangerous goods concerning the fatalities' causes.

The road transport of dangerous goods suffers from a large amount of fatalities caused by the accident itself (mechanical impact). Each year the loss of life only due to crashes involving trucks carrying dangerous goods (without substance release) is estimated to be equivalent to three 'Viareggio accidents'. Sometimes the release of the substance leads in addition to catastrophic impacts. As an example, in 1978 the road tanker catastrophic accident in Los Alfaques resulted in 217 fatalities and 400 injuries.

[7] Estimate of fatalities number in EU-25 based on DG Tanker accidents reported by FR from 1998 to 2009 and dangerous goods traffic data in EU.

[8] Estimate of fatalities number in EU-25 based on DG Tanker accidents reported by FR from 1998 to 2009 and dangerous goods traffic data in EU.

On contrary, in railway freight transport, very few fatalities have been caused by the accident itself (crash) and only few catastrophic accidents involving the dangerous goods have happened since 1990, the Viareggio accident (32 fatalities) being the most severe accident known since that date.

As a preliminary conclusion, the present analysis clearly shows that any measure on freight railway safety must be economically practicable. Because, in case the effect of a measure on the rail transport of dangerous goods would reduce the competitiveness of the rail service then it may directly create a shifting of railway traffic to road traffic and in turn increase the risk level for EU citizens.

In relation with the topic discussed above the Agency has received the following comments:

- (Rail Cargo Austria) – most of freight train derailments are harmless, efforts should be devoted to the prevention of derailments ; any measure which would affect the economic competitiveness of rail sector would have a negative impact on transport safety due to induced shifting of rail transport to road transport.
  a) Considering the analysis reported above on the current situation of freight train derailments in EU, the Agency fully agrees the comments reported by Rail Cargo Austria.

4.3 Results from the study by Det Norske Veritas Ltd. (DNV)

4.3.1 Conclusions of DNV's study

As a final result the DNV's study identified a top ten ranking of the most efficient short and medium term measures.

As general information, the Agency quotes hereinafter the conclusions reported by DNV in its final part B report. However the Agency invites the reader to directly consult the DNV's reports for more detailed information. These reports are publicly accessible on the Agency's website at the following address: http://www.era.europa.eu/Document-Register/Pages/Freight-train-derailments-relevant-documents.aspx

(source [30])

"…

0.4 Study Conclusions

0.4.1 Opening Remarks and Context

It is important to clarify that this report looks at the ***potential for improvement***, and is not an absolute assessment of the efficiency of all measures that are applied today. Therefore it follows that if a measure is applied extensively already there is little room for improvement through the further application of that measure. For this reason some measures that are extensively applied already are not considered in this work. Their omission should not be considered as suggesting such measures are not efficient.
In this context the measures listed in this section can be seen as efficient in addressing the

potential reduction in risks associated with freight train derailments and providing the detailed background against which public policy can be formulated.
The assessment of measures does not consider the way or the order in which these interventions should be pursued, for example it is not considered whether these interventions should be introduced in a mandatory or voluntary way or whether the measure should be introduced as an EU harmonised measures or only within certain member states or only certain companies.

0.4.2 Efficiency Assessment of Measures

0.4.2.1 Technical Preventative Measures

We consider the following technical measures as being efficient (they have a positive or unity benefit / cost ratio in our reference case and all sensitivity studies):

- P13-Wheel Load Impact Detectors / Weighing In Motion (a measure that addresses a number of common freight train derailment causes such as wheel defects, loading anomalies).
- P28-Replacement of Brass for Polyamide Roller Cages (a measure that addresses hot axle box caused freight train derailments).
- P15-Bogie Hunting Detectors (a measure that addresses problems associated with lateral instability, caused by wheel or other defects).
- P11-Bearing Acoustic Monitoring (a measure that addresses hot axle box caused freight train derailments).

Considering measure P28, we have considered an immediate replacement of brass for polyamide roller cages. We have also discussed an alternative option which is for the replacement of brass for polyamide roller cages at the next scheduled maintenance interval for axles / axle boxes. This is almost a zero cost option, although the benefits would take longer to materialise, and be a function of the maintenance cycle for freight wagons.
Potential drawbacks to the use of these measures (excluding measure P28) relate to the rate of false alarms. To some extent these can be overcome by the use of good alarm management processes. Further false alarms from those technical measures that are based on early defect detection are unlikely to have an immediate operational impact.

In addition the following two measures are efficient based on the parameters in our reference case:

- F7-Sliding Wheel Detectors (a measure that addresses problems associated with handbrakes which may be left on, seized axles and similar events).
- P16-Wheel Profile Detectors (a measure that addresses problems associated with wheel defects).

Potential drawbacks include false alarms as reported above. Finally, measure F7 is to the best of our knowledge a market with only a small number of suppliers. This may give rise to market advantage to existing suppliers of these systems if they were to form the basis of formal recommendation.

…

(source [30])

0.4.3 Technical Mitigation Measures

We consider the following mitigation measure as potentially efficient if the significant identified drawbacks could be solved:
• M1a-Derailment Detection (with automatic brake application) applied to All Freight Trains
This present assessment is fully in line with the previous assessment made by the Agency [4]. The significant drawback previously identified is confirmed by the present study and the related accident analysis. A false alarm of such a device may lead to train compression which is a contributory cause of freight train derailments (and also a significant operational disruption). In this respect we note that CSM Regulation[9], Annex I, point 2.5.4 states:
For technical systems where a functional failure has credible direct potential for a catastrophic consequence, the associated risk does not have to be reduced further if the rate of that failure is less than or equal to 10-9 per operating hour.
(Measure P1: Check rail has similar disadvantages, although this is not considered efficient by our assessment.)
Finally, we acknowledge an alternative type of derailment detection device which provides an alarm to the train driver when a derailment is suspected, but without an automatic brake application (type M1b). We are however not aware of these being available on the market (for freight application). We consider that an assessment of these devices, considering the human factors issues involved and their costs would be required before these could be formally assessed.

0.4.4 Organisational Measures
We note that the measures above are technical measures that are aimed at addressing, in some cases, organisational problems. Therefore we would add the following organisational and supervision items:

• F-2: Awareness Programme for Rolling Stock Maintenance. This measure may serve to address the problem of poor maintenance standards of rolling stock. This may include training that sought to concentrate on main rolling stock maintenance derailment causes (which can be extracted from our task report, [3]) and best practice. This measure may be followed by increased supervision of these parameters by NSAs to ensure that practicable risk reduction objectives are being applied.[10]
• P-18: Track Geometry (all tracks). Although the case for improvements in this area are not conclusively made from a quantified perspective, the problem of poor track geometry (in particular track twist), and the possible requirement to improve this aspect just to maintain current performance levels (see Section 9.3.1) should be considered. This is of course an area for each IMs own management system. However a specific measure in this regard must be concerned with increased supervision of these parameters by NSAs to ensure that practicable risk reduction objectives are being applied.[11]
The two measures above represent significant contributors to the derailment problem and organisational failures of individual IMs and RUs in fulfilling their obligations.
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(source [30])

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[9] For correct reading of DNV conclusions the Agency clarifies that DNV refers to the CSM Regulation on Risk Evaluation and Assessment.

[10] The Agency dealt with the application of supervision regime in sections 6.4.2 and 6.5.2.

[11] The Agency dealt with the application of supervision regime in sections 6.4.2 and 6.5.2.

The details concerning the method and assumptions used by DNV's to come to the above conclusions are reported in reports which have been made publically available on the Agency's website at this address:

http://www.era.europa.eu/Document-Register/Pages/Freight-train-derailments-relevant-documents.aspx

4.3.2 Comments received by the Agency on DNV's study

As requested by the Agency, we receive a list of comments either concerning directly the study carried out by DNV or more general comments. In general the comments show that there is a general agreement that the study is considered as a good study.

Considering some measure-specific comments, some misunderstanding of the methodology or some questions have been expressed.

The following parties have sent specific comments which are summarized by the Agency as follows:

- **16-05-2011 - Rail Cargo Austria**, considering that most of freight train derailments are harmless and that efforts should be devoted to the prevention of derailments, reminding that EVIC measure was implemented in 2010 for preventing the main cause of severe derailments which is broken axles, mentioning that they have good experience with P28 (Replacement of brass roller cages by polyamide ones), reminding that derailment detection would only have the possibility to reduce the impact of some derailments but not all, considering that any measure which would affect the economic competitiveness of rail sector would have a negative impact on transport safety due induced shifting of rail transport to road transport.

  The Agency commented these comments in sections 4.2, 4.3.2, 6.1.2, 6.5.3 and 6.5.4.

- **03-10-2011 - French NIB**, commenting the assumption made on the implementation scope of additional Hot Axle Boxes (measure P10) in EU and proposing another implementation strategy, asking for a clarification on the implementation scope proposed for measure P28 (Replacement of brass roller cages by polyamide ones), questioning the implementation scope of measure F7 (Sliding wheel detectors).

  The Agency commented these comments in sections 6.3.6 and 6.5.3.

- **10-10-2011 – Belgian ECM – SNCB Technics**, expressing the need for a more in depth assessment of measure P28 (Replacement of brass roller cages by polyamide ones),

  The Agency commented this comment in section 6.5.3.

- **11-10-2011 – UIC** – commenting that the efficiency of the measures studied by DNV may differ following countries due to potential specificities in regards national breakdown of causes, concerning the lack of explanations concerning the potential extension of derailment detectors implementation scope to all dangerous goods wagons or to all freight wagons, questioning the potential effectiveness of the measure P13 (Wheel load impact detectors/Weighing in Motion) when applied to tank wagons,

The Agency commented these comments in sections 6.1.1, and 6.3.2.

- **12-10-2011 – Knorr Bremse**, considering that the study reports reasonable assessments, however considering that the drawbacks of the measures other than the one of the derailment detectors (measure M1-a) have not been assessed[12], mentioning that no false alarms have been reported since 2004 with the new detector's version (EDT 101), and considering that a derailment detector acts in the same way than an emergency brake initiated by a locomotive driver. Knorr Bremse informed also the Agency that 56 false-alarms occurred with the old type (EDT 100) derailment detector but none of them caused a derailment. However Knorr Bremse recognises that the data base on false-alarms is very small, so real statistics are not possible.

  The Agency commented these comments in section 6.1.1.

- **12-10-2011 – Danish NSA**, considering that the study is of high quality, reminding that the issue of tunnels (including tunnels under water) must be carefully examined which is not the case in the study, and considering that the way an alarm reported by a derailment detection should be handled (possibilities – limitations) should be clearly defined in case this measure would be made mandatory,

  The Agency commented these comments in section 6.1.2 – 4).

- **12-10-2011 – RID working group on Tank and Vehicle Technology** (RID WG-TVT),
  As a working group most the comments already reported in the present section (from UIC, UNIFE/Knorr-Bremse, Belgium/measure P28) have also been expressed in the minutes of the 12th working group meeting. Other more general comments concerning the studied application scopes of the derailment detectors in relation with the cost-effectiveness, and also nature of causes targeted by the different measures (infrastructure vs wagons) were also reported.

  The Agency commented additional comments to UIC, Knorr-Bremse and Belgium in the section 6.1.1. Please, see also Agency's comments to UIC, Knorr-Bremse and Belgium comments.

- **14-10-2011 – Switzerland – Federal Office for Transport**, concerning derailment detectors (M1-a) including also consideration on national versus international benefits of measures considered in the study, considering the possible extension of the application scope for derailment detectors in Switzerland, concerning the DNV remark on the potential combination of measure P10 and measure

[12] The Agency remarks that all the measures have been fairly assessed in terms of drawbacks by DNV, for example please see section 10.1 of DNV report B3 which summarises drawbacks for measures P1, M1, P11, P13, P15, P16, P10&P12, F7.

P28 (Replacement of brass roller cages by polyamide ones) and, stressing the importance of the future networking of data reported by wayside train monitoring systems for preventing derailments.

The Agency commented these comments in a footnote and in sections 6.1.2, 6.3 and 6.5.3.

- **17-10-2011 – Finnish NSA** – concerning the percentage of third country wagons operated in Finland for the transport of dangerous goods, questioning the comprehensiveness of the tests of the derailment detectors under severe winter conditions, being against the mandatory application of derailment detectors whatever the application scope, and supporting the prevention of derailments, in particular in preventing operational causes, failures in maintenance of rolling stock and infrastructure with more mature risk avoidance methods and culture.

  The Agency commented these comments in a footnote and in sections 6.1.2 and 6.2.

- **21-10-2011 – CER** – concerning the overall number of derailments per year in EU, the average breakdown of causes in EU which do not reflect national specificities, doubts concerning the cost benefit evaluations and in turn DNV's conclusions, and some specific comments concerning measure P28 (Replacement of brass roller cages by polyamide ones), measure P15 (Bogie hunting detector), the difficulties for implementing wayside infrastructure monitoring. Recommendations and examples are also provided by CER.

  The Agency commented these comments in sections 6.1.1, 4.3.3.2, 6.3.5 and 6.5.3.

- **21-12-2011 – Italian NSA** – supporting the prevention of derailments, for example with measures P13 (Wheel load impact detectors/Weighing in Motion) and P10 (Hot Axle Boxes detectors) as well as supporting the mitigation of occurred derailments, for example with track-side derailment detection located before the entrance of tunnel/bridge sections and with "*retaining system of axles*" which in case of axle breaking can sustain the axles themselves on the wagon. In general, it is also suggested that the measures should not only target tank wagons but all wagons and to extend the DNV study scope with a further examination of all types of mitigation systems.

  The Agency commented these comments in sections 4.3.3.1, 6.3.2 and 6.3.6.

In the present report, the Agency introduces answers, clarifications or explanations where it is the most suitable for the readers' understanding. In this case the Agency clearly indicates to which comment it refers.

4.3.3 Use of the DNV's study results by the Agency

4.3.3.1 Integration of DNV's findings with other sources of information

The Agency has carefully read the reports performed by DNV and has tried not to report any misinterpretation in the present document.

The Agency has used the DNV findings for reviewing/re-assessing:

- The measures assessed quantitatively by DNV as being amongst the most promising measures,
- The measures assessed qualitatively by DNV as showing a clear potential in term of number of prevented or mitigated derailments,

In addition the Agency assessed the efficiency the EVIC[13] measure currently implemented and monitored by the Joint Sector Group, as a result of the work carried out by the Task Force on Freight Wagon Maintenance (see section 6.5.4).

The Agency also assesses measures which could be improved and new measures which could require longer term developments and which have a potential positive impact on the achievement of EC policies, in particular:

- The measures which are already covered by the current EU legislation,
- The measures which would support the achievement of EU policies' objectives, including the White Paper on Transport [14].

Concerning the general content of the DNV's study, the Agency received the following comments:

- (Italian NSA) – Study scope should be extended to all measures mitigating the impacts of occurred derailments.

  Agency position:

  a) In principle, the Agency agrees that some mitigation measures could be of interest but the prevention measures should be the priority, in accordance with the Railway Safety Directive.
  b) This is the reason why the scope of the mandate addressed by the European Commission to the Agency requested to study all possible prevention measures while in the field of mitigating measures the mandate covered only the issue of the derailment detection.
  c) Nevertheless the Agency requested DNV to identify other potential mitigating measures. DNV identified 13 mitigating measures (M-2 to M-13 and F-9) in addition to the detection of derailments, as reported in [25], but did not assess these measures in detail in line with the specification of the study.
  d) The Agency shares the Italian NSA's view that some of identified mitigating measures could be of interest as a supplement to prevention measures and could be further assessed in a future study. In particular:
     - Use of M-7 measure could correspond the measure "*track-side derailment detection located before the entrance of tunnel/bridge*" suggested by the Italian NSA,
     - Use of M-4 measure (to be checked) might correspond the objective of "*retaining system of axles*" suggested by the Italian NSA
  e) In addition, and considering the potential cause of the puncture of the tank in the case of the Viareggio accident, the F-9 measure (harmless infrastructure), should also be considered.

[13] EVIC: The European Visual Inspection Catalogue which defines an EU harmonised procedure for the visual inspection of freight wagon axles.

4.3.3.2 Use of quantified assessment carried out by DNV's

For getting an understanding of the potential risk reduction impact of each measure, the Agency reports, for information, the potential number of prevented or mitigated derailments (noted as '*ref. value*' hereinafter) estimated by DNV.

Concerning these figures, derived from the overall reference number of derailments per year in EU and from the average breakdown of freight train derailment causes in EU, the Agency considered the following comments:

- (CER comment) - Too high number of freight train derailments in EU assumed by DNV

  Agency position:

  a) The Agency has re-assessed the overall number of freight train derailments in EU in section 4.1 of the present report. The Agency agrees that it might be possible that the overall number of derailments taken as the main entry data in the DNV assessment models might be too high. However the Agency preferred to keep a conservative approach in order not to minimise the freight train derailment risks without firm evidence that the number of derailments has actually dropped off during the last three years.

  b) In case a lower reference number of freight train derailments in EU would have been used by DNV for the calculation of risk reduction estimates it would not affect the ranking of measures as it has a proportional impact for all the assessed measures.

  c) In case the actual number of freight train derailments in EU would be lower than the reference used by DNV it would mean that a lower risk reduction potential might apply and that the cost-benefit indicators would be worse than those reported by DNV.
  In consequence, it means that only clearly cost-effective measures would be advisable.

  d) The sensitivity analysis made by DNV allows clearly identifying the measures which stay cost-effective even when their assumed benefits have been reduced (See DNV - B report [30] – Table 29 – Minimising parameters). From this point of view the Agency notes that the measures P-13 stay cost-effective at medium term (10 years) even if reduced benefits are assumed. P28, P15 and P11 would only stay cost-effective at longer term (20 years).

  e) The Agency has noticed that the reference number of freight train derailments in EU might be lower than the one used by DNV, and has taken into account the potential influence of this issue when drafting the present report.

- (CER comments) – CER strictly refuses any calculation without comparison and extrapolation to axle-kilometres per year, because without any train, the amount (*of derailments*) would be also zero.

  Agency position:

  a) The DNV's study bases its assessment on the current level of derailments in EU, considering the current EU railway traffic level, and analyses the potential for improvements (derailment risk reduction measures) on the top of the current measures in place.

b) Therefore the DNV's study assessed, as a snapshot, the most efficient ways for reducing the current risks of freight train derailments.

c) The Agency agrees that for medium and longer term measures the trends in EU railway traffic need to be considered. It is the reason why the Agency took into account several traffic scenarios when it drew the conclusions of the present report, including in the one hand, the effect of the current economic crisis on EU freight transport, and in the other hand, the objective to significantly increase the EU railway freight traffic as stated in the White Paper on Transport.

- (CER comments) - Average breakdown of freight train derailment causes in EU

  Agency position:

  a) In total DNV studied 556 past derailments:
     - 212 accident summaries from a range of European countries provided by the Agency.
     - 201 additional accidents reports collected by DNV, concerning derailments occurred in EU during the last ten years, and containing a description of causes.
     - 143 other detailed derailments' descriptions containing information on causes, provided by the French NSA in response to the Agency's survey carried out for the previous Agency's impact assessment in 2009 [11].

  b) From the two last data sets DNV established two independent breakdowns of derailment causes, the first representing an EU derailments data set, the second an FR derailments data set. DNV informed the Agency that the two independent breakdowns showed quite close results. Therefore DNV considered that adding more derailments in the analysis would not significantly change the EU average breakdown of causes and in turn would not significantly change the results of their study.

  c) The Agency considered that it was a reasonable assumption, as in principle it would mean that the breakdown was in fact representing the causes of 344 past derailments in EU, and also because the results would be used for drawing conclusions at EU level, but not at country specific level.

  d) Therefore, the Agency points out that the results provided by DNV must be considered for the purpose under which they have been established, namely as an EU average, and contrary of the way CER used the breakdown established by DNV, this breakdown should not be interpreted as reflecting a specific breakdown of causes in a specific country.

- (UIC and RID WG TVT comments) Country-specific breakdown of freight train derailment causes

  Agency position:

  a) The Agency agrees that the DNV conclusions concerning the most promise measure are to be considered at EU level but do not necessarily reflect potential country specific improvements.

  b) In principle this means that only few measures recommended by DNV could be the object of an EU wide recommendation.

c) However the DNV study offers a robust review of existing measures and potential improvement which should be used by the Member States, the IMs and the RUs for improving country-specific situations, where relevant.

4.3.3.3 Use of qualitative assessment carried out by DNV's

For getting an understanding of the potential risk reduction impact of each measure, the Agency reports, for information, the potential number of prevented or mitigated derailments (noted as '*ref. value*' hereinafter) estimated by DNV. This information is available both for qualitative and quantitative assessments made by DNV and allows the Agency to also consider qualitatively assessed measures in a balance way.

4.3.3.4 General Agency's appreciation of the results provided by DNV

Having taken into consideration the comments received, the Agency has the following general appreciations:

- The methodology used fulfils the requirements specified by the Agency in the tender's technical specifications.
- The methodology used corresponds to existing good practices in the fields of accident analysis, risk assessment, economic evaluation and impact assessment models.
- The data used as inputs to the different models has been collected through extensive surveys with a sufficient level of representativeness and allows for estimates which are sufficiently robust for drawing sound conclusions.
- The results provided by the study allow meaningful comparisons with the previous Agency's impact assessment [11].
- Considering the comments on the study's findings received at the request of the Agency after the 2nd Workshop or during the study development, there is a general agreement that the study is considered to be of good quality.
- The study can be used for drawing general conclusions, without amendments of the results concerning the quantitative ranking of measures for reducing the freight train derailment risks in EU. In addition the measures which have been qualitatively assessed are also to be considered for drawing well balanced conclusions without giving undue pre-valance to the quantitative assessments.
- The Agency confirms that the study reflects an assessment of potential measures applicable at EU level while it might not reflect correctly the potential improvements in a specific country of for specific company. It must be reminded that drawing country specific conclusions was not an objective for the study, in accordance with the study's terms of reference.

As a conclusion, the Agency believes that the risk reduction potential and the cost-benefit assessments established by DNV are sufficiently robust to allow for drawing conclusions at EU level in the present report.

For facilitating the reading of the present document, only the DNV's findings relevant for the Agency's assessment are reported in the present document.

4.4 Information from the Task-Force on freight wagon maintenance

The final report from the task force on freight wagon maintenance [13] reported in October 2010 that, besides other priorities, "*the EVIC and of the sampling will be the basis for the reflection about necessary future measures*."

Since that date the Joint Sector Group (JSG) reported detailed results on the on-going sampling programme which was devoted to assess the efficiency of the EVIC measure.

The results reported by the JSG on the 13th of December 2011 are following:

- EVIC measure allows to identify 2% of axles which fail to pass EVIC criteria,
- Among those 2%, around 6/1000 needs actually to be reformed according to further non-destructive tests (NDTs).

On the basis of the sampling programme the task force concluded that:

- Some axles that succeeded to EVIC do not pass successfully the NDTs. It means that the risks related to corrosion of axles cannot be reduced to zero when only EVIC measure is applied.
- Therefore the effectiveness of the EVIC measure is limited.
- The overall additional EVIC cost is roughly estimated by the JSG to amount to 135 euros per wheelset and per year. The JSG should further confirm this figure.

On the basis of currently available information the Agency puts forward the following cost-effectiveness estimation:

- There are currently around 1,800,000 axles used in the current EU wagon fleet,
- The overall cost of EVIC would then be around 1,800,000 x 135 = 243 million Euro per year,
- DNV estimated the EVIC measure potential (maximum) risk reduction to 66 derailments per year,
- Using the same method than DNV has used for monetising the risk reduction benefits, the Agency estimates that the B/C ratio (10 years) of EVIC measure would be 0.26, meaning that the EVIC measure would be far from being cost-effective,
- In addition the Agency remarks that the potential benefit would probably be in reality less than 66 derailments a year, as initially assessed by DNV, as the EVIC measure is not 100% effective and cannot identify all kinds of axle's failures.

To date the Agency concludes that the EVIC measure should not be a priority for reducing freight train derailment risk in comparison to other more efficient measures.

4.5 European Commission study on respective competence of EU Railway legislation and RID

As a result of the joint meeting of the Railway Interoperability and Safety Committee (RISC) and of the Inland Transport of Dangerous Goods Committee (ITDGC) in 2009, it was decided that the Commission services will undertake a study on "… *the comparison of the decision-making process in the context of the safety/interoperability directives and RID*".

The European Commission informed the Agency that this study will start beginning 2012.

Therefore the present impact assessment is not affected by potential changes in decision-making processes on safety related aspects. Here the current EU railway legislation framework applies, i.e. safety improvements and developments must be reasonably practicable as well as interoperable.

4.6 European Commission study on feasibility of harmonised risk acceptance criteria for inland transport of dangerous goods

As a result of the joint meeting of the Railway Interoperability and Safety Committee (RISC) and of the Inland Transport of Dangerous Goods Committee (ITDGC) in 2009, it was decided that the Commission services will undertake a study on "*the feasibility of harmonising risk acceptability* …for inland transport of dangerous goods".

The European Commission informed the Agency that a study has been included in the EC 2012 work programme.

Therefore the present impact assessment report does not consider the question of risk acceptability. The results of the present impact assessment are only based on facts, estimations and forecast of risk reduction potentials in combination with the potential costs of associated measures.

5. AGENCY METHOD FOR ASSESSING POTENTIAL RISK REDUCTION MEASURES

5.1 Definitions concerning the assessment

In the following sections some definitions are introduced in order to categorise and facilitate the description of each measures assessed by the Agency.

5.1.1 Risk Reduction category (of potential improvement/measure)

The potential derailment risk reduction measures at short and medium terms are presented under the following categories:

- Derailment detection (see section 6.1),
- Safety management system(see section 6.2),
- Operation (see section 6.3),
- Infrastructure (see section 6.4),
- Wagons (see section 6.5),

The reason is that each measure arranged in one of the category has the potential to reduce the number or the impact of derailments by acting on derailments causes related to either the (lack of) quality of the infrastructure, the wagons, the operations or the safety management system.

The findings reported in the DNV's Study and other relevant works are reported in the corresponding sections from a risk reduction point of view.

Potential longer term measures, other than those applicable at short or medium term, have been reported for information in section 6.6.

5.1.2 Time Scope category

As a requirement to DNV's Study the Agency introduced the need to have a clear understanding of the potential implementation time scope for each assessed measure. The meaning of allocating a potential measure in one of the time scope categories is the following:

- Short term:
  A measure which is possible to implement before 1st January 2013 and which would bring the assessed benefits within a short period of time,
- Medium term:
  A measure which is possible to implemented in 5-10 years and which would bring the assessed benefits within the same period of time,
- Long term:

A measure which is not possible to implement before 5-10 years, but which could be efficient after further developments, testing and/or further verification/validation.

5.1.3 Implementation scope category

The implementation scope must be distinguished from the above mentioned Risk Reduction category.

While the Risk Reduction category targets the derailment causes that are allocated to one or another subsystem the Implementation scope defines where the proposed risk reduction measure is implemented. For example the risk reduction of derailments due to hot axle boxes lies in the Risk Reduction category 'wagon' while the implementation of the measure can be either 'Infrastructure' if hot axle box detectors are installed on side-tracks or can be 'Wagon' if it refers to on-board hot axle box detectors.

The main categories considered for the implementation scope of the Risk Reduction measures are the following:

- Safety management system: The measure is implemented by Infrastructure Managers and Railway Undertakings in their SMS.
- Maintenance system: The measure is implemented by the Entities in Charge of Maintenance in their maintenance system.
- Operation: The measure is implemented by the Railway Undertakings in the area of procedures and rules for operations,
- Infrastructure: The measure is implemented by the Infrastructure Managers and requires investments in technical equipment installed on the railway infrastructure,
- Wagons: The measure is implemented by the Railway Undertakings and requires a change in the wagons design or the use of on-board equipment,
- Others: The measure is implemented by another stakeholder but the Railway Undertaking or the Infrastructure Manager.

5.2 Criteria concerning the assessment of measures

In this section the most important criteria for assessing if a given measure should be introduced in the EU legal framework are analysed. From this analysis the Agency considers that the most important criteria are the following:

a. Any new requirement which might be introduced at EU level must comply with the current general and specific requirements of the Railway Safety Directive (RSD) and of the Interoperability Directive (IOD),
b. When such a requirement specifically targets the operation of dangerous goods trains it must also comply with the general and specific requirements of the Inland Transport of Dangerous Goods Directive.

In particular one can derive from the requirements of the Directives mentioned above that:

c. The nature of the measure must be consistent with the responsibilities allocated to the different actors by the RSD and the IOD as well as with the secondary EU legislation developed in application of these Directives.
d. The required safety levels and the processes for developing and improving railway safety must comply with the targets and the processes established by the RSD.
e. The reduction of human impacts from freight train derailments must be reasonably practicable for the sector. For stating on the practicability of a given measure the Agency assesses the cost-benefit indicators of the measure.

In addition the Agency considered that:

f. It is important to take care of the consistency between the potential risk reduction measures in order to avoid that short term measures hinder the development of longer term measures which would contribute to the achievement of EU policies, in particular the White Paper on Transport.

5.2.1 Safety improvements

The development and improvement of railway Safety is the purpose of Article 4 of the Directive on Safety of Community Railways (RSD) 2004/49/EC [1] which states, amongst other important requirements, "*Member States shall ensure that railway safety is generally maintained and, where reasonably practicable, continuously improved, taking into consideration the development of Community legislation and technical and scientific progress and giving priority to the prevention of serious accidents*".

One element of the proposed level of safety (expressed in term of Fatalities and Weighted Serious Injuries - FWSI) is defined by the Common Safety Targets (CSTs) and the related National Reference Values (NRVs). The NRV represents the minimum level of safety (expressed in term of quantified risk) tolerable for different category[14] (group) of persons which is one element of decision making on safety improvements.

It must be noted that there is no specific risk category defined for 'freight transport'. The risk categories, integrating the risks related to freight transport, are defined by the group of persons supporting the risks: passengers, employees, level-crossing users, un-authorised persons on railway premises, others, societal.

It also must be noted that the current EU freight train derailment risk (including the risk of carrying dangerous goods) correspond to a very small part of the risk levels (Common Safety Targets) agreed and adopted in application of the RSD.

In practice, and considering the current risk induced by railway freight transport (see sections 4.1 and 4.2), this means that the achievement of NRVs by EU Member States is not conditioned by the reduction of freight train derailment risks.

[14] For detailed definition see Commission Decision 2009/460/EC

For the present impact assessment it means that any new mandatory measure at EU level would not be justified unless more stringent quantified safety targets (new CST and NRVs), which would be specific to railway freight transport, would be adopted at EU level.

5.2.2 (Non) acceptance of high consequence accidents

However, even if the freight train derailment risk can be seen as "Acceptable" from statistical point of view, in practice this level of risk results from the two following different accident categories:

- Quite frequent but very low human impact,
- Very rare but potentially catastrophic (typically the Viareggio accident).

For the public, the acceptability of the first accident type is not the same than the acceptability of the second accident type which is generally seen as more unacceptable.

The issue of public reaction to catastrophic accidents, and the political consequences, were discussed by the Joint meeting of RISC and TDG EC Regulatory Committees, in September 2009.

As a result it was agreed that the Risk Acceptance issue must not only be considered for the railways but shall be considered for all modes of transports, as all modes of transport have experienced these catastrophic accidents in the past.

As a conclusion this meeting concluded that harmonised risk acceptance criteria should be established for all surface transport modes in order to allow regulating all modes in a non-discriminating way and in turn to allow avoiding uncontrolled risk shifting between modes.

Following this agreement the European Commission informed the Agency that a study has been included in the EC 2012 work programme on this topic.

For the present impact assessment it means that, before such risk acceptance criteria are established at EU level, the Agency applies a statistical approach for assessing the human risk reduction potential. Therefore the present impact assessment considers in the same way the acceptance of very rare but catastrophic events and the acceptance of low impact events. However the present assessment takes into account all the human impacts potentially arising from either type of accidents.

5.2.3 Economically practicable safety improvements

The present impact assessment must ensure that the safety objectives are achievable in a cost-effective manner. The main economic indicators used for assessing the cost-effectiveness are the following:

- Net Present Value (NPV): The sum of the present values (PVs) of the individual cash flows,
- Benefit to Cost Ratio (BCR): The ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms,

- Internal Rate of Return (IRR): The discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.

In order to take into account the criteria f), the Agency believes that the consistency between short, medium and longer term measures should be ensured whatever the foreseeable scenarios for freight market development.

The detailed assessment of these scenarios is not reported in the present report. Nevertheless the conclusions reported in the present report were drawn with due consideration of the potential scenarios for the development of the railway freight transport.

6. ASSESSMENT RESULTS

6.1 Two types of derailments' detections (Mitigation of derailments' consequences)

As reported in section 2.1, the Agency was requested to examine different questions concerning the derailment detection.

Two different types of derailment detection have been considered in the DNV's Study.

The M1-a type:

- The 'M1-a' type corresponds to derailment detectors acting automatically on the train brakes similarly to the derailment detectors previously studied in [11]. In this category the DNV study identified:
  - M1-a1: 3 detectors similar to the EDT-101 detector are currently available on the market,
  - M1-a2: 1 detector still under development aiming at zero-false alarm by design. This new type of detector is not currently available on the market.

The M1-b type:

The 'M1-b' type would correspond to the functional objective expressed in the provisional text proposed for RID 2013, i.e. a detector which would report an alarm to the locomotive driver without immediate automatic application of the brakes. The DNV's study reports that this type of detector is currently not available on the market.

6.1.1 Consideration of comments received on the derailment detection

On this topic, the Agency received the following comments on the DNV study:

- (UIC comment) concerning the lack of explanations concerning the potential extension of derailment detectors implementation scope to all dangerous goods wagons or to all freight wagons.

  Agency position:

  a) The Agency agrees that DNV does not explain why they consider the M-1a type of derailment detection, applied to all freight wagons, "*… as potentially efficient if the significant identified drawbacks could be solved*.",
  b) In order to compensate this weakness the Agency has re-assessed the question of derailment detection in the light of the DNV study results and has given an answer to the questions raised by the RISC and EU TDG Committees in 2009 in section 6.1.2.

- (Knorr Bremse) commenting:
  "*it is true that "inappropriate application of brakes" might cause derailments, but this refers to*

- hand brake in a wagon applied

- incorrect main brake pipe connection (meaning parts of the train are not braked at all)

but not to applying all brakes of a train at the same time. By the way: In none of the false alarms of the old DDD type any instability of the train occurred."

Agency position:

a) The analysis of past derailment performed by DNV tells us that over 238 analysed derailments there were 6 derailments where strong braking, <u>applied to the whole train</u>, has led to derailments or has been a contributory cause. Therefore it is credible that a full application of the brake invoked by a M1-a type detector under false-alarm conditions could lead to a derailment.

- (Knorr Bremse) considering that the study reports reasonable assessments, however considering that *"It's not only a problem of the derailment detector that it may produce false alarms. So why are the consequences of false alarms of other measures not evaluated?"*

  Agency position:

  a) All the measures have been fairly evaluated in terms of drawbacks by DNV, for example please see section 10.1 of DNV report B3 which summarises drawbacks for measures P1, M1, P11, P13, P15, P16, P10&P12 and F7.

  b) In particular the Agency reminds the following DNV's assessment in the B3 report which says:

  <u>Concerning P1 and M1 measures</u>

  "We consider that measures P1-Check Rail and M1-Derailment Detection (types that apply full emergency train braking) have a common drawback. That is that they each may provoke derailments (albeit not very frequently)."

  "For example an accident in Finland on 09 March 2009 had as a cause "ice packed in the flange way between the crossing frog and the check rail in a turnout. Poor alignment and maintenance of check rails may also contribute to derailments. Similarly, train compression under heavy braking is also a known cause of derailments and hence a false alarm of some M1 devices may lead to this outcome."

  <u>Concerning measures P11, P13, P15, P16, P10&12 and F7</u>

  "False alarms are a potential issue with the majority of <u>technical measures discussed in this report although some may have more direct impacts than others</u>.

  <u>Measures based on trending or to detect early defects are less likely to have a service affecting consequence</u>. We consider technical measures P11-BAM; P13-WLID; P15-Bogie Hunting; P16-Wheel Profile fall into this category. Alarms or warnings are likely to be dealt with at a convenient time without undue impact on the operational railway.

  Measure P10/12-HABD/HWD and F7-Sliding Wheel Detectors are, in our opinion, more likely to have operational impacts as they may need more immediate attention which could involve bringing the incident train to an immediate stop (although in the case of the latter this is likely to be in at a location where an inspection is relatively straightforward and not service affecting)."

  c) The Agency concludes that both measures P1 and M1-a have the potential to directly provoke a derailment under unfavourable circumstances. Concerning the M1-a measure the identified unfavourable circumstances are, for example if a false-alarm occurs where tracks are under performing, or/and if it occurs at a curve, or/and if it is combined with an unsuitable composition/loading of the train.

d) The Agency also concludes that measures P11, P13, P15, P16, P10&12 and F7 cannot directly provoke a derailment, but they could have an impact on the quality of the railway services if their alarms - including false-alarms - are not timely and correctly handled.

- (Knorr Bremse) informing:

  "*Some words on the false alarms themselves:*

  - The data base is very small, so real statistics are not possible

  - Since the installation of the derailment detectors with higher trigger level (EDT101) in 2004 we had had no false alarms anymore.

  - There had been 56 cases of false alarms reported with the old type EDT100. By the way: none of them caused a derailment."

  Agency position:

  a) In principle the fact that no false alarm have been reported since 2004 with the new version of detectors does not mean that false alarms cannot occur with this new version.

  b) The Agency notes that Knorr-Bremse agrees that "*The data base is very small, so real statistics are not possible*"

  c) Therefore the Agency believes that only a detailed assessment concerning the reliability of the new version could provide an estimate of the false-alarm rate. The Agency did not receive such detailed information since the 'false-alarm' issue has been raised in 2009.

- (Finnish NSA) – Questioning the comprehensiveness of the tests of the derailment detectors under severe winter conditions.

  And,

- (Knorr Bremse) – Stating that "*The test conditions were approved by the Finnish and Swedish people, the tests were done and the result (no false alarms even under very low temperature conditions) was reported to RID.*".

  Agency remark:

  a) Concerning winter tests the Agency did not receive detailed information and therefore could not assess the behaviour of the derailment detectors (M-1a type) under severe winter conditions; however the RID Committee of experts reported that such tests have been carried out.

- (Knorr Bremse) considering that: "*The derailment detector acts in the very same way as if the loco driver does an emergency braking: the main pipe pressure is quickly reduced. This is normal train handling which happens frequently without causing derailments*." "*What the DDD does is nothing else than what the loco driver does in an emergency situation!*".

Agency position:

a) A derailment detector automatically acting on the train brakes is different from an 'emergency braking', at least for the following reasons:
   - A locomotive driver knows the circumstances in which he/she applies a real 'emergency braking',
   - The propagation of the brake effort (UIC pneumatic brake systems) goes from the locomotive towards the rear of the train,
   - The traction cut-off occurs immediately, as the real 'emergency braking' is applied from the locomotive.

b) An 'emergency braking' complies with both technical specifications and operational specifications in relation with the previously listed points which are not complied with by the ('DDD') M1-a type derailment detectors.

c) In 2009, the amendments of the RID provisional text were devoted to solve these issues, and this is why the provisional text reported in annex 1 requires that a detection device:

   - reports an alarm only: "*provides an immediate and clear signal to the locomotive driver that a derailment has occurred*". " ~~Venting of the main brake pipe shall be considered as a clear signal.~~."

   - does not automatically vent the main brake pipe (text withdrawn from the initial version).

d) In this respect, the M1-a type derailment detectors do not comply with the provisional RID text reported in annex 1.

- (Knorr Bremse) commenting:
  "*To my knowledge the attached version of the TSI SRT is the latest one. Here on page 28 it is clearly written*:
  [4.4.2. Emergency rule
  The IM's operation rules shall adopt and develop in more detail, if necessary, the principle that in case of an incident (except a derailment, that requires an immediate stop)]
  So the DDD is fully in line with the TSI!"

  Agency remark:

a) The current SRT TSI section 4.4.2 establishes the following general principles:

   [The IM's operation rules shall adopt and develop in more detail, if necessary, the principle that in case of an incident (except a derailment, that requires an immediate stop)

   — The train shall be brought to a halt before entering a tunnel, or driven out of a tunnel.

   — In tunnels with underground stations, the train may be evacuated at an underground platform.

   The procedures for this situation shall be developed by the IM and the RU and be detailed in the emergency plan.

   In all cases, the IM shall be informed immediately by the train crew and no additional scheduled train shall be permitted to enter the tunnel.]

b) The SRT TSI is currently under revision process. The section 4.4.2 mentioned above is currently re-discussed by the Working Party on SRT TSI which proposed to align the requirement with the general requirement of the OPE TSI on managing emergency situations, which requires:

[4.2.3.7 Managing an emergency situation
The infrastructure manager must, in consultation with:
– all railway undertakings operating over his infrastructure, or, where appropriate, representative bodies of railway undertakings operating over his infrastructure,
– neighbouring infrastructure managers, as appropriate,
– local authorities, representative bodies of the emergency services (including fire fighting and rescue) at either local or national level, as appropriate.

define, publish and make available appropriate measures to manage emergency situations and restore the line to normal operation.]

c) The way the M1-a type detector ('DDD') acts does not allow the Infrastructure Manager to apply the general safety principle of section 4.4.2. of SRT TSI while other more efficient measures detecting degraded conditions of a train before entering a tunnel (e.g. hot axle box detectors) allow the Infrastructure Manager to comply with it.

d) Therefore the Agency considers that the 'DDD' is not fully in line with the SRT TSI safety principle and is not in line with the requirements of some other TSIs, as explained in the answer to the previous comments.

- (Knorr Bremse) mentioning that "*We do therefore not understand why "emergency braking" should be evaluated according CSM Regulation, Annex I, point 2.5.4 as it is normal operation rather than it "has credible direct potential for a catastrophic consequence"!*"

Agency position:

a) As it is explained previously the automatic application of brake by a derailment detector is something different than an 'emergency braking' invoked by a locomotive driver.

b) In this respect, the automatic brake application triggered by a derailment detector must be considered as a change (new technical system) in the railway system.

c) In EU Member States the SMS requires every change to be risk assessed and that a procedure is in place to apply the CSM on Risk Evaluation and Assessment (Regulation 2009/352/EC) when the change is deemed to be significant under the terms of this CSM.

d) This CSM states: *"Where hazards arise from failures of technical systems not covered by codes of practice or the use of a reference system, the following risk acceptance criterion shall apply for the design of the technical system: For technical systems where a functional failure has a credible direct potential for a catastrophic consequence, the associated risk does not have to be reduced further if the rate of that failure is less than or equal to 10^{-9} per operating hour. Nevertheless, if the applicant can demonstrate that the national safety level can be maintained with a less demanding criterion than the 10^{-9}, this criterion can be used by the applicant after agreement with the assessment body "If a technical system is developed by applying the 10^{-9} criterion defined in paragraph 4, mutual recognition shall be applied according to section 5.3"*

e) The Agency, supported with the assessment performed by DNV, concluded that a false-alarm (functional failure) of the M1-a type detector has a credible direct potential for a catastrophic consequence.

f) "Credible": The analysis of past derailment performed by DNV tells us that over 238 analysed derailments there were 6 derailments where strong braking (applied to the whole train) has led to the derailments or has been a contributory cause. Therefore it is credible that a full application of the brake invoked by a M1-a type detector under false-alarm conditions could lead to a derailment.

g) "Direct": The direct nature of this potential effect is explained by the fact that there is no possibility to override the automatic full brake application invoked by an M1-a type detector when the detector has wrongly (false-alarm) suspected a derailment. Therefore a false-alarm is a functional failure which can directly lead to a derailment.

h) "Potential for a catastrophic consequence": a derailment can potentially lead to catastrophic consequences, depending on the circumstances.

i) In conclusion, because the derailment detectors of M1-a type represents a change in the current railway system, and because a functional failure of the derailment detector has a credible direct potential for a catastrophic consequence, the Agency considers that the above mentioned CSM is applicable to the M1-a type derailment detectors.

- (RID WG-TVT) taking note that the most efficient implementation scope for the M-1a type of derailment detection is on highly dangerous tank-wagons.

  Agency position:

  a) It is correct that DNV assessed the implementation scope reduced to high dangerous tank-wagons as the most efficient one, however the Agency reminds that DNV assessed that even this implementation scope has negative cost-benefit indicators, i.e. M-1a measure is not efficient.

  b) It must also be clarified that the potential benefits assessed by DNV do not fully consider the implementation scenario envisaged by the RID Committee for implementing this measure which is applied on new wagons. In practice it means that following the level of replacement rate of the targeted wagons the potential benefits assessed by DNV would in fact take place after several years.

  c) It is also important to remark that the identified drawbacks (proportion of derailments provoked by a false alarm) have not been discounted from the benefits quantified for the M-1a measure. This means that in principle, the cost-benefit indicators are likely to be more negative than the situation reported by DNV.

- (RID WG-TVT) concerning the nature of causes targeted by the different measures (infrastructure vs wagons).

  Agency position:

a) In addition to the measure quantitatively assessed, DNV has also identified other measures (qualitatively assessed) which concerns derailments related to infrastructure causes. One of the measures is concerning the way the Infrastructure Managers identify track deficiencies and repair the track within a reasonable time. In number of cases, the track deficiencies problems could be solved with an appropriate use of IMs safety management systems. As safety management systems are already required in the current EU legislation, the Agency believes that cost-beneficial improvement can be achieved in this area.

b) Improvement of safety management system implementation has the potential to reduce more significantly and effectively the infrastructure related derailment causes than derailment detection.

c) Derailment detection could also be a wrong signal sent to the Infrastructure Managers which should not rely on derailment detection for compensating a reduction of the tracks maintenance, especially when local track deficiencies could be repaired in due time if timely and correctly handled through a correct application of the safety management systems.

6.1.2 Findings concerning the issues identified by the EU Committees in 2009

Hereinafter a re-assessment of the derailment detection topic is reported by the Agency in the light of findings reported in the DNV's report, and in the light of the comments received by the Agency on this topic.

1. ***"Study on derailment preventive measures (which would lead to better impact assessment results)"* -than the device (DDD) assessed by the Agency in [11].**

As reported in the table below, if we consider the application of scope of derailment detection (see Annex 10.1) as proposed by the RID Committee of Experts, the DNV study shows also that at least 4 prevention measures have the potential to reduce the derailment risks in a more cost-effective way than the derailment detection. These measures have furthermore the potential to reduce the number of fatalities induced by the transport of dangerous goods in a greater extent than the reduction achievable by the derailment detectors M-1a.

Potential yearly reduction of fatalities in EU			**Potential cost-effectiveness**		
Rank	Measure	Fat./Year	Rank	Measure	Benefits/Costs ratio at 10 years
1st	Wheel Load Impact Detectors / Weighing in Motion	-0.59	1st	Wheel Load Impact Detectors / Weighing in Motion	3.1

2nd	Hot axle box detectors / Hot wheel detectors	-0.47	2nd	Use of polyamide roller cages	1.7
3rd	Bogie Acoustic Monitoring	-0.41	3rd	Bogie Hunting Detectors	1.4
4th	Track Geometry maintenance	-0.36	4th	Bogie Acoustic Monitoring	1.1
5th	Use of polyamide roller cages	-0.29	…		
	Bogie Hunting Detectors	-0.29	…		
…					
10th	Derailment Detectors (RID provision scope)	-0.12	6th	Derailment Detectors (RID provision scope)	0.9

(Source – DNV final report – part B, [30])

Concerning the assessment of the derailment detection itself and using a risk based approach assorted with a cost-benefit assessment, the DNV Study confirms similar results than the one reported in the Agency's impact assessment on derailment detection issued in May 2009. In particular DNV confirms:

- The potential for reducing the number of fatalities in EU (from 0.12 fatalities up to less than 0.95 fatality depending on the application scope),
- The costs for implementing the derailment detection are higher than the potential benefits expected at short and medium terms (< 10 years) for all application scopes.

In relation with the topic discussed above the Agency has received the following comments:

- (Switzerland – Federal Office for Transport) – Concerning derailment detectors (M-1a type) including also consideration on national versus international benefits of measures considered in the study, considering the possible extension of the application scope for derailment detectors in Switzerland.

  Agency position:

  a) The Agency disagrees with the view of Switzerland which considers that only the measures "Use of polyamide roller cages" and "Derailment Detectors" have a global impact on the reduction of freight train derailments, the other measures assessed by DNV being considered by Switzerland as only having the potential to reduce locally the derailment risks.

  b) For example, the measures "Wheel Load Impact Detectors / Weighing in Motion", "Bogie Hunting Detectors" and "Bogie Acoustic Monitoring" have the possibility to detect under-performance of wagons' wheelsets at an early stage. In practice it means that instead of continuing its operation for a long operating time, possibly everywhere in EU or outside EU, without being repaired, the wagon identified with the help of these measures could be checked and repaired before a derailment occurs.

c) Therefore even if the measures mentioned in the previous point are detecting a problem where the detectors are installed (locally), the use of this measure has an effect on the safe performance of all wagons passing by this point and potentially failing elsewhere during its further operation. As these measures are installed as a network of detectors located on the most relevant places, they contribute to prevent the derailments of the whole wagon fleet, including all dangerous goods wagons, everywhere in EU and partly in third countries.

d) Concerning the application scope of derailment detectors in Switzerland, there is a critical issue for the free movement of freight trains in case Switzerland would require the wagons crossing its territory to be equipped with such detectors, especially if the railway undertakings and infrastructure managers, outside Switzerland, have based their risk reduction strategy on the prevention of derailments with the help of measures which detect under-performing wagons at an early stage.

e) The Agency believes that, considering the better efficiency of other measures than the derailment detection, the prevention of derailment must be the priority.

f) At the long term, and in addition to the prevention of derailments, the Agency sees the derailment detection as a possible complement to the prevention measures in the framework of the development of IT applications on-board the wagons. Please see section 6.1.3 concerning M-1b type detection.

- (Rail Cargo Austria) – Derailment detection would only have the possibility to reduce the impact of some derailments but not all.

  Agency position:

  a) The Agency agrees with this comment. Both the Agency impact assessment made in 2009 and DNV study shows that the derailment detection is not the most effective measure to reduce freight train derailment risks and would have a limited action on the reduction of the risks related to the transport of dangerous goods.

- (Finnish NSA) – Concerning the percentage of third country wagons operated in Finland for the transport of dangerous goods, and being against the mandatory application of derailment detectors whatever the application scope.

  Agency position:

  a) The Agency agrees that due to the traffic composition in Finland the potential benefits of the derailment detection (M-1a type) would be lower, and in turn the efficiency of this measure would be lower in Finland than in other countries, whatever the application scope would be,

  b) The Agency share the view that M-1a type detectors should not be mandatory as other more efficient measures having a better impact on the reduction of the risk induced by the transport of dangerous goods can be used. Please see also section 6.1.3.

2. *"Study on the impact of false alarms and the level of reliability that should be imposed for the derailment detection device (DDD)".*

DNV's study confirmed that the question of false-alarm remains an issue for the derailment detection because the false activation of an alarm (i.e. without actual derailment occurred) has the potential to provoke a derailment. Effectively the DNV's analysis of past derailments shows that a small proportion of these derailments (around 5%) has been caused by inappropriate application of brakes in combination with unfavourable train composition, track condition or wagon loading.

The M-1a type of detector applying automatically full brake by venting the main brake pipe there is a (small) probability that such an action on brake, in case of false-alarm, would provoke a derailment.

3. *"Market research on products that meet the DDD provision in its current version (and/or in the version modified)".*

DNV has identified that three (3) detectors of M-1a type (similar to the EDT-101 detector) are currently available on the market [27].

The Agency was informed that another type of mechanical detectors (M1-a2 type), aiming at zero-false alarm by design is currently under development. This new type of mechanical detector is not currently available on the market.

DNV reported that the detection which would strictly correspond to the functional objective expressed in the provisional text proposed for RID 2013 (M-1b type), i.e. a detector which would report an alarm to the locomotive driver, is not currently available on the market.

4. *"Study on the impact of automatic braking in tunnels/bridges".*

For the electronic detection (M-1b type), and similarly to the functionalities adopted for handling an alarm in passengers' trains, the Agency would suggest handling the alarms reported by an electronic detection with the following process:

a. the derailment alarm is reported to the locomotive driver in the cabin without applying brakes,
b. the driver must acknowledge the alarm,
c. after acknowledgement of the alarm, the driver must bring the train to a safe stop in accordance with the applicable operational rules relating to the management of emergency situations,
d. in case the alarm is not acknowledged by the driver, the train is automatically brought to a stop,
e. the alarm handling system should offer the possibility to deactivate, where required, the automatic braking trigger on specific sections (e.g. tunnel/bridges).

Under this topic, the Agency received the following comments:

- (Danish NSA) – considering that the study is of high quality, reminding that the issue of tunnels must be carefully examined in case derailment detection would be made mandatory and considering that the way an alarm reported by a detection should be handled (possibilities – limitations) should be clearly defined.

  Agency position:

  a) The Agency agrees the view of the Danish NSA and analysed carefully the question of tunnels and bridges. As a result the Agency proposed, as reported above, the way an alarm should be handled in case of use of M-1b type derailment detection in the EU.
  b) The Agency also supports the Danish NSA view that the M-1a type derailment detection should not be mandatory, as explained in section 6.1.3 below.

5. ***"Additionally, the TSIs need to be revised in order to include the technical requirements of such devices…* (DDD or modified) *…and the corresponding conformity assessment/verification procedures*".**

As a first step the relevant committees should express their views concerning the future application of the M-1b type derailment detection reporting an alarm to the locomotive driver.

In case this type of detection would be supported for the future, then detailed functional and performance parameters should be developed. The corresponding functional requirements should comply with the requirements of the Interoperability Directive and the secondary legislation, i.e. the TSIs. Such functional requirements should therefore be developed by, or under the auspice of, the working parties in charge of the Safety in Railway Tunnels TSI, the Operations TSI, the Rolling Stock TSI and the Control-Command and Signalling TSI.

6.1.3 Agency conclusions on the derailment detection

The new findings concerning derailment detection of M-1a type (DDD) lead the Agency to the following conclusions:

- There exist a lot of preventive measures which show a more effective reduction of risks related to the transport of dangerous goods and which show a better efficiency from cost-benefit point of view at EU level. These preventive measures should be used in priority.
- Most of the issues raised by the RISC and EU TDG Committees concerning the M1-a type derailment detectors, applying automatically full brake when a derailment is suspected, remain:
  - The new study findings confirms that this type of detector has the potential to provoke a derailment in case of false alarm,
  - This type of detector does not offer the functionalities corresponding to the new provisional text proposed for inclusion in RID 2013, because it does not report an alarm to the locomotive driver.

    - The venting of the main brake pipe by this type of detector cannot be clearly interpreted by the driver as a derailment alarm.
- One issue (monopoly) concerning the derailment detection market could be considered as solved, because the M1-a type detector is now offered by three suppliers while it was only proposed by one supplier in 2009.
- Considering these results the Agency confirms its recommendation addressed to the European Commission in 2009: The M-1a type detector (DDD) should not be introduced in RID.

Concerning the M-1b type of derailment detection, reporting an alarm to the locomotive driver the Agency concludes:

- There exist a lot of preventive measures which show <u>today</u> a more effective reduction of risks at EU level related to the transport of dangerous goods and which show a better efficiency from cost-benefit point of view. These preventive measures should be used in priority.
- Today it does not exist on the market any derailment detectors fulfilling the desirable functionalities (reporting an alarm), as provisionally adopted for the RID 2013, the Agency recommends to withdraw this provision from RID 2013.
- For the long term, the Agency considers that the detectors reporting an alarm have the following advantages:
    - The issues identified for the M-1a type detectors -automatic-braking- could be mitigated or even avoided by using M-1b type detection –alarm reporting-, because:
        - the automatic application of brakes by the M-1b type detection would be an exception, mitigating potential human errors by the locomotive drivers in case they would mishandled the pre-defined procedure for handling a reported alarm,
        - the M-1b type detectors, probably based on electronic systems, would offer more possibilities for limiting the number of false alarms (multiple checks of actual derailment occurrence would be feasible with this type of detection) or for identifying a false alarm (driver check),
        - concerning the specific case of tunnels and bridges it would be easier to comply with specific operating rules (e.g. overriding automatic braking from the locomotive in specific locations) .
    - The M-1b type detectors could become cost-effective in the general framework of future telematics applications for freight because the cost related to data transmission and power supply could be shared between all the potential future applications,
    - The M1-b type detectors could be a good complement to preventive measures for reducing the impact of occurred derailments.
- Therefore the Agency supports the idea to re-assess the M1-b type measure, when the market will offer products which fulfil the desirable functionalities, and when the market concerning IT applications for railway freight transport will be more mature.

As a conclusion the Agency considers that in the long term the M-1b measure might have the potential to reduce the impact of around 15% of occurred freight train derailments in a cost-effective way.

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Derailment detection reporting alarm	Mitigation of 76 (15%) derailments	(Mitigation) Operation	Long term	All freight wagons, Supported with Safety Management System	DNV / M-1b measure. ERA / present document.

6.2 Safety management system and maintenance system (Prevention of derailments)

The following measures are considered by the Agency to have potential to effectively prevent derailment causes related to (lack of) quality in the safety management system and maintenance system:

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Better implementation of safety management system and maintenance system	Prevention of 5 up to 129 (1% - 26%) derailments	Safety management system and maintenance system	Short term	Safety management system and maintenance system	DNV, ERA
Maturity of safety management system and maintenance system					

In organisations with high demand on safety, a management system addressing safety is the best way to manage safety and control risks. In addition to be the best solution to manage safety, this is also a legal requirement in RSD Articles 9, 14(a) and Annex III.

According to the article 9(2) of RSD, the safety management system aims at controlling the risks related to the activities performed by the railway undertaking / railway infrastructure manager.

The safety management system is a set of interrelated processes set-up by the railway undertaking / infrastructure manager to develop control measures addressing the risks related to their activities.

These control measures may be:

- Operational rules for vehicles and infrastructure,
- Maintenance rules for vehicles and infrastructure,
- Prescriptions on the design of infrastructure and vehicles,
- Prescriptions on competence of staff leading to staff competences under control,
- Monitoring of the behaviour of vehicles/infrastructure in service addressing remaining risks not fully covered by preceding control measures.

According to Article 14(a) of RSD, the Entity in Charge of Maintenance (ECM) has to establish a maintenance system that aims at controlling the risks related to maintenance of vehicles. The maintenance system is a set of interrelated processes set-up by the ECM to develop maintenance rules appropriate to the use of vehicles by railway undertakings.

Those considerations mean that the measures related to sections 7.3, 7.4 and 7.5 of this document should always be linked to and supported by the safety management and maintenance systems.

The Agency has assessed, that to better implement the safety management system (detailed in section 6.2.1) and work on the maturity of it (detailed in section 6.2.2), are two measures which will bring great benefits to Infrastructure Managers, Railway Undertakings and Entities in Charge of Maintenance to find weaknesses in their risk control measures in combination with their business objectives.

The current legislation already requires the need for and the implementation and use of such systems. Railway undertakings and infrastructure managers must have a safety management system proportionate to their risks while entities in charge of maintenance must have a maintenance system proportionate to their risks. These two systems are interrelated.

A mature safety management and maintenance systems would mean that the railway undertaking, the infrastructure manager and the entity in charge of maintenance are effectively managing all safety risks according to their safety objectives and business needs.

The Agency is currently carrying out tasks which will help the sector to improve the implementation of the safety management systems and maintenance systems, as follows:

- The forthcoming CSM regulation on monitoring,
- The Agency has also undertaken works on the safety maturity of organisations.

Therefore, in the current situation the Agency believes that it is not necessary to mandatorily introduce specific detailed measures which could already be defined, introduced and managed by the IMs, the RUs and the ECMs through the correct application of their safety management systems and their maintenance systems respectively. These systems can therefore be used to control the risks from day to day operations.

In principle, the main exemptions for introducing mandatory requirement in the legislation in addition to the management of safety under the responsibility of IMs , RUs and ECMs should be the following:

- In case any harmonisation, through the legislation would be necessary to ensure the achievement of common safety targets at EU level,
- In case, at country level the introduction of national rules may be necessary to help RUs and IMs achieve the national (safety) reference values,
- In case, obstacles for opening the market or for ensuring interoperability must be removed by the adoption of specific requirements, i.e. for other reasons but safety.

In relation with the topic discussed above the Agency has received the following comments:

- (Finnish NSA) – Supporting the prevention of derailments, in particular in preventing operational causes, failures in maintenance of rolling stock and infrastructure with more mature risk avoidance methods and culture.

  "*We believe that there are also other options than technical devices in reducing the amount of derailments. The key factor in preventing derailments caused by technical reasons is the maintenance of rolling stock and infrastructure. Preventing derailments caused by operational issues should be advanced by steering work methods and culture towards more risk avoiding direction*."

  Agency position:

  a) The Agency shares the Finnish NSA views that the improvement of the maturity for implementing correctly the safety management systems is probably the most promise measure for reducing organisational, operational and human factor causes of derailments. This task is clearly allocated by the current EU legislation to the IMs and RUs and it covers in particular the maintenance of rolling stock (in collaboration with the Entities in Charge of Maintenance) and of infrastructures.
  b) The examples of operational issues reported in section 6.2.3 are supporting the comment reported by Finland. It is clear that mishandling of operational issues and under-performing operations have a significant impact on the number of freight train derailments.

c) The Agency believes that a well-defined and well-implemented SMS has the potential to significantly reduce the amount of derailments related to under-performing operations.

d) In accordance with the current EU legislation, the NSAs are responsible for granting authorisations and certificates and in particular under the condition that IMs and RUs implement a safety management system. NSAs are also responsible for supervising the correct implementation of these systems by IMs and RUs.

e) Progress in this whole field is also a question of culture and maturity in safety management systems.

6.2.1 Better implementation of Safety Management System and maintenance system

The overall purpose of the safety management system is to ensure that an organisation (IM or RU) delivers its operational requirements safely. The overall purpose of the maintenance system is to ensure that an ECM as an organisation maintains vehicles safely.

For an IM , RU or an ECM those safety objectives need to be fulfilled in today's ever changing and complex railway environment, giving evidence that the organisation complies with all of the safety obligations that apply to it.

It is commonly recognised that there are wide benefits of managing business in a structured way. It adds value helping to improve overall performance, introduce operational efficiencies, enhance relations with customers, providers and regulatory authorities and build a positive safety culture.

In addition for safety, adopting a structured approach enables the identification of hazards and the continuous management of risks related to the organisation's activities, in the railway sector this includes the prevention of derailments and of other risks. When appropriate it should take into account the interfaces with other actors in the railway system. Implementing all relevant elements of a safety management system or a maintenance system in an adequate way can provide an organisation with the necessary assurance that it controls and will continue to control all the identified risks associated with its activities, under all conditions.

Mature organisations thereby recognise that an efficient control of its risks can only be achieved through a process that brings together three critical dimensions: a technical component with the used tools and equipment, a human component of front line people with their skills, training and motivation and an organisational component consisting of procedures and methods defining the relationship of tasks. Consequently, a good safety management system or maintenance system succeeds in monitoring and improving the risk control measures in the three dimensions.

Safety is never better than the weakest link and therefore it is extremely important to be aware of the weaknesses and to be able to keep them under control, i.e. monitor the existing risk control measures and to know when additional measures must be taken and, if so, what that measure should be. Each RU , IM or ECM will have the most benefits from a safety point of view and a business point of view if they strive to have a safety management system or maintenance system as mature as possible.

6.2.2 Maturity in the safety management system

A railway undertaking, an infrastructure manager or an entity in charge of maintenance that adopts a mature approach to managing the safety of their railway operation would have a safety management system or maintenance system which ensures that the business objectives include safety objectives. This covers visionary objectives, based on solid evidence of what the business can achieve, and it is necessary to promote a consistent approach to safety at all levels of the business. The leaders (and the Board) would set and communicate clear direction that reinforces a consistent approach to safety and shapes day-to-day activities. This means that the business objectives will provide the framework for using people, equipment and processes successfully (because efficiency, effectiveness and safety are all linked back to the business objectives) and the competencies (knowledge, skills, experience and abilities) needed to work effectively, efficiently and safely are understood by everyone. Because of this employees are actively involved in developing processes and making the business successful and safe. And if monitoring (including performance measurement and auditing) is an important part of the management arrangements at all levels, then everyone will be encouraged to achieve the business objectives and reduce the risk to the business and variations from expected outcomes are reviewed to understand where there are failings and what corrective action is necessary to restore performance.

The Agency believes that there is room for improvement in the implementation and use of the railway undertaking's and infrastructure manager's safety management systems and the ECM's maintenance system. It is difficult to assess how many derailments which could be prevented compare to existing situation. It would depend on the maturity of the safety management and maintenance systems. However, continuous improvement would always be achieved and that is not only for derailments but in the safety area as a whole as well as within the business area. To work on the maturity of the safety management and maintenance systems is one measure which is considered to be very important from a safety point of view but will also give benefits in other areas. Besides standards and guidance for achieving improvements on the maturity of the safety management system or maintenance system, the forthcoming CSM regulation on monitoring safety will also support progress in these fields.

The section below lists a set of risk reduction measures targeted on freight train derailments which have been assessed by DNV as having the potential to reduce significantly the number of derailments in case they are correctly applied and controlled through a mature safety management and maintenance systems.

6.2.3 Examples of DNV findings concerning safety management systems

In the DNV assessment report there are several measures which are qualitatively assessed and have to do with shortcomings which are related to the safety management system, in one or more of the three, above mentioned, dimensions.

The measures are implemented through the safety management system but the risk category is operation, wagon or infrastructure. It is mentioned here in order to give an overview how important it is to have a well-functioning safety management system and the importance of working with the maturity of the safety management system. It also points out examples of measures which will not work properly unless the safety management system works properly.

Measures which are qualitatively assessed by DNV and have to do with implementation and use of the safety management system are the following:

- *P20 Ultrasonic rail inspection (ref. value 18)*[15]
- *F2 Awareness program and improved maintenance , which also include*
    - *P35 Regular greasing and check of fastening of rolling stock buffers to reduce risk of a buffer falling off. (ref. value 5)*
    - *P36 Wheel set integrity inspection (ultrasonic) programs (ref. value 129)*
    - *P39 Requirement for double check and signing of safety-classified (S.-marked) maintenance operations. (ref. value 5)*
- *P41 Locomotive and first wagons of long freight train in brake position G (Lange locomotive) (ref. value 34)*
- *P42 Limitations on use of brake action in difficult track geometry (ref. value 34)*
- *P43 Perform a dynamic brake test on the route to get actual test information with regard to the train braking performance (ref. value 16)*
- *P46 Traffic controllers and drivers should not be allowed to override detector alarms. (ref. value 15)*
- *P40 Qualified and registered person responsible for loading. (ref. value 32)*
- *P21 Track geometry measurement of all tracks (ref. value 113)*

In principle the decision for using (or not) the measures listed above should be the result of the implementation of the safety management system or maintenance system.

All the above examples represent a substantial number of derailments which could be prevented through a better implementation and supervision[16] of safety management systems.

Two examples are explained hereinafter in more details to show the connection to the safety management system:

DNV measure P20 Ultrasonic rail inspection

The IMs provide for ultrasonic inspection of the rails by various forms of wagons in order to detect cracks and fractures that can cause rail ruptures. Either the IM owns the inspection equipment or the inspection is done by contractors. The ultrasound inspection provides the IMs with information with regard to the quality of the rails and the need for rail replacements. The frequency of ultrasonic rail inspections is determined by the IMs based on the rail age and traffic

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[15] The reference value (*ref. value*) indicates the number of derailments which could be prevented by the considered measures, as assessed by DNV, when a total reference number of 500 freight train derailments per year in EU is assumed.

[16] For details concerning the supervision regime please see sections 6.4.2 and 6.5.2.

loads on the actual line accounting for available resources and equipment performance. A detailed description of the measure is available in the DNV reports.

Ultrasonic rail inspection could be a good way of collecting data on the quality of the rails. If the measure is used, an infrastructure manager must have a process (in their safety management system) and make sure that the process is known, understood and used, to systematically collect the data and analyse the data. All this must be done in order to be able to make an informed decision on what measures are the most efficient to make.

P43 Perform a dynamic brake test on the route to get actual test information with regard to the train braking performance (ref. value 16)

The ATP-system of some countries including Norway, Sweden and Finland, called ATC, has a function to perform a dynamic brake test on the route to get actual test information with regard to the train braking performance.

In this case there must be a process or a rule when and how to perform a brake test and what to do if something goes wrong. The process or rule (in the safety management system) must be known, understood and used.

6.3 Quality of railway operations (Prevention of derailments)

The following measures, having the potential to effectively prevent derailment causes related to the (lack of) quality of railway operation, are considered by the Agency:

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
High quality performance of staff	Prevention of (N/A) derailments	Operation	Short term	Safety Management system	ERA
Wheel Load Detectors & Wheel Impact Load Detectors	Prevention of 114 (23%) derailments	Operation (indirect wagon)	Medium	Infrastructure, and Safety management system	DNV (measure P13)
Wheel Profile Detectors	Prevention of 10 (2%) derailments	Operation (indirect wagons)	Medium	Infrastructure, and Safety management system	DNV (measure P16)
Bearing Acoustic Monitoring	Prevention of 63 (13%) derailments	Operation (indirect wagons)	Medium	Infrastructure, and Safety management system	DNV (measure P11)

Bogie Hunting Detectors	Prevention of 42 (8%) derailments	Operation (indirect wagons)	Medium	Infrastructure, and Safety management system	DNV (measure P15)

In principle the decision for using one or more of the measures listed above should be the result of the implementation of the safety management system or maintenance system. In particular the measure "High quality performance of staff" belongs to the category of measures addressed by the safety management system in the field of "Prescriptions on competence of staff" as introduced in section 6.2 while the other measures belongs to the field "Monitoring of the behaviour of vehicles in service".

Therefore it remains under the responsibility of RUs, IMs or ECMs to judge the appropriateness of using these additional measures in supplement of their existing operational and maintenance rules.

However the Agency believes that, in any case, such additional measures should not hide any deficiencies in safety management system or of the maintenance system, these deficiencies should be corrected in priority.

The Agency considered the comments on DNV study concerning way-side monitoring:

- (Switzerland – Federal Office for Transport) comments concerning the importance of wayside monitoring systems and the possible added value of system networking, data management and data transfer.

  Agency position:

  a) The Agency shares the view expressed in this comment. The performance of a Safety Management Systems depends on the input safety data (monitoring) processed by the SMS. Efficient data monitoring assorted with a well-defined process for deciding on appropriate actions is a key factor for reducing safety risks in day to day operations. As it is explained in the present section the implementation of a well-designed SMS has the potential to reduce significantly the number of derailments in EU.
  b) The Agency considers the measure of developing and using the safety management system and in particular the monitoring process as one of the key measures for preventing derailments.
  c) This is not only valid for the SMS of each individual organisations but the networking of relevant safety monitoring information to the concerned stakeholders is also crucial. In principle this function must also be covered by an SMS.
  d) For example the transfer of relevant maintenance information between the RUs and the ECMs is a key requirement of the ECM Regulation 445/2011/EC.
  e) Concerning longer term development, it must be noted that both DNV [29] and the D-Rail consortium have also well identified the importance of future harmonisation and networking of safety related data and has devoted a work-package of this research project to that issue. See also section 7.3.

6.3.1 High quality performance of staff

Several measures, which are related to that the staff have no support by procedures and methods to be able to carry out the correct task in a correct way or don't have the right training or skills are addressed here. As stated in the section 7.2, operational rules, maintenance rules and prescriptions on competences of staff are outputs of safety management systems and maintenance systems. The Agency is of the opinion that all the measures mentioned by DNV are useful but shall be considered within the specific organisation's safety management system or maintenance system (see 6.2).

Processes which could be affected are e.g. recruiting processes, training processes, processes for performing a certain task in a certain way.

6.3.2 Wheel Load Detectors & Wheel Load Impact Detectors

Wheel load detectors are wayside detectors measuring the size and variations of the load of wheels as they pass by. This measure addresses a number of common freight train derailment causes such as wheel defects or loading anomalies (ref. value 114). A detailed description of the measure is available in the DNV reports.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure. However the decision for using (or not) such a measure must be the result of the work with the safety management system (See 6.2 and 6.3).

In the context of this measure it should, for example, also be considered to improve the enforcement of the existing controls when it comes to train loading rules.

The Agency considered the comments on DNV study concerning this measure as follows:

- (Italian NSA) Supporting the use of measure P13.

  Agency position:

  a) The Agency shares the view expressed in this comment as this measure shows the best cost effectiveness amongst the measures quantitatively assessed by DNV.
  b) The Agency believes that the potential benefits could be achieved by the use of this measure on a voluntary basis.

- (UIC) Questioning the effectiveness of this measure for tank wagons.

  Agency position:

  a) The Agency agrees that the potential effectiveness of measure P13 might be lower because skew loadings are less likely to occur in tank-wagons.
  b) However the measure P13 is also detecting wheel defects which are also concerning the tank wagons.

6.3.3 Wheel Profile Detectors

Damage to the wheel profile may be a contributing cause to derailments. Whereas wheel impact load detectors can detect some wheel profile problems, wheel profile measurement systems provide a more complete picture. They are also based on other technology: analysis of wayside digital camera images highlighting the profile using lasers or strobe light. A number of wheel profile parameters are captured, e.g. flange height, flange width, flange slope, tread hollow and rim thickness. Some measurement systems can operate with trains passing at high speeds (e.g. up to 140 km/h) (ref. value 10). A detailed description of the measure is available in the DNV reports.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure. However the decision for using (or not) such a measure must be the result of the work with the safety management system (See 6.2 and 6.3).

6.3.4 Bearing Acoustic Monitoring

Acoustic bearing detectors are, like hot axle box/bearing detectors, used to detect developing mechanical structural defects associated with wheel bearings. It is, however, not based on temperature measurement, but on the analysis of the sound as wheel sets pass by. The major advantage over hot axle box detectors is that acoustic bearing detectors are able to detect developing defects much earlier as such defects will result in increased noise. Acoustic bearing detectors are placed wayside and consist of a microphone array and a system unit which analyses the sound and raises an alarm if dangerous defects are detected. Used in combination with vehicle identification systems, the system may also be used to store information on individual vehicles and wheel sets in a central database, allowing for trend analysis and preventive maintenance (ref. value 63). A detailed description of the measure is available in the DNV reports.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure. However the decision for using (or not) such a measure must be the result of the work with the safety management system (See 6.2 and 6.3).

6.3.5 Bogie Hunting Detectors

This wayside defect detection system is capable of detecting and identifying train bogies that exhibit poor performance, i.e. addresses problems associated with lateral instability caused by wheel or other defects. This system monitors safety performance in several regimes such as: potential of flange climb derailment, gauge spreading, and rail over. This state-of the-art system has the capability to benchmark bogie performance on a fleet-wide basis (ref. value 42). A detailed description of the measure is available in the DNV reports.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure. However the decision for using (or not) such a measure must be the result of the work with the safety management system (See 6.2 and 6.3).

The Agency considered the comments on DNV study concerning this measure as follows:

- (CER comment) "*This measure is currently not applicable on freight trains because no power and no data transmission are on-board.*"

  Agency clarification:

a) Here a checking should be made concerning the measure P15. As described in the DNV reports and above this measure seems only requiring wayside equipment. Therefore there would be no need for power supply and data transmission on-board the wagons. The concerned wayside equipment is available on the market and used outside EU.

6.3.6 Other (less) promising measures at EU level

Within the area of measures for improving "Operation quality" the Agency considered also the following comments:

- (French NIB) questioning the implementation scope of measure F7 – Sliding wheels detectors.
  Agency position:
  a) The comment might lead to review the potential implementation scope of the F7 measure which in turn would increase the cost of the measure, and therefore for would lead to a lower efficiency than the one estimated by DNV,
  b) Considering the already low efficiency of the F7 measure estimated by DNV, the Agency did not further considered this measure as a potentially promise measure at EU level. Therefore this measure was not further assessed by the Agency in the present report.
  c) However it does not exclude that for specific reasons the F7 might be efficient in a specific country.

- (French NIB) commenting the assumption made by DNV on the implementation scope of additional Hot Axle Boxes Detectors – HABD (measure P10) in EU and proposing another implementation strategy.
  Agency position:
  a) First of all it must be recalled that DNV has assessed the potential improvement which could be achieved with additional measure at EU level and in addition of existing measures,
  b) The DNV conclusions on (low) improvements achievable at EU level through implementing more HABD does not mean that the current use of HABD is not efficient. On contrary the already wide application of HABD in EU is a good measure but because it is already widely applied, the potential additional benefit by the mean of implementing more HABD is now small at EU level,
  c) On the contrary, a country where HABD would not be currently used could likely reduce the derailment risks with this measure in an effective way,
  d) The comment raised by the French NIB illustrates also a country specific issue which is the choice of the locations and the density of HABD which must be used for reaching a targeted risk reduction,
  e) The Agency agrees that different strategy for implementing HABD are applicable and also depends on country specific network features,
  f) DNV has proposed one strategy which they considered to be relevant at EU level and has assessed its potential cost-effectiveness,

g) The Agency do not oppose the results provided by DNV which reflect one specific strategy, however considering the quite low overall potential benefit at EU level the Agency believes that the risk reduction by the mean of HABD should be assessed at country level.

h) Therefore this measure was not further considered by the Agency in the present report.

- (Italian NSA) Supporting the use of Hot Axle Boxes Detectors – HABD (measure P10)

  Agency position:

  a) As mentioned in the answer to the French NIB's comment on this measure, the Agency agrees that depending on the considered country an extended use of HABD could be effective.

  b) However DNV did not ranked the extended use of HABD as a cost-effective measure at EU level because, at EU level, the HABD are already extensively used and therefore the remaining potential risk reduction achievable with this measure is small.

  c) Therefore the Agency believes that an extended use of this measure should be considered on a voluntary basis by interested countries. However the decision must be the result of the work with the safety management system. (See 6.2 and 6.3)

  d) However it seems that as a first step the countries already using HABD should in priority check if the current performance of HABD already installed is acceptable or if it should be improved. This late action is seen as an action which is in principle already covered by the Safety Management Systems of Infrastructure Managers.

6.4 Infrastructure quality (Prevention of derailments)

The following measures, having the potential to effectively prevent derailment causes related to the (lack of) infrastructure quality, are considered by the Agency:

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Track geometry defects, Sufficient availability of maintenance resources,	Prevention of 113 (23%) derailments	Infrastructure	Short term	Safety management system	DNV (measure P18) ERA (risk control measures for controlling track geometry in general)
Supervision targeted on		Infrastructure	Short term	Others/NSA	DNV (measure P18)

maintenance					

6.4.1 Track geometry defects, track failures, maintenance, informed decisions

DNV measure P18- Track geometry

The problem of poor track geometry (in particular track twist) increase the risk of derailment. The possible requirement to improve this aspect is to maintain current performance levels. The measure is addressed for each IMs own management system (ref. value 113). A detailed description of the measure is available in the DNV reports.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure which is considered as being low.

However maintenance of the infrastructure remains a very important task in order to be able to achieve good railway safety performance. Maintenance problems have been seen predominately to secondary lines by DNV. DNV has faced both aspects that infrastructure managers are of the opinion that they have enough resources to maintain to an acceptable level, but also have showed in the quantitative assessment that there are derailments due to lack of maintenance . DNV has even found that in some cases the situation is known by the infrastructure manager that the agreed parameters have not been applied, i.e. the infrastructure manager knows that the quality of the infrastructure is not acceptable (report B1 section 4.3.2) but did not have been able to restore it (for whatever reasons). In those cases it is a matter of being capable of finding the safety problems and solve them within an acceptable time and at the same time balance the business objectives of e.g. punctuality. This part is handled within the safety management system (see 6.2).

6.4.2 Supervision targeted on infrastructure maintenance

DNV has suggested that a specific measure must be concerned with increased supervision of the parameters of maintenance by NSAs to ensure that practicable risk reduction objectives are being applied. A detailed description of the measure is available in the DNV reports.

The Agency would like to underline that supervision shall according to CSM on Conformity assessment EU Regulation N° 1158/2010, *be targeted primarily at those activities which a national safety authority believes give rise to the most serious risks or where the hazards are least well-controlled*.

The Agency is of the opinion that the IM and RU are responsible for managing risks arising from operation through the use of their SMS. The NSA initially assesses whether the arrangements set out in the SMS show that a RU or IM is capable of delivering safe operation prior to issuing either a safety certificate or safety authorization. After issuing the certificate or authorization, the NSA checks whether these arrangements are consistently and effectively delivered in practice by undertaking supervision activity.

6.5 Wagon quality (Prevention of derailments)

The following measures, having the potential to effectively prevent derailment causes related to the (lack of) wagon quality, are considered by the Agency:

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Under performance of Wagons, maintenance, informed decisions	Prevention of 53 (11%) derailments	Wagons	Short term	Safety management system	ERA (risk control measures for under-performance of wagons in general) DNV (measure F-2)
Supervision targeted on maintenance	Prevention of 113 derailments	Wagons	Short term	Others/NSA	DNV (measure F-2)
Replacement of brass for polyamide roller cages	Prevention of 33 (7%) derailments	Wagons	Medium	Wagon (retrofit and new wagons), and Safety management system	DNV (measure P28)
European Visual Inspection Catalogue (EVIC)	Prevention of 66 (14%) derailments	Wagons	Medium	Safety management system	ERA, DNV (measure P38- not assessed in terms of cost/benefit by DNV)

6.5.1 Under performance of wagons, maintenance, informed decisions

DNV measure F2 Awareness program and improved maintenance

A concern expressed to DNV by several IMs was regarding the quality of freight wagons from some countries. In particular that maintenance is of varying standards. [8, and others]

This measure may serve to address the problem of poor maintenance standards of rolling stock. This may include training that sought to concentrate on main rolling stock maintenance derailment causes, as documented in this report, and best practice. This measure may be followed by increased supervision of these parameters by NSAs to ensure that practicable risk reduction objectives are being applied.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure.

Maintenance is one important part to be able to achieve good quality of the wagons. The problem has the same aspects as shortcomings in the infrastructure (see 6.4.1). In addition it is also here a matter of being capable of finding the safety problems and solve them within an acceptable time and at the same time balance the business objectives. This type of issue is improved through improvements of the safety management system and maintenance system (see 6.2).

6.5.2 Supervision targeted on wagon maintenance

DNV has suggested that a specific measure must be concerned with increased supervision of the maintenance by NSAs to avoid varying standards. A detailed description of the measure is available in the DNV reports.

The Agency reminds that RUs are responsible for managing risks arising from operation, including the arrangements with keepers and ECMs for maintenance supply, through use of their SMS. The NSA initially assesses whether the arrangements set out in the SMS show that an RU is capable of delivering safe operation prior to issuing a safety certificate. After issuing the certificate, the NSA checks whether these arrangements are consistently and effectively delivered in practice by undertaking supervision activity.

In addition, according to the ECM regulation the maintenance system of the ECMs is not supervised by the NSAs but is under the surveillance regime of the certification body. The Agency has produced a guide concerning the surveillance tasks of the certification body in the framework of the ECMs accreditation scheme.

6.5.3 Replacement of brass for polyamide roller cages

DNV suggests that the brass roller cages shall be replaced by polyamide roller cages. The polyamide roller cages are considered less prone to failures due to vibration impact. The measure addresses the cause of hot axle boxes. A detailed description of the measure is available in the DNV reports.

The Agency does not oppose the result from DNV concerning the assessment of the potential efficiency of the measure.

However the Agency reminds that this change in the design belong to the category of "Prescriptions on design of vehicles", one of the field covered by the safety management system and maintenance system.

It remains under the responsibility of RUs and ECMs to judge the appropriateness of the measure in addition to their respective existing operational and maintenance rules.

The Agency considered the comments on DNV study concerning this measure as follows:

- Several comments from Belgian ECM, CER, French NIB, Rail Cargo Austria, RID WG-TVT and Swiss Federal Office for Transport were received.

  Agency position:

  a) The Agency believes that the results reported by DNV on this measure should be taken with some caution.

  b) The received comments showing that there are good experience with the replacement of brass roller cages with polyamide ones; however the potential benefits might have been overestimated by DNV.

  c) Information to be considered is the on-going task carried out by the Joint Sector Group - JSG (CER, ERFA, UIP, UIRR, UNIFE) on the risk analysis of axles failures. They concluded on the 14th September 2011 that they come to the same conclusions than DNV, namely bearing failure is the main cause of axles failures. Therefore they recommend focusing their effort on the reduction of bearing failures.

  d) Nevertheless the Agency believes that this measure should be further considered as a potential promise one and that further discussions supported by the current JSG should take place in Freight Focus Group in order to carry out a more in depth assessment of P28 measure.

- (Switzerland – Federal Office for Transport) – Concerning the DNV remark on the potential combination of measure P10 and measure P28 (Replacement of brass roller cages by polyamide ones).

  Agency position:

  a) In principle, the control of risks must be based on a system approach, as required by the Railway Safety Directive. Therefore, in principle it is possible to change the application scope of one safety measure with another safety measure targeting the same risk with at least the same efficiency.

b) The comment made by DNV is considering that from a system point of view, there might be a winning strategy consisting to reduce the density of HABD while using the Polyamide Roller Cages extensively, as these two measures target the same root cause of axle failures.

c) The Agency did not check this possibility but do not oppose this strategy in principle.

d) Nevertheless the Agency considers, like Switzerland, that such a strategy must be carefully examined before deciding it with a very detailed analysis of induced changed in the control of the targeted risk (hot axle failure), taking into account a system approach.

6.5.4 European Visual Inspection Catalogue (EVIC)

The final report of the Task Force Freight Wagon Maintenance informs the following: *EVIC is part of the work carried out by the Task Force Freight Wagon Maintenance. It is a harmonised maintenance program of inspection of axles that was developed by Joint sector group in 2009 and has been in force since April 2010. …. As part of the EVIC programme, the JSG has also set up a sampling initiative. The objective of this sampling is to check the efficiency of the EVIC through comparisons of the NDT results of "EVIC failed" and "EVIC passed" axles.*

The sampling will take place over a 12 month period from June 2010 onwards.

The Agency reminds that the EVIC measure belongs to the category of "Maintenance rules", covered by the outputs of a maintenance system. Therefore it remains under the responsibility of ECMs to judge its appropriateness in addition to its existing maintenance rules.

In the framework of the present report the Agency has tried to collect sufficient information from the sampling exercise in order to establish cost-effectiveness indicators. To date it is still difficult to firmly conclude on the effectiveness of that measure however some pieces of information would show that the EVIC programme would not be efficient in comparison to the other measures assessed by DNV.

Therefore the Agency believes that risk reductions with other more efficient measures should be implemented with higher priority. See also section 4.4 for more details.

The Agency considered the comments concerning EVIC measure as follows:

- (Rail Cargo Austria) - reminding that EVIC measure was implemented in 2010 for preventing the main cause of severe derailments which is broken axles.

  Agency position:

  a) In the present impact assessment the Agency considers all the potential measures which prove to be efficient for reducing the derailment risks,

  b) As discussed in section 4.4 and in the present section the EVIC measure might not be very efficient for addressing this risks,

c) It must also be noticed that initially the Task Force on Wagon Maintenance discussed the EVIC measure in collaboration with the JSG without justifying this measure by an impact assessment but as a swift reaction to the Viareggio accident.

d) Today this measure should be re-assessed by the sector in the light of findings on the cost-effectiveness of the measure in comparison with the risk reduction offered by other more efficient measures.

6.6 Longer term measures

As a results of the overall assessment made by DNV and by the Agency in the present report, some measures have been identified which could be efficient in the long term but are not practicable at short or medium term. These measures are presented below for information.

It must also be noticed that some of these measure could be assessed in more details in other forums, for example in the D-Rail project.

As an indication the tables presented below suggest which measures might be further considered by this project.

Reduction of derailments combined causes

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	May be assessed by / or Reference
Wheel/Rail interactions	Not assessed by DNV	Infrastructure/ Wagon	Long		D-Rail project – WP3
Revision of intervention limits concerning track quality	Prevention of 83 (17%) derailments	Infrastructure	Long	Infrastructure, and Safety management system	D-Rail project / DNV (P22- P23- P24 & P25)

Harmonised safety monitoring

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	May be assessed by / or Reference
Harmonised real-time monitoring	Prevention of	Operation	Long	Infrastructure, wagons, Safety	D-Rail project

of tracks/wagon/train composition quality	? (-- %) derailments			Management System	
Harmonised Safety data exchange between IMs, RUs and ECMs	Prevention of ? (-- %) derailments	Maintenance & Operation	Long	Safety Management System	D-Rail project

Change in wagon design

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	May be assessed by / or Reference
Increase the use of central coupling	Prevention of 47 (9%) derailments	Wagons	Long	Wagon, and Safety management system	D-Rail project / DNV (measure P-30 – identified but not assessed in terms of cost-benefit), and White Paper on Transport

7. AGENCY RECOMMENDATIONS ON SHORT & MEDIUM TERM MEASURES

7.1 Making the current legislation better applied

The present impact assessment shows that there is still a significant room for improvements in applying the current railway legislation better and in particular the implementation of Safety Management Systems and maintenance systems requested by the Railway Safety Directive.

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Better implementation / maturity of safety management system and maintenance system	Prevention of 5 up to 129 (1% - 26%) derailments	Safety management system and maintenance system - Wagons	Short term	Safety management system and maintenance system	ERA / DNV measures (inc. P20, P21, F2 (inc. P35, P36, P39), P40, P41, P42, P43, P46)
Track geometry defects, Sufficient availability of maintenance resources,	Prevention of 113 (23%) derailments	Infrastructure	Short term	Infrastructure, Safety management system	DNV (measure P18) ERA (risk control measures for controlling track geometry in general)
High quality performance of staff	Prevention of (N/A) derailments	Operation	Short term	Safety Management system and maintenance system	ERA

In section 6.2 the Agency has described in which areas a significant risk reduction could be further achieved in this field. The Safety Management Systems have been formally required since the introduction of the Railway Safety Directive in 2004 and have already been put in place by Infrastructure Managers and Railway Undertakings for more than few years. The maintenance systems are introduced by the Railway

Safety directive in 2008 and the regulation 445/2011. They are now being put in place by ECMs. Therefore the Agency believes that the extra-costs induced by a better implementation of the Safety Management Systems and maintenance systems would be limited.

The Agency is making big efforts to provide guidance to the concerned parties for improving the performance of the existing Safety Management Systems and maintenance systems.

The benefits of the estimated improvements, up to 26% of derailments prevented, are considered to outweigh the extra- resources necessary for making existing Safety Management Systems and maintenance systems working better.

The Agency believes that there is no need to amend the current EU legislation for this purpose.

7.2 Promoting the use of efficient voluntary measures

In addition to the improvements of the current implementation of the Safety Management Systems and maintenance systems, these improvements being the priority, the present impact assessment clearly shows that efficient risk reduction measures are available today.

The technical measures listed in the table below are considered as the most promising technical measures at EU level, at short and medium terms, besides the improvements of the Safety Management Systems and maintenance systems achievable in the organisational, procedural, and human factors fields.

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Wheel Load Detectors & Wheel Impact Load Detectors	Prevention of 114 (23%) derailments	Operation (indirect wagons)	Medium	Infrastructure, and Safety management system	DNV (measure P13)
Bearing Acoustic Monitoring	Prevention of 63 (13%) derailments	Operation (indirect wagons)	Medium	Infrastructure, and Safety management system	DNV (measure P11)
Bogie Hunting Detectors	Prevention of 42 (8%) derailments	Operation (indirect wagons)	Medium	Infrastructure, and Safety management system	DNV (measure P15)

Replacement of brass for polyamide roller cages	Prevention of 33 (7%) derailments	Wagons	Medium	Wagon/retrofit, and Safety management system	DNV (measure P28)

Nevertheless the Agency believes that, in accordance to the current legal framework concerning the development and the improvement of EU Railways Safety, it is not justified to make these technical measures mandatory at EU level.

This position is supported by the following reasons:

- In principle, the Agency sees no justification for requiring additional mandatory measure to the railway sector while rail mode is far safer than the road mode for carrying freight. This assessment also applies to the carriage of dangerous goods even if decision-makers might face a different perception from the general public.
- The achievement of the Common Safety Targets established for the EU Railway Safety and the achievement of these targets in EU member states is not directly conditioned by the achievement of risk reduction in relation to freight train derailments,
- The technical measures listed above are assessed as being cost-effective; this result should be a sufficient incentive for Infrastructure Managers, Railway Undertakings and Entities in Charge of Maintenance for considering the use of such measures, on voluntary basis, as a mean for improving the performance of their services in a cost-effective manner,
- Finally, as an output of the implementation of safety management systems and maintenance systems, Infrastructure Managers, Railway Undertakings and Entities in Charge of Maintenance could identify other efficient measures better suiting with the specificities of their services.

This is why the Agency believes that a voluntary approach is the best option for using the cost-effective measures listed above. This option is in line with the existing legal framework which requires continuous and practicable safety improvements through the implementation of processes that are already required and well defined in the current legislation. Depending of their types, the safety improvements should take place:

- under the responsibility of the Infrastructure Managers and Railway Undertakings, supervised by the National Safety Authorities,
- under the responsibility of Entities in Charge of Maintenance with the surveillance of the Certification Body.

Therefore, the Agency recommends that the measures listed above are discussed in the framework of the Agency's Freight Focus Group, following the above principles, in order to facilitate their practical implementation, on a voluntary basis, by the sector.

The derailment detection applying automatic braking (M-1a type products) was not assessed as a good candidate for being introduced in the EU legislation in 2009. This is confirmed by the present impact assessment.

The previous Agency recommendation is reinforced by the fact that other risk reduction measures (listed in the table above) would be more efficient, including for the reduction of the risks related to the carriage of dangerous goods. These measures are available on the market and do not entail the drawbacks identified for the derailment detection products currently available on the market.

Therefore the Agency believes that making mandatory the derailment detection currently available on the market would be clear market distortion in regards the other available measures assessed as being more efficient than the derailment detection. As a consequence the Agency reiterates its recommendation for removing from the RID the provisional text concerning the derailment detection.

Finally, as already assessed in 2009, the Agency reminds that it is still possible to use the derailment detection currently available on the market on a voluntary basis, if authorised by the authority in charge of granting the placing into service of wagons equipped with these systems. However, it should be clear that wagons without derailment detection should not be prevented to be operated.

7.3 Anticipating longer term developments

Finally, the present impact assessment shows that efficient risk reduction measures could be available at longer term and should be further considered for the following reasons:

- The achievement of the White Paper objective for increasing the share of the railway freight transport might be hindered if the derailment rate would remain stable, which in practice would mean a mechanical increase of the number of derailments with the traffic increase.
- Therefore in addition to the actions recommended by the Agency in the two above sections it is advisable to prepare longer term measures for reducing the rate of freight train derailments.
- Another reason is the potential benefits which might be obtained in combining different objectives, for example the White Paper on Transport suggests an increased use of central-couplings, mainly for improving the efficiency of the logistics of specific freight railway services.
- If we consider the use of central-coupling from another point of view, it could also contribute to the reduction of freight train derailments (see DNV measure P-30) and, if combined with data transmission and power supply, it may significantly contribute to the development of on-board IT applications in railway freight transport.
- The on-board (electronic) derailment detection (M-1b type products) could be one of these future applications.
- More generally, the monitoring of safety-related data and the networking these data between the relevant stakeholders could also be improved in the future by using harmonised definitions and functionalities of dedicated IT systems, on-board wagons as well as off-board.

The Agency has listed the identified opportunities in the table below.

Name	Risk Reduction Potential	Risk Reduction Category	Time Scope	Implementation Scope	Assessed by / Reference
Revision of intervention limits concerning track quality	Prevention of (17%) derailments	Infrastructure	Long	Infrastructure, and Safety management system	D-Rail project / DNV (P22- P23- P24 & P25)
Harmonised real-time monitoring of tracks/wagon/train composition quality	Contribution to a more cost-effective prevention of derailments	Operation	Long	Infrastructure, wagons, and Safety management system	D-Rail project,
Harmonised Safety data exchange between IMs, RUs and ECMs	Contribution to a more cost-effective prevention of derailments	Maintenance & Operation	Long	Safety Management System	D-Rail project, / DNV (identified in A4 report)
Increase the use of central coupling	Prevention of (9%) derailments	Wagons	Long	Wagons, and Safety management system	D-Rail project, / DNV (P30)
Telematics for safety & logistics applications	Contribution to further risk reduction in railway freight transport	Operation	Long	Infrastructure, Wagons, and Safety management system	

Some of these opportunities could be further assessed in the framework of the D-Rail project co-ordinated by the University of Newcastle and the UIC. This project initially proposed by the Agency in collaboration with the DG Research has already started in autumn 2011 and should be completed within three years.

Finally, the Agency is currently considering, as another future development, the need for better coordinating the development of IT applications related to safety and logistic improvements in railway freight transport, with the help of other parties already working on this topic.

8. CONCLUSION

For reducing the occurrence of freight train derailments and reducing the risks related to the carriage of dangerous goods, the Agency recommends the following actions:

- In priority, the implementation of the Safety Management Systems of the Infrastructure Managers and Railway Undertakings and maintenance systems of ECMs should be further improved with the objective to achieve a better performance of organisational, operational and human 'safety barriers' related to the prevention of freight train derailments.
- In addition, the sector in collaboration with the National Safety Authorities should consider using the technical measures identified in the present impact assessment as being cost-effective at EU level, on a voluntary basis, taking into account the specific situation of already existing measures in each country. The Agency Safety Platform could serve as a facilitator for promoting the use of these measures by the sector.
- Finally, opportunities in the field of freight train derailments prevention and mitigation of their impacts have been identified for longer term developments. These opportunities should be further assessed and developed in the relevant forum. The results of these developments should then be re-considered within 3-5 years as potential supplementary measures for reducing the freight train derailment risks in combination with the achievement of other relevant objectives.

The Agency will continue to facilitate the implementation of these recommendations where and when necessary and suggest to monitor the progress achieved.

9. References and Definitions

9.1 Reference Documents

Ref. N°	Author	Title	Last Issue
European legislation - Directives			
[1]	European Commission	Directive 2004/49/EC of the European Parliament and of the Council on safety on the Community's railways, as amended. OJ L 220/16, 21/06/2004.	2008
[2]	European Commission	Directive 2008/57/EC of the European Parliament and of the Council on interoperability of the rail system within the Community. OJ L 191/1, 18/07/2008.	2008
[3]	European Commission	Directive 2008/68/EC of the European Parliament and of the Council on Inland Transport of Dangerous Goods. OJ L 260/13, 30/09/2008.	2008
European legislation - Regulations			
[4]	European Commission	Commission decision (2006/861/EC) of 28 July 2006 concerning the technical specification of interoperability relating to the subsystem 'rolling stock — freight wagons' of the trans-European conventional rail system. (notified under document number C(2006) 3345)	2006
[5]	European Commission	Commission decision (2006/920/EC) of 11 August 2006 concerning the technical specification of interoperability relating to the subsystem 'Traffic Operation and Management' of the trans-European conventional rail system. (notified under document number C(2006) 3593)	2006
[6]	European Commission	Commission decision 2008/163/EC of 20 December 2007 notified under document number C(2007)6450. Technical specification of interoperability relating to "safety in railway tunnels" in the trans-European conventional and high speed rail system	2008
European legislation - Agency			
[7]	European Commission	Regulation (EC) No 881/2004 of the European Parliament and of the Council of 29 April 2004 establishing a European Railway	2004 / 2009

Ref. N°	**Author**	**Title**	**Last Issue**
		Agency, as amended.	
[8]	ERA	Draft technical specification for interoperability relating to the 'infrastructure' sub-system of the trans-European conventional rail system. Version 3.0	2008
[9]	European Commission	Request from the European Commission to the Agency - Ref. TREN/E/2-PRa/as D(2009) 73073 ; 03.13.02.04.07.F001	25/11/2009
[10]	ERA	Recommendation on the provision proposed by the RID Committee of Experts requiring the use of Derailment Detection Devices (ERA/REC/01-2009/SAF)	11/05/2009
[11]	ERA	Impact Assessment on the use of Derailment Detection Devices in the EU Railway System (ERA/REP/03-2009/SAF)	07/05/2009
[12]	ERA	Further analysis of specific situations in tunnels, automatic braking derailment detection devices, and false alarms	2011
[13]	ERA - Safety Unit	Final report on the activities of the Task Force – Freight Wagon Maintenance http://www.era.europa.eu/Document-Register/Pages/Report-from-Task-Force-on-Maintenance.aspx	05/10/2010
European legislation - Guidelines and technical documents			
[14]	European Commission	White Paper – Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system	2011
[15]	European Commission	Impact Assessment Guidelines. SEC(2009) 92.	2009
[16]	ERA Economic Evaluation Unit	Economic Evaluation: Methodology Guidelines	2007
International regulation			
[17]	OTIF	(RID)	2011

Ref. N°	**Author**	**Title**	**Last Issue**
		Appendix C of the Convention concerning International Carriage by Rail (COTIF) – Regulations concerning the International Carriage of Dangerous Goods by Rail	
[18]	RID/CE	A 81-03/501.2003, Final report of the 47th session of the RID Committee of Experts on the Transport of Dangerous Goods. (Sofia, dd-dd November 2009)	2009
[19]	RID/CE	OTIF/RID/CE/2007-A, Final report of the 44th session of the RID Committee of Experts on the Transport of Dangerous Goods. (Zagreb, 19-23 November 2007).	2007
[20]	RID/CE	INF 2 Report on derailment tests carried out with goods wagons – Transmitted by the Technical university of Berlin	2007
[21]	OTIF	A 81-03/501.2006/Add.2 Generic guidelines for the calculation of the risk inherent in the carriage of dangerous goods by rail	2006
[22]	RID/CE/WG	INF_UIC_1_D – Sachstansberight des UIC-Unterausschusses 'Brenswesen" zum pneumatischen Entgleiungsdetektor – Mitteilung des Internationalen Eisenbahnverbands (UIC)	2005
[23]	OTIF	COTIF - Convention concerning International Carriage by Rail of 9 May 1980 in the version of the Protocol of Modification of 3 June 1999.	1999
References concerning input studies			
[24]	TED	http://ted.europa.eu/udl?uri=TED:NOTICE:98322-2010:TEXT:EN:HTML	03/04/2010
[25]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures Part A - Final Report	08/06/2011
[26]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures A1 Report – Existing measures	18/04/2011
[27]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures A2 Report – Markets for Technical Measures	12/04/2011
[28]	Det Norske Veritas	Assessment of freight train derailment risk reduction measures	12/04/2011

Ref. N°	Author	Title	Last Issue
	Ltd	A3 Report – Functional and Performance Assessment	
[29]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures A4 Report – New Technologies and Approaches	19/04/2011
[30]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures Part B - Final Report	20/10/2011
[31]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures B1 Report – Derailment Risk Models	27/06/2011
[32]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures B2 Report - Risk model and potential effectiveness of measures	21/07/2011
[33]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures Annex 1 to B2 Report (accident analysis)	08/07/2011
[34]	Det Norske Veritas Ltd	Assessment of freight train derailment risk reduction measures B3 Report - Top ten ranking of safety measures	21/09/2011
Other relevant references			
[35]	Imperial College London Consultants & Lloyd's Register	ERA/2007/SAF/OP/01 - A study to develop an historical database (archive) of serious train accidents in the Countries of the European Union, Norway and Switzerland from 1990 to the present day.	2008
[36]	Ministerie van Verkeer en Waterstraat	Quantitative risk analysis NL – Presented during the meeting of the RID Working Group on Standardized Risk Analysis – June 2008 – The Hague	2008
[37]	UIC	UIC CODE 541 – 08 (OR), 4th edition, June 2007 Brakes – Regulation concerning the manufacture of the different brake parts – Derailment Detectors for wagons	2007
[38]	Technical University of Berlin	Bericht 20/07 – Durchführung von Entgleisungsversuchen mit Güterwagen	2007
[39]	French Transport and Environment Ministries	Développement d'un modèle d'évaluation multi-modale des risques pour le transport de marchandises dangereuses - INERIS	2003

Ref. N°	**Author**	**Title**	**Last Issue**
[40]	Eurostat	Personnes tuées dans les accidents de la route [road_ac_death]	10/10/2011
[41]	Eurostat	Nombre annuel de victimes par type d'accident (ferroviaires) [rail_ac_catvict]	07/10/2011
[42]	European Road Safety Observatory - DaCoTa	(Road) Traffic Safety Basic Facts 2010 – Heavy Goods Vehicles and Buses	2010
[43]	French ministry in charge of Transport	Road tanker accidents carrying dangerous goods in FR from 1995 to 2009. (Information reported by FR to the UNECE Working Group on BLEVE)	2010
[44]	Eurostat	Transport routier annuel de marchandises dangereuses par type de marchandises dangereuses, ventilé par type d'activité (Mio Tkm, Mio Veh-km, 1000 BTO) [road_go_ta_dg]	02/08/2011
[45]	Eurostat	Récapitulatif du transport routier annuel par type d'opération et type de transport (1000 T, Mio Tkm, Mio Veh-km) [road_go_ta_tott]	02/08/2011
[46]	Eurostat	Nombre annuel d'accidents par type d'accident (ferroviaires) [rail_ac_catnmbr]	06/09/2011
[47]	ERA	ERADIS – see link to Archive Database - https://pdb.era.europa.eu/default.aspx	30/11/2011
[48]	Eurostat	Nombre annuel d'accidents par type d'accident (ferroviaires) [rail_ac_catnmbr]	06/09/2011

9.2 Terms and definitions

Table 1 : Terms and definitions

Term	**Definition**
CBA	Cost-Benefit Analysis
CST	Common Safety Targets – (see definition in Directive 2004/49/EC)

Table 1 : Terms and definitions

Term	**Definition**
DDD	Derailment detection device
DG	Dangerous Goods
Effectiveness	The extent to which options/measures achieve the objectives of a proposal, without consideration of the resources needed for implementing the options/measures.
Efficiency	The extent to which objectives of a proposal can be achieved with options/measures for a given level of resources/at least cost (cost-effectiveness).
Hazard	See Recommendation for the 1st set of Common Safety Methods for the definition used
IM	Infrastructure Manager (as defined in Article 3 of Directive 91/440/EEC)
Risk	See Recommendation for 1st set of Common Safety Methods for the definition used
Risk management	See Recommendation for 1st set of Common Safety Methods for the definition used
RU	Railway Undertaking (as defined in Directive 2001/14/EC)
Safety measures	See Recommendation for 1st set of Common Safety Methods for the definition used
Safety requirements	See Recommendation for 1st set of Common Safety Methods for the definition used.

10. LIST OF ANNEXES

Ref. N°	Author	Title	Last Issue
[1]	RID/CE	Provisional text for RID 2013, as amended in 2009. 47th session of the RID Committee of Experts - Sofia	2009

10.1 Annex 1 – Provisional text for RID 2013, as amended in 2009

“[6.8.4 (b) Insert the following new special provision TE xx in 6.8.4 (b) (left-hand column only):

TE xx *Tank-wagons for substances carried in the liquid state and gases, and battery-wagons shall be equipped with a detection device that provides an immediate and clear signal to the locomotive driver that a derailment has occurred.* ~~*Venting of the main brake pipe shall be considered as a clear signal.*~~

This device shall meet the requirements of the relevant technical specifications for interoperability (TSI) and OTIF’s uniform technical prescriptions (UTP) (wagons, operation, tunnel safety).” ~~*The requirements shall be considered to have been fulfilled if the device is approved in accordance with UIC leaflet 541-08 (version applicable as at June 2007, 4th edition).”*~~*]*

With a following transitional provision:

[1.6.3 Add a new transitional provision to 1.6.3 as follows:

1.6.3.x Tank-wagons and battery-wagons

- for gases of Class 2 with classification codes containing the letter(s) F, T, TF, TC, TO, TFC or TOC, and

- for substances of classes 3 to 8 carried in the liquid state and to which tank code L10BH, L10CH, L10DH, L15CH, L15DH or L21DH is assigned in column (12) of Table A of Chapter 3.2,

constructed before 1 January 2011 which do not, however, conform to the requirements of 6.8.4 (b) concerning special provision TE xx applicable from 1 January 2011 may continue to be used.]

End of report