Joint Network Secretariat Normal Procedure Task Force

**Great Belt bridge Accident/Incident**

# Final report

25.04.2022

# Contents

# 1. Introduction

# Role of JNS procedures in the EU safety framework

- **Railway Undertaking (RU)** and **Infrastructure Manager (IM)** are responsible for safe operation. In case of incidents and accidents RUs and IMs shall define together with all further parties involved (e.g. **Entities in Charge of Maintenance (ECMs), keepers and loaders**) measures immediately preventing any related danger

- **RUs** and **IMs** have to share relevant information (currently (in Safety Alert IT (SAIT)) to allow others actors to react appropriately to ensure safety

# Role of JNS procedures in the EU safety framework

- After incidents and accidents the **National Safety Authority (NSA) supervises** stakeholder´s immediate actions aiming at assessing whether the measures taken by the companies involved sufficiently prevent any related danger (at European level).

- If not, the **NSA shall intervene** respecting the responsibility of all actors. These immediate measures might increase costs for the sector and may harm interoperability

- **NSAs** have to share relevant information within the SIS system to allow other NSAs to react appropriately in order to ensure safety. This is usually done in the form of a **Safety Alert**

# Role of JNS procedures in the EU safety framework

- In parallel the **National Investigation Body (NIB) may run an independent investigation** of the incident or accident with the objective to find the causes and to give recommendations to the different actors involved within one year

- In case of an incident or accident any entity (preferably the competent NSA) might notify a **Joint Network Secretariat (JNS) urgent (fast track) or normal procedure** by submitting a filled notification form https://www.era.europa.eu/activities/joint-network-secretariat_en to ERA (jns@era.europa.eu)

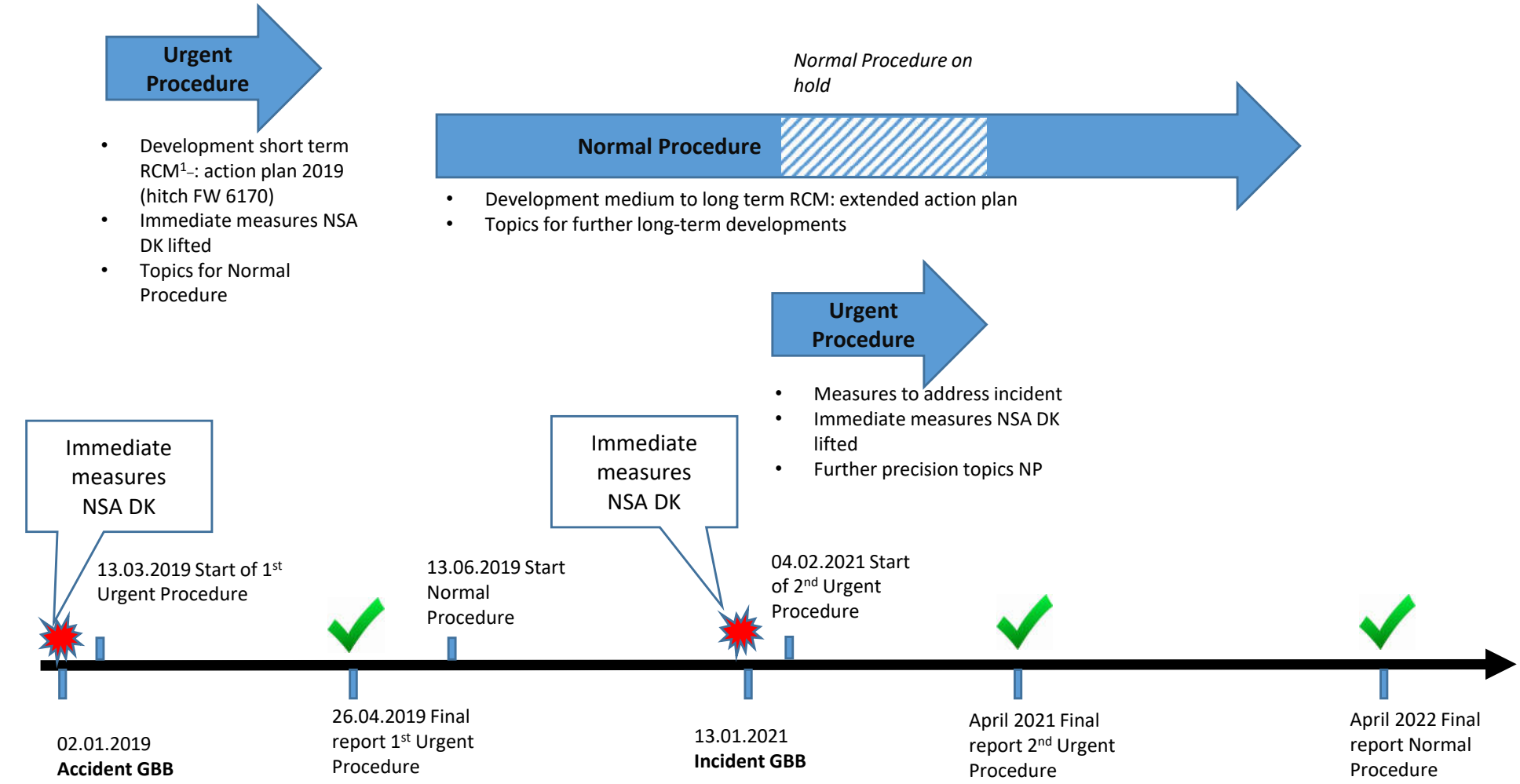
# JNS Normal procedure

- The objective of an **JNS normal procedure task force** is to define mid-term and long-term measures to sustainably solve the issue. In particular to:
  - maintain or further improve the safety level
  - ensure interoperability, and
  - return to the original cost base or even lower the level of related costs
  - Timescale usually up to 2 years
- The work of the experts might lead to the identification of
  - research needs
  - changes in regulation, standardisation, company rules, etc.

- This document describes the outcome of the Joint Network Secretariat (JNS) Normal Procedure on the Great Belt bridge accident 02.01.2019 and the Great Belt bridge incident of 13.01.2021

- The intention of this Normal Procedure is to replace the outcomes of two related Urgent Procedures:
  - Outcome Urgent Procedure Accident 02.01.2019
  - Outcome Urgent Procedure Incident 13.01.2021

# Overall timeline JNS procedures on the Great Belt bridge




1) Risk Control Measure

- In both these events, semi-trailers transported on pocket wagons over the Great Belt bridge were moved outside of the gauge, caused by cross-wind. Both events were investigated by the Danish National Investigation Body. The respective final reports including the description of the accident resp. incident are to be found under Forside (havarikommissionen.dk)
- The risk to be treated within this Normal Procedure

# Semi-trailers on pocket wagons move outside the gauge during transport

# Organisation of the Task Force

- A dedicated Task Force, consisting of experts from NSAs and Representative Bodies met in total 13 times (see next slide)
- Dedicated sub-group meetings were created to work on particular topics:
  - Cluster I : Secure loading
    Subgroup Ia. Update of Action Plan 2019
    Subgroup Ib. Communication and training related to hitches
  - Cluster II: Cross-wind safety
    Subgroup IIa. Cross-wind stability of rolling stock
    Subgroup IIb. Measures at infrastructure side
  - Cluster III: Reliable king-pin locking
    Subgroup IIIa. Hitch sensors
    Subgroup IIIb. Locking force

# Organisation of the task force – Task Force meetings overview

| Date | Main topics discussed | Attendance stakeholders | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NSA | UIRR | UIP | ERFA | CER | EIM | MAN [1)] | UIC | UNIFE | EC |
| 13.06.2019 | Setting up & Action Plan | 4 | 1 | 1 | - | 2 | 2 | 2 | 1 | - | - |
| 01.10.2019 | Update Action Plan & site visit Hamburg | 5 | 3 | 3 | 1 | 2 | 3 | 2 | 1 | - | - |
| 29.11.2019 | Update Action Plan | 3 | 4 | - | 1 | 2 | 3 | 2 | 1 | - | - |
| 06.02.2020 | Discuss NIB report (accident 2019) & Action Plan | 4 | 3 | 2 | 1 | 3 | 3 | 2 | 1 | - | - |
| 01.04.2020 | *Cancelled due to COVID'19 pandemic* | - | - | - | - | - | - | - | - | - | - |
| 08.10.2020 | Update Action Plan & review Urgent Measures | 4 | 4 | 1 | 1 | 3 | 3 | 2 | 1 | - | - |
| 27.11.2020 | Update Action Plan & review Urgent Measures | 3 | 3 | 2 | 1 | 4 | 3 | 2 | 1 | - | - |
| 04.02.2021 | Discuss incident 13.01.2021 (see UP 2021) | 10 | 4 | 3 | 1 | 4 | 3 | 4 | 1 | 1 | - |
| 05.05.2021 | Reorganisation Action Plan after UP Incident 13.01.2021 | 5 | 5 | 3 | 1 | 3 | 4 | 3 | 2 | - | - |
| 29.06.2021 | Discuss progress of sub groups | 6 | 3 | 3 | 1 | 4 | 3 | 1 | 2 | 1 | - |
| 30.09.2021 | Discuss progress of sub groups and draft report | 5 | 5 | 2 | 1 | 8 | 3 | - | 1 | 1 | - |
| 25.11.2021 | Discuss progress of sub groups and draft report | 3 | 5 | 1 | - | 6 | 2 | 1 | 2 | 1 | 1 |
| 04.02.2022 | Discuss NIB report incident 2021 and draft report | 6 | 5 | 2 | 1 | 3 | 4 | 2 | 2 | - | 1 |
| 31.03.2022 | Discuss final report & comments | 7 | 3 | 2 | 3 | 5 | 2 | 1 | 2 | - | 2 |



1) Manufactors of hitches involved in accident (SAF Holland - manufacturer of hitch type FW6170) and incident (MAZ – manufacturer of hitch type MAZ80800)

# Publication and dissemination of the final report

1. After conclusion by the JNS Task Force, the JNS secretariat informs the JNS Panel to verify whether the procedure was correctly applied and the initial objectives are met

2. The dissemination of the outcome was agreed among the Task Force members. The final report containing among others the risk control measures will be disseminated by the JNS Secretariat as follows:

   - to ERA for publication on the its website and for distribution to ECM certification bodies;
   - to the Group of Representative Bodies (GRB) for the distribution to its members;
   - to the official entities (OTIF, NIB Network, NSA Network, OSJD[1)]) for the distribution to their members;
   - to UIC for the distribution to its members.

1) Suspended at the time of the publication of this report. Distribution pending political developments.

# 2. Outcome

# Contents

# 2. Outcome
# Executive summary (1/2)

**Subgroup Ia** : (1) extended action plan with clear safety measures to be executed by stakeholders involved in the transport of semi-trailers on pocket wagons (2) best practices guidelines for the terminal operators handling semi-trailers on pocket wagons

Next steps: (1) the extended action plan will be integrated in the existing AMOC[1)] for safe loading
(2) dissemination plan by the representative bodies

**Subgroup Ib** : summary and clarification of best practices on the communication and the initial training related to hitches

➔ **The application of these best practices stemming from subgroups Ia and Ib by the different actors is strongly recommended. Actors who do not apply these practices shall be able to demonstrate achieving at least a similar level of safety through alternative measures.**

**Subgroups IIa and b** : collection of best practices from European infrastructure managers on cross wind safety and a deep analysis of the BaneDanmark risk assessment on the Great Belt west bridge.

Follow-up : Extent the methodologies and models for cross wind risk assessment (as in SAFIRST) to freight transport and in particular to the transport of semi-trailers.

➔ New guideline (AMOC) for the CSM Risk Evaluation and Analysis.

➔ Change requests to TSI INF and RST

1) Acceptable Means of Compliance

# 2. Outcome
# Executive summary (2/2)

**Subgroup IIIa** : In order to avoid a multitude of non-standardized solutions, the design and development of such devices/sensors shall follow a single set of requirements (basic prerequisites, functional requirements and minimum information transmitted to data systems).

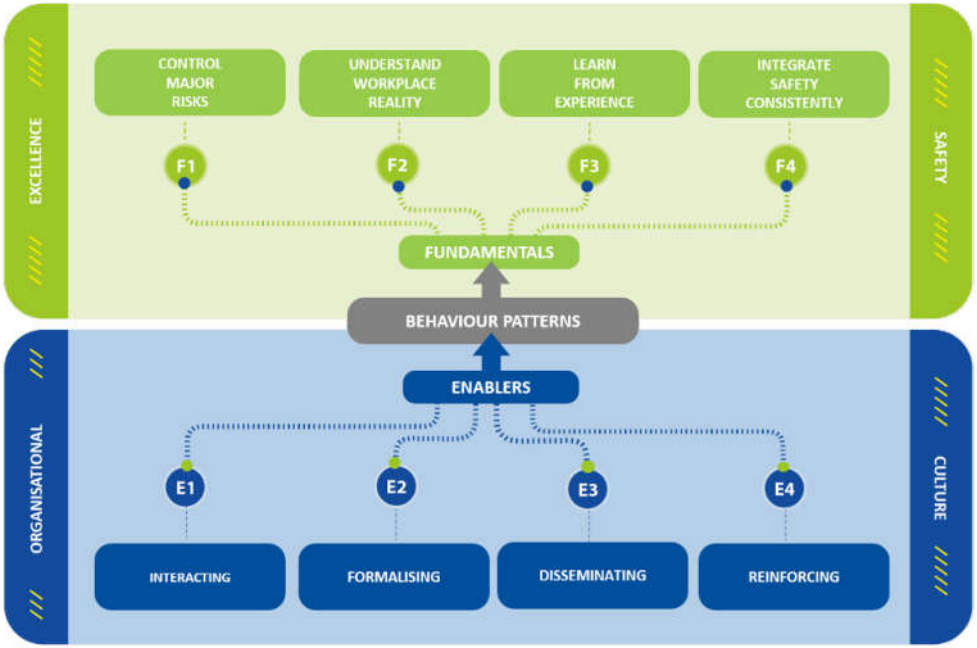
**Subgroup IIIb** : (1) analysis of the current legal and standardization framework for the locking mechanism, (2) pocket wagon safety relevant measures in a system approach, (3) possible methodologies and standards to be used for the calculation of wagon running behavior in windy conditions, (4) collection of studies and performed on seating devices and locking forces, (5) best practices of hitch manufacturers

Main outcome: A minimum vertical locking force of the hitch is necessary in order to keep the semitrailers in gauge. The value of this force will depend on the wind speed. Concrete values/formulas for the minimum vertical locking force can only be derived after a systemic risk analysis on the GBB (see **subgroups II**)

For the outcomes of each subgroup, an impact assessment has been carried out and can be found in Annex 1

# 2. Outcome
# European Railway Safety Culture Model 2.0: Components

*"Safety culture refers to the interaction between the requirements of the safety management system, how people make sense of them, based on their attitudes, values and beliefs and what they actually do, as seen in decisions and behaviours."*




**Railway Safety Fundamentals**:
Keywords and Attributes

**Railway Safety Enablers**:
Keywords and Attributes

*Source: Introduction to the European Railway Safety Culture Model -*
*https://www.era.europa.eu/sites/default/files/activities/docs/european_railway_safety_cultutre_model_en.pdf*

# 2. Outcome
## Safety Culture in the EU Railway Legislation

*In the EU rail sector, the 4th railway package introduced safety culture in 2016 in the Railway Safety Directive, which has been underpinned by the common safety methods on safety management system requirements in 2018.*

### EU Railway Safety Directive 2016/798

- Recital 10: promote by MS of a culture of mutual trust with focus on IMs and RUs
- Article 9(2): imposition of SMS on IMs and RUs
- Article 29(2): role of the Agency – occurrence reporting – report to Commission (June 2024)

### CSM on SMS for IMs and RUs 2018/762

- Recital 7: promotion of safety culture through SMS
- Annex I and II – Section 2.1.1 (j): involvement of top management promoting a positive safety culture
- Annex I and II – Section 7.2.3: strategy to be implemented by each organisation

*Source: Introduction to the European Railway Safety Culture Model - https://www.era.europa.eu/sites/default/files/activities/docs/european_railway_safety_cultutre_model_en.pdf*

# Railway Safety Directive: common responsibility of all actors

Article 4: Without prejudice to the responsibilities of railway undertakings and infrastructure managers referred to in paragraph 3, **entities in charge of maintenance and all other actors having a potential impact on the safe operation of the Union rail system, including manufacturers, maintenance suppliers, keepers, service providers, contracting entities, carriers, consignors, consignees, loaders, unloaders, fillers and unfillers**, shall:

a) implement the necessary risk control measures, where appropriate in cooperation with other actors;

b) ensure that subsystems, accessories, equipment and services supplied by them comply with specified requirements and conditions for use so that they can be safely operated by the railway undertaking and/or the infrastructure manager concerned.

# Interoperability Directive: safety also an essential requirement in TSIs

## MIX OF SAFETY REQUIREMENTS

**Those Directives are addressed to the railway system as a whole: holistic system approach is fundamental.**

### Interoperability Directive 2016/797

- Harmonisation of essential interoperability requirements through TSIs (design, parameters, construction, maintenance, monitoring…)
- Safety requirements also integrated as essential requirement into TSIs (e.g. TSI WAG, TSI INF…)
- Common understanding and univocal application of requirements as key factor to improve safety of complete system

### EU Railway Safety Directive 2016/798

- A common approach to management of safety (SMS)
- Single safety certificates
- Common Safety Methods (CSM), Indicators (CSI) and Targets (CST)

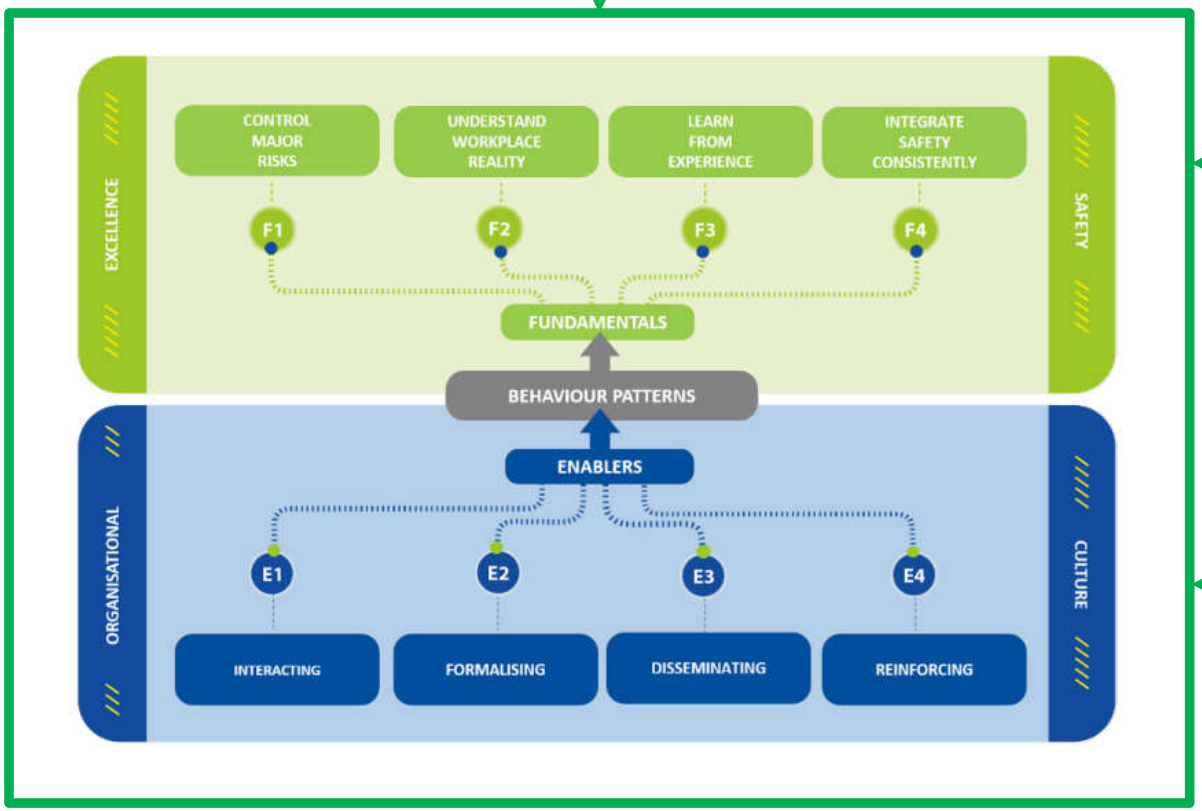
*Example of safety requirements into TSI WAG*

- *4.2.3.5 – Running safety (gauging and track interaction)*
- *4.2.4.2 – Safety requirements (brake)*
- *4.2.6.1 – Fire safety (system protection)*
- *6.2.2.2 – Safety against derailment running on twisted track*

# Wagon keeper: example of application towards the European Railway Safety Culture Model 2.0

**Common Safety Methods**

- *Implementing Regulation 402/2013*
  *(CSM for risk evaluation and assessment)*
- *Regulation 1078/2012*
  *(CSM for monitoring)*
- *Delegated Act 2018/762*
  *(CSM on SMS)*





**Regulations**

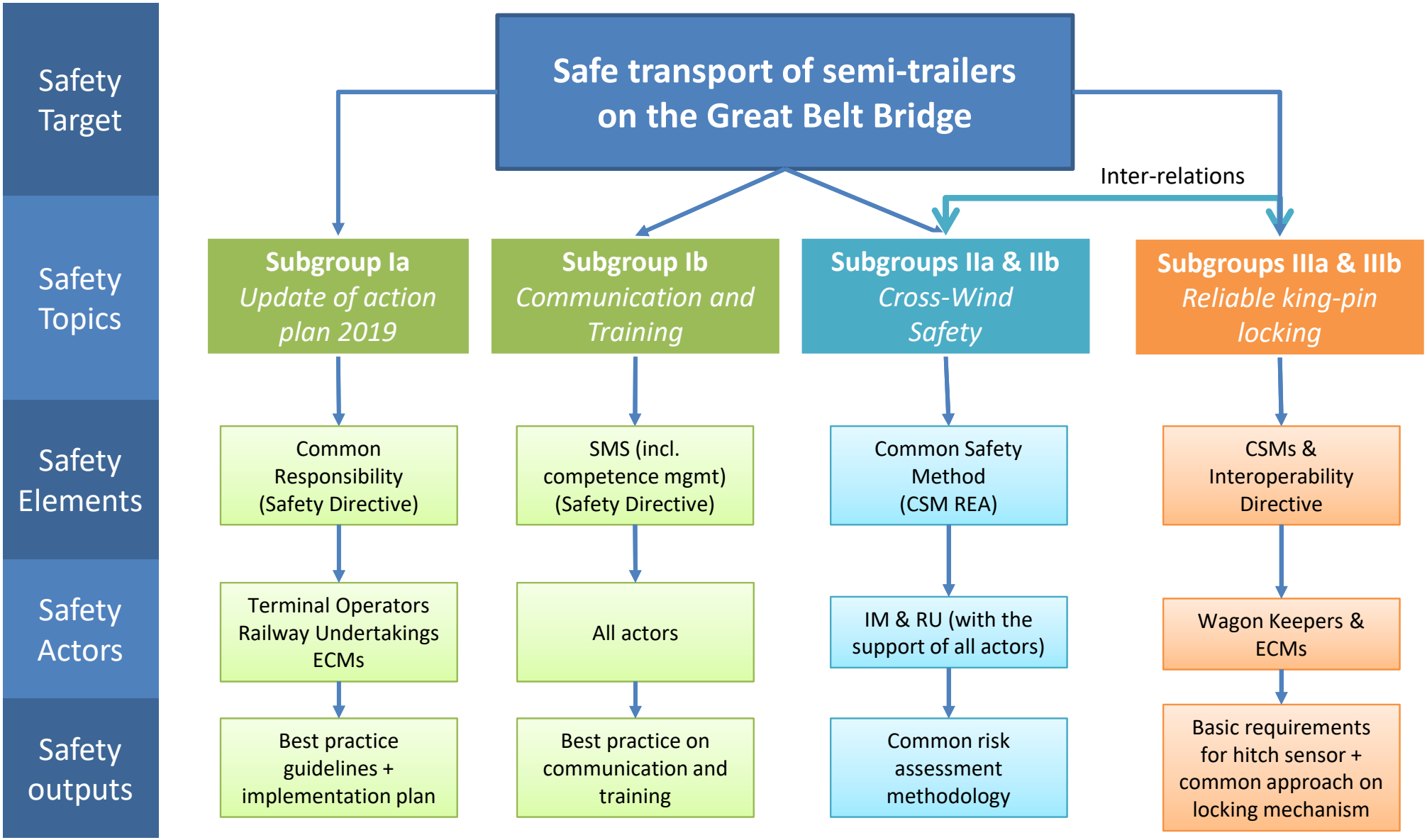
- *Safety Directive 2016/798*
- *ECM Regulation 2019/779*
- *TSI WAG*

**Operational**

- *TSI OPE*
- *GCU*
- *VPI EMG*
- *National Rules*
- *EN standards*
- *UIC Irs*
- *JNS action plans*

# 2. Outcome

## System approach applied to JNS Great Belt Bridge



## Cluster I: Secure loading

# Subgroup Ia: Update of Action Plan 2019

Lead: UIRR

Support: CER, ERFA, NSA DK, NSA SE, UIP, UIC

# 2. Outcome of subgroup Ia
## Introduction

- The subgroup Ia made an update of the action plan of 2019 ("Action Plan - JNS UP Task Force on the Great Belt Accident")

- The outcome of this exercise is the risk mitigation measures for pocket wagons equipped with any hitch types – see next slides

- These risk mitigation measures are applicable for all types of hitches and replace the short-term risk mitigation measures agreed in the JNS Urgent Procedure of 2019 ("Action Plan - JNS UP Task Force on the Great Belt Accident")

# 2. Outcome of subgroup Ia

## Risk mitigation measures for pocket wagons equipped with any hitch types (1/5)

| When | Who | Actions, tools and resources | Consequences | Documentation |
|---|---|---|---|---|
| 0) Maintenance | ECM (see footnote 1) | The Entity in Charge of Maintenance (ECM) plays an important safety role in the European railway system by ensuring that the vehicles for which it is in charge are in a safe state of running by means of a system of maintenance. This European system of certification for ECMs has been set up in Regulation 2019/779.<br><br>Manufacturer of wagons are responsible of the production and the correct development of maintenance manuals. ECMs in charge of pocket wagons are responsible for the correct management of these vehicles by applying/managing these maintenance manuals of the pocket wagons including the hitches.<br><br>*Tools*<br>- *ECM Regulation*<br>- *Guidelines on Communication and Staff Competences (see note 7)* | Manufacturer shall set up/develop maintenance manuals for their produced wagons.<br>ECM shall manage these maintenance manuals according to the manufacturers' instructions and/or based on their return of experiences with such vehicles. | ECM maintenance plans<br><br>The next hitch maintenance date shall be preferably indicated on both sides of the pocket wagon. As a second option, it might be made available by the ECM/keeper to the RU by other means (for example through the RSRD). |
| 1) Optional:<br>At arrival, after removing the semi-trailer or container from the pocket wagon (unloading). | RU, Terminal or third-party on behalf of RU (see footnote 1) | Visual checks in the terminal that…<br>a. …the handles or any other locking mechanism both sides are in their correct position;<br>b. …the hitch is free of damages, and<br>c. …the wagon is not marked with a K-label (note 2).<br><br>*Tools:*<br>• *appropriate lighting.*<br>• *red tape.*<br>• *K-label (RU or the terminal operator or any other third party contracted by the RU)*<br>• *GCU contract (K label processes)* | If the checks a) and b) returns a negative result<br>• red tape and/or K label shall be affixed on the wagon on both sides;<br>• pocket wagon shall not be used for the transport of semi-trailers, and<br>• wagon keeper/ECM shall be informed.<br><br>In case of a presence of a K-label (related to check c), the GCU processes have to be followed. | Traceability of checks shall be assured.<br><br>Documentation from RU to the wagon keeper/ECM.<br>If the terminal acts on behalf of the RU, the information shall be communicated to the responsible RU. |

# 2. Outcome of subgroup Ia

## Risk mitigation measures for pocket wagons equipped with any hitch types (2/5)

| When | Who | Actions, tools and resources | Consequences | Documentation |
|---|---|---|---|---|
| 2) Before placing the semi-trailer on to the pocket wagon (loading - preparation) | Terminal Operator<br><br>&<br><br>Truck Drivers | The following operations should be performed by the terminal operator on the wagon:<br>a) Fold and secure all intermediate supports and spigots (at both lateral sides)<br>b) Position, if necessary the hitch at the right height position (as indicated on the codification plate of the semi-trailer)<br>c) Position, if necessary, the hitch in the longitudinal direction of the semi-trailer at the right place<br>d) Secure (for certain types of pocket wagons) the handwheel of the wagon or the hand T bar.<br>e) Position, if necessary, the wheel wedges (for certain types of pocket wagons)<br>f) Check the status of the hitch (no visible damages)<br>g) Check the compatibility of the wagon and semi-trailer (based on the physical markings)<br>h) Check the hitch maintenance intervals (by any means)<br>i) Check if the locking systems are functioning correctly (based on the hitch manuals)<br>The following tasks are under the responsibility of the truck drivers in case of direct loading (if not: these tasks will be performed by the terminal operator):<br>1. Place the semi-trailer in parallel of the railway track and wagon<br>2. Fold up and secure the lateral and back underrun protection (f necessary – depends on the types of semi-trailers and pocket wagons)<br>3. Release air suspension (visible marking on the semi-trailer) and trailer brake<br>4. In case of non-direct loading, crank down the support legs and set the semi-trailer in brake position<br>Best practices terminal instructions are given in the separate terminal instructions guidelines (see note 3).<br><br>*Resources & Tools:*<br>• *skilled terminal staff*<br>• *appropriate lighting*<br>• *hand light* | If any of the actions and/or checks performed by the terminal operator a) to i) is not possible or returns a negative result<br>• Semi-trailer is not allowed to be loaded on the wagon<br>• RU, wagon keeper/ECM and/or CT Operators shall be informed.<br><br>In case of visible damages on the hitches identified by the terminal operator, an information should be exchanged with the CT operator and/or RU inspector/wagon keeper/ECM.<br><br>In case of lack of action (cf. 1 to 4) by the truck drivers, the semi-trailer won't be loaded onto the wagon.<br><br>In case of visible damages on the hitch, it does not forbid to load containers and/or swap bodies on the same pocket wagon. | Traceability of checks a) to i) shall be assured.<br><br>Documentation by email from the terminal to the CT Operator, RU and/or wagon keeper/ECM. |

# 2. Outcome of subgroup Ia

## Risk mitigation measures for pocket wagons equipped with any hitch types (3/5)

| When | Who | Actions, tools and resources | Consequences | Documentation |
|---|---|---|---|---|
| 3) During placing the semi-trailer onto the pocket wagon (loading). | Terminal Operator | The transfer of the semi-trailer is performed by the crane operator with the support of a dedicated ground staff member, standing next to the pocket wagon.<br><br>This ground staff member shall assure that (1) the kingpin is placed into the guiding ring of the hitch and (2) that there are no gaps between the hitch top plate and the semi-trailer plate (note 4).<br><br>The semi-trailer loaded onto the pocket wagon is compatibility (based on the visible markings on the pocket wagon and semi-trailer)<br><br>The correct position of the king pin into the hitch is in most cases accompanied by a clearly identified noise ("CLAC"). | If any of the checks returns a negative result<br>• Mitigation measures are applied and if not possible the semi-trailer is moved back to the ground.<br>• CT Operator shall be informed in case of no transfer of the semi-trailer to the wagon. | Traceability of checks (1 to 2) shall be assured if the semi-trailer cannot be correctly loaded onto the wagon.<br><br>Documentation by email from the terminal to CT Operator |
| 4) Immediately after placing the semi-trailer onto the pocket wagon (loading) | Terminal Operator | Checks in the terminal that...:<br>a) ...the king pin is placed into the guiding ring of the hitch and that there are no gaps between the hitch top plate and the semi-trailer plate (note 4);<br>b) ...that the locking system is correctly secured according to the hitch manuals, the locking indicator is activated and on (if the wagon is fitted with such telematic features) (note 5)<br>c) ... the hitch and wheels are the single connecting points between the wagon and the semi-trailers<br>d) ... the air suspension has been deflated (for semi-trailers equipped with air suspension) and the lever is in the right position (visible markings on the unit)<br><br>*Tools:*<br>• *Terminal best practice safety instructions (see note 3)*<br>• *Hitch operational manuals*<br>• *Training materials* | If any of the checks a) to d) returns a negative result<br>• Mitigation measures are applied and if not possible the semi-trailer is moved back to the ground.<br>• CT Operator and eventually wagon keeper/ECM and RU (for example in case of point b) shall be informed in case of no transfer of the semi-trailer onto the wagon. | Traceability of checks shall be assured if the semi-trailer cannot be loaded and secured.<br><br>Documentation by email from the terminal to CT Operator and eventually to wagon keeper/ECM and RU |

# 2. Outcome of subgroup Ia

## Risk mitigation measures for pocket wagons equipped with any hitch types (4/5)

| When | Who | Actions, tools and resources | Consequences | Documentation |
|---|---|---|---|---|
| 5) Before train departure | RU or Terminal Operator on behalf of RU (see footnote 1) | The technical transfer inspection shall be performed by a skilled and trained railway operational staff.<br>Checks pocket wagons loaded with semi-trailers that…:<br>a) … the checks performed by the terminal operator returned no negative results;<br>b) … the semi-trailer loaded onto the pocket wagon is compatibility (based on the visible markings on the pocket wagon and semi-trailer)<br>c) …the king-pin is correctly placed and locked,<br>d) … the locking system is working correctly according to the hitch manuals<br>e) …that the hitch system with sensors (if available) is visible and activated on both sides of the wagon (see note 5).<br>f) … that the moving parts (spigots…) are properly secured<br>g) … that the scotching of the wheels of the semi-trailer is correct (if necessary according to the wagon operational instructions)<br>All other aspects related to the technical transfer inspection (see GCU catalogue) shall also be verified.<br><br>*Tools:*<br>• *GCU Contract (appendix 9) (see note 6)*<br>• *Red tape*<br>• *K-label (see note 2)* | If any of the checks a) to g) returns a negative result…<br>• …the semi-trailer shall be removed from the pocket wagon concerned or if not possible;<br>• …the pocket wagon concerned shall be detached from the train set;<br>• In both cases, a K Label (note 2) and red tape shall be affixed on both sides of the pocket wagon concerned, if not yet present.<br><br>In case of a malfunctioning hitch system with sensors, the final decision to transport or not the semi-trailer will remain under the responsibility of the RU during the visual inspection.<br><br>The RU shall ensure that all wagons having red tape have a K label affixed on both sides.<br><br>In case of a K label (not possible to transport semi-trailers according to GCU appendix 9 – see note 6), it does not prevent from loading containers and/or swap bodies on the same pocket wagon. | Traceability of checks shall be assured.<br><br>RU shall report to the Keeper/ECM if required by contract (e.g. GCU Appendix 4). |
| 6) Communication : actors involved and links | All actors of the CT chain (railway part) | An efficient and regular information exchange shall be in place between the involved parties concerning at least the following elements:<br>• User manual (Owner = wagon keeper)<br>• Maintenance manual (Owner = ECM)<br>• Damage information (RU is the producer of the damage report)<br>• Return of experience (Safety Alert Information Tool for example)<br>*Tools:*<br>• *Guidelines on Communication and Staff Competences (see note 7)* | All actors of the CT chain (railway part) shall check if all the information were correctly communicated before the train departure. All communication details are described in the Guidelines on Communication and Staff Competences (see note 7).<br><br>In case the check returns negative result the train shall not depart. | Traceability of communications shall be assured. |

# 2. Outcome of subgroup Ia

## Risk mitigation measures for pocket wagons equipped with any hitch types (5/5)

| When | Who | Actions, tools and resources | Consequences | Documentation |
|---|---|---|---|---|
| 7) Staff competences | All actors of the CT chain (railway part) | In order to ensure a safe transportation of semi-trailers, staff shall be trained and acquire the right competences in the following areas for safe loading and transportation of semi-trailers:<br>• 1st training – use (audits and checks shall be performed to monitor the process)<br>• 1st training – maintenance of wagons<br>• Self-maintaining skills and monitoring process (audits and checks can/shall be performed to monitor the process by third-parties)<br><br>*Tools:*<br>• *Internal/external audits*<br>• *Guidelines on Communication and Staff competences (see note 7)* | All actors of the CT chain (railway part) shall check if their staff were correctly trained and have the right skills to perform the various activities.<br><br>In case the check returns negative result, corrective measures have to be implemented by the respective parties. | Traceability of the staff competences shall be assured. |

***Footnote***

*1) If these checks are performed by the terminal operator or a third party, a contract with the RU must be concluded. The checks must be controlled within the scope of the RU´s safety management system, especially in regards of procedures to be applied, and qualifications of staff involved. The RU might also check through audits and monitoring that actors have the adequate competence requirements on staff working with loading and controls according their SMS. RU might also check that staff working with loading and unloading has knowledge of actual loading guides according to the RU's SMS.*

# 2. Outcome of subgroup Ia

## Note 1: ECM functions

ECM functions and their relations according to:

1) Commission Implementation Regulation (EU) 2019/779 of 16 May 2019 on a system of certification of entities in charge of maintenance of vehicles and repealing Commission Regulation (EU) No 445/2011

2) ERA Guide for the application of the Art 14 of Directive (EU) 2016/798 and Commission Regulation (EU) No 2019/779 on a system of certification of entities in charge of maintenance for vehicles

According to Article 1.1 of the Regulation 2019/779/EU, the maintenance system shall be composed of the following functions described in Article 14(3) of Directive (EU) 2016/798 and in ERA guidance:

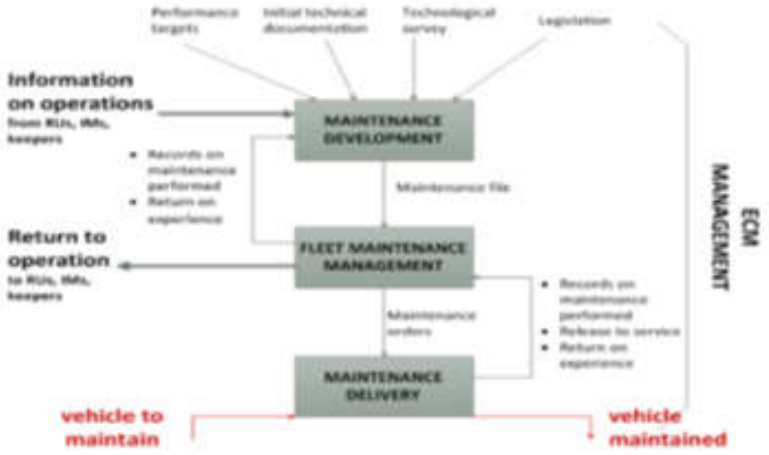
(a/ aka ECM1) the **management function**, which **supervises** and **coordinates** the maintenance functions referred to in points (b) to (d) and ensures the safe state of the vehicles in the railway system; The certified ECM is the one who performs this function and is responsible for the others through its SMS.

(b/ aka ECM2) the **maintenance development function**, which is responsible for the management of the maintenance documentation, including the configuration management, based on design and operational data as well as on performance and return on experience;

(c/ aka ECM3) the **fleet maintenance management function**, which manages the vehicle's removal for maintenance and its return to operation after maintenance; and

(d/ aka ECM4) the **maintenance delivery function**, which delivers the required technical maintenance of a vehicle or parts of it, including the release to service documentation.

These 3 last functions are integrated in the maintenance system through a MANAGEMENT PROCESS (see the figure to the right).




It should not be understood as a strictly mandatory organisational structure for ECMs. Nevertheless the structure put in place by the ECM has to reflect on this functional maintenance breakdown. The ECM has to attach all elements (internal services, subdivisions and contractors) of its organisational structure to one or more maintenance functions.

Note: The ECM4 functions shall be under the control of ECM 1, even if it is outsourced and certified. ECM4 to deliver "records on maintenance performed" to ECM3 who report further to ECM2. ECM1 is responsible and certified for the entire process.

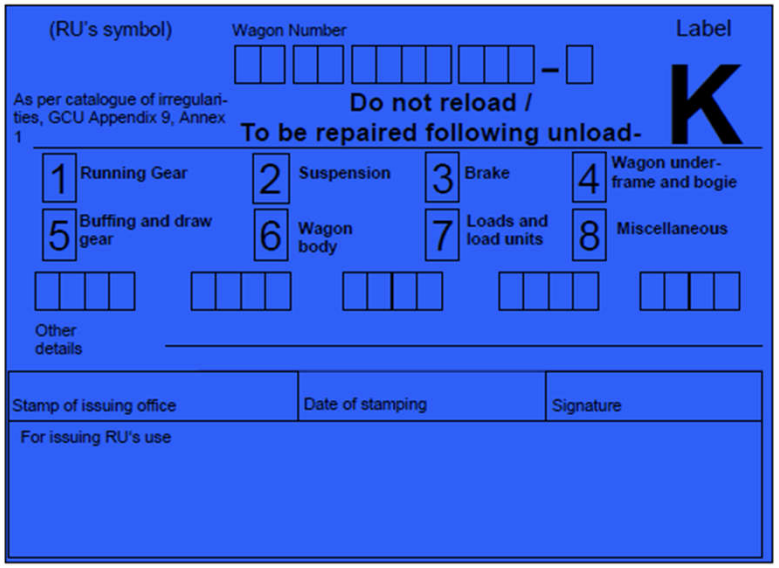
# 2. Outcome of subgroup Ia

## Note 2: GCU label

**GCU Label K shall be applied to the pocket wagon, indicating that it may not be loaded or reloaded with a semi-trailer:**



**LABEL K**




blue, size roughly 148 x 210 mm

K labels serve to indicate that there is a problem with the wagon or load unit, but that these can – for the time being – continue to be operated. However, the problems must be resolved prior to reloading; any reloading of the wagon will lead to its withdrawal.

The defect code must be filled out completely in accordance with GCU Appendix 9, Annex 1:

1. Circle or tick the number of the defect group/category
2. Enter the exact defect number in the empty boxes

K labels are to be affixed to both sides of the wagon in a clearly visible position, close to the label-holder or on the inscription plates. The printed version of the K label must contain the data provided for by this annex.

# 2. Outcome of subgroup Ia

## Note 3: Terminal actions and checks (best practices)

Intermodal terminals are the interface between different transport modes (for example between road and rail) and thus are key to access intermodal transport services and to ensure efficient, safe and secured supply chains throughout Europe. Every single terminal facility handling semi-trailers in Europe shall design and maintain operational instructions to safely load/unload the units from/onto the CT wagons. These terminal guidelines shall set working rules for at least the following processes: (1) check-in gates (when the semi-trailer is delivered at the terminal), (2) planning (compatibility checks), (3) loading preparation and (4) loading operations (before and during the transfer).

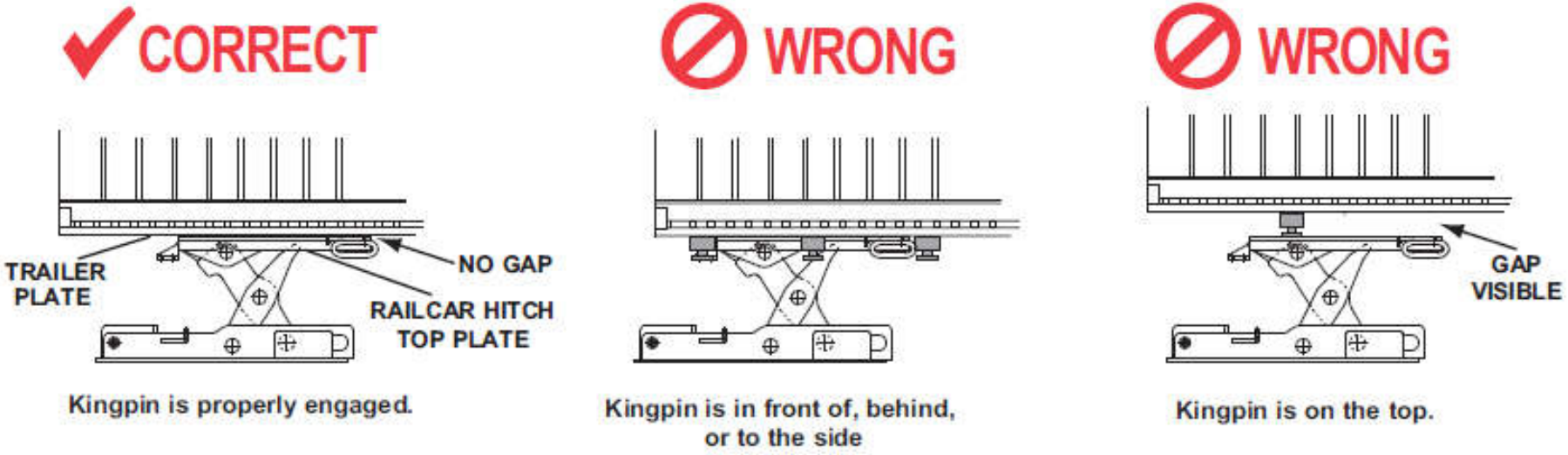
**See Annex 2 : Terminal Instructions –**
**Operational rules for semi-trailers in combined transport terminals**

# 2. Outcome of subgroup Ia

## Note 4: Visual check

Visually check that the semi-trailer is loaded correctly and the king-pin is in the right position inserted into the guide ring

A. The kingpin must be fully inserted into the guide ring and there must be no gaps between the trailer plate and the railcar hitch top plate.



# 2. Outcome of subgroup Ia

## Note 5: Hitch systems with sensors

Telematics and sensors can be only used as a support (and do not replace the visual inspections of the terminal and RU staff) to the terminal operators and railway undertakings' checking activities regarding to the securing of the king pin into the hitch. In order to avoid a multitude of non-standardized solutions (impacting the overall terminal activities), the design and development of such devices/sensors shall follow a single set of requirements (basic prerequisites, functional requirements and minimum information transmitted to data systems).

➔ **See also the outcome of Subgroup IIIa Hitch sensors**

# 2. Outcome of subgroup Ia

## Note 6: GCU Contract – Technical Transfer Inspection (1/2)

The General Contract of Use for Wagons (GCU) is a multilateral contract based on the international convention COTIF 1999 and Annex CUV. The GCU specifies the mutual rights and obligations of Wagon Keepers (K) and Railway Undertakings (RU) with regard to the use of rail freight wagons as a means of transport throughout Europe and beyond. The Annex 1 of appendix 9 sets out binding provisions governing the technical condition of wagons for the exchange of freight wagons, as established during a technical transfer inspection (for example at the departure of the train at the terminal). It also describes a quality assurance procedure to be applied by RUs that have signed agreements governing the technical conditions for this exchange.

# 2. Outcome of subgroup Ia

## Note 6: GCU Contract – Technical Transfer Inspection (2/2)

| | | | | |
|---|---|---|---|---|
| **Wagon body in general** | 6.1 | | | |
| **Markings on wagons** | 6.1.1 | Missing, illegible or incomplete | | |
| | 6.1.1.1 | – wagon number[7] | Detach wagon | 4 |
| | 6.1.1.2 | – "RIV" sign, "TEN" + "GE" or acceptance marking ("TEN" + "G1", country acronym in approval plate)[7] or | Detach wagon | 4 |
| | 6.1.1.3 | – agreement plate (if showing exchange codes 41, 43, 45, 81, 83 or 85)[7] or an acceptance marking ("TEN" + "CW" + country acronym in approval plate)[7] | Detach wagon | 4 |
| | 6.1.1.4 | – tare weight[7] | Detach wagon | 4 |
| | 6.1.1.5 | – braked weight of hand brake[7] | Detach wagon | 4 |
| | 6.1.1.6 | – load limits[7] | Detach wagon | 4 |
| | 6.1.1.7 | – capacity of tank wagons[7] | Detach wagon | 4 |
| | 6.1.1.8 | – both the VKM and full address of wagon keeper[7] | Detach wagon | 4 |
| | 6.1.1.9 | – length-over-buffers of wagon[7] | Detach wagon | 4 |
| | 6.1.1.10 | – "high voltage" warning sign on wagons with step or ladder access up to a height > 2 m above rail level | Detach wagon | 4 |
| | 6.1.1.11 | – indication of compatibility with ILUs on carrying wagon[7] | Detach wagon | 4 |
| | 6.1.1.12 | - reserved - | | |
| | 6.1.1.13 | - reserved - | | |

| Component | Code no. | Irregularities/Criteria/Notes | Action to be taken | Irregularity class |
|---|---|---|---|---|
| **Gear for securing load units (ILU) on carrier wagons** | 6.7 | | | |
| | 6.7.1 | Trestle or spigot distorted or defective | | |
| | 6.7.1.1 | – trestle not in use | K | 3 |
| | 6.7.1.2 | – trestle in use | Rectify +K. If not possible, detach wagon | 5 |
| | 6.7.1.3 | – spigot not in use | K | 3 |
| | 6.7.1.4 | – spigot in use | Rectify +K. If not possible, detach wagon | 5 |
| | 6.7.2 | Coupling pin of trailer not locked into trestle | Lock. If not possible, detach wagon | 5 |
| | 6.7.3 | Trestle not in use and not locked | Place trestle in its end position and lock. If not possible, secure temporarily + K | 3 |
| | 6.7.4 | Trestle adjustment device unlocked and potentially fouling the gauge | Push in and secure trestle adjustment device. If not possible, detach wagon | 5 |
| | 6.7.5 | Moving parts not properly secured (e.g. retractable spigots, handrails for shunters, etc.) | | |
| | 6.7.5.1 | – no risk of fouling the gauge | Rectify. If not possible, secure provisionally | 3 |
| | 6.7.5.2 | – Risk of fouling the gauge | Rectify. If not possible, detach wagon | 5 |
| | 6.7.6 | Anti-crash system of trestle triggered, damaged elements | | |
| | 6.7.6.1 | – in use | Detach wagon | 5 |
| | 6.7.6.2 | – not in use | K, close emergency stop cock | 4 |

# 2. Outcome of subgroup Ia

## Note 7: Communication & Staff competences

A safe transport requires a clear communication (digitalized or not) between the actors involved in the management, maintenance and operations of pocket wagons in Combined Transport. Stakeholders such as Authorities (NSAs), wagon manufacturers, wagon keepers, ECMs, lessors, lessees, intermodal operators, Railway Undertakings, Infrastructure Managers, workshops, maintenance mobile teams, last mile shunting RUs and terminal operators shall exchange information in case of business preparation (new wagon for example), of identified damages and of daily experiences during operations (return of experiences).

In addition, safe and secure intermodal transport requires competent and skilled staff at all levels. Internal and external training sessions shall be organized before start of operations (for example in case of a new wagon) and during operations to maintain the competences at the right levels. Regular monitoring and sample auditing are means to keep the staff competences.

A basic training course template has been developed for the loading of intermodal loading units on railway wagons at intermodal terminals (see enclosed).

- If there is no contract between the RU and the terminal operator, the responsibility for the training course lies with the terminal staff. The validity of the results achieved and the monitoring is the responsibility of the RU.

- if there is a contract between the RU and the terminal operator, both the training and the validation and monitoring over time will be under the responsibility of the RU (even if carried out by third-party staff or directly by the terminal operator).

➔ See also the outcome of subgroup IIa : communication and training related to hitches

**See Annex 3 : Loading of intermodal loading units on railway wagons at intermodal terminals - Training course (template)**

# 2. Outcome of subgroup Ia
# Implementation: how to bring the action plan to real life operations ?

**Goals**

- Correct application of the extended 2019 action plan by all relevant parties
- Restoration of trust between all concerned stakeholders and the national safety authorities

**Recommendations**

- #1 Action Plan into AMOC (safe load) (under UIRR coordination
- #2 Active exploitation by representative bodies (under GRB coordination)

**Planning**

- 6-month schedule

# 2. Outcome of subgroup Ia
# Action plan into an AMOC (1/4)

*Article 19(3) of Regulation (EU) 2016/796 of the European Parliament and of the Council of 11 May 2016*

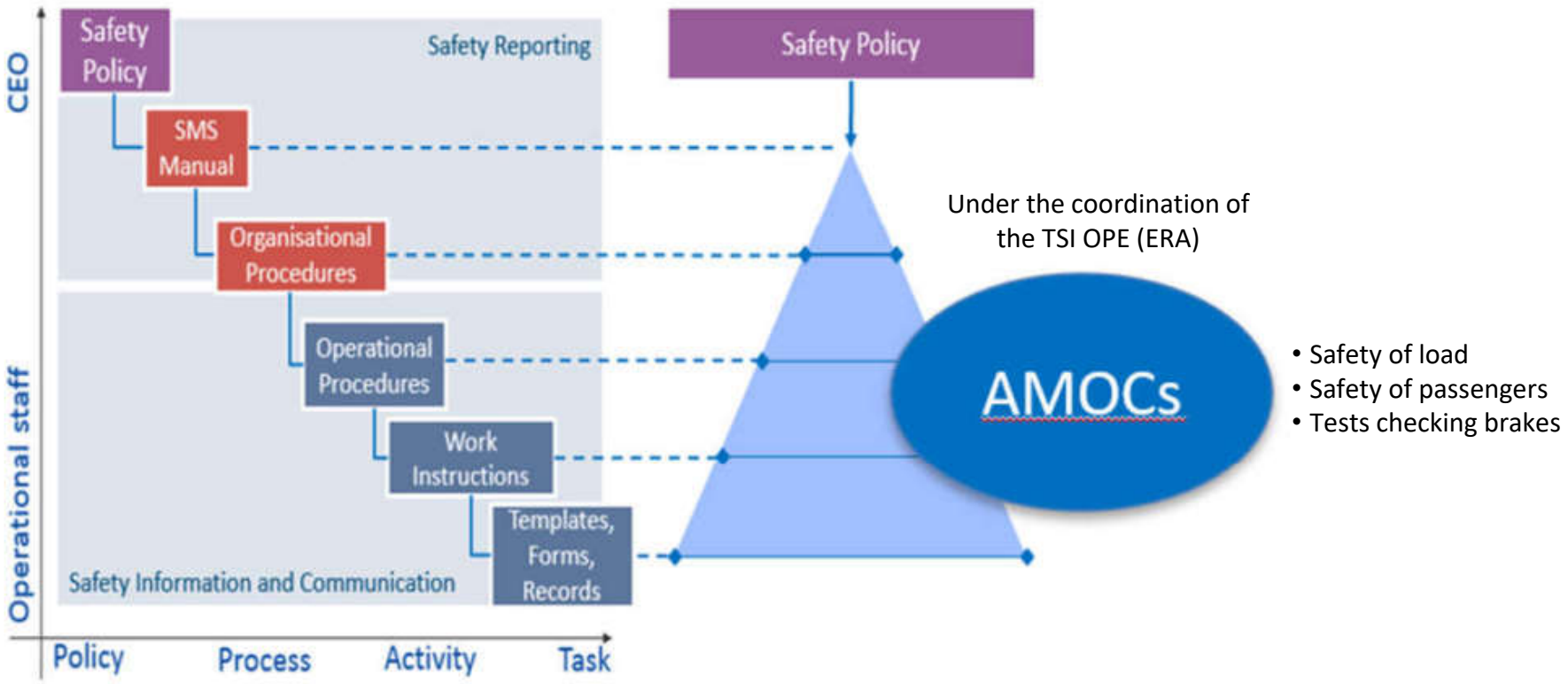
- The Agency may issue guidelines and other non-binding documents to facilitate the implementation of railway interoperability legislation, including assistance to Member States in identifying national rules that can be repealed further to the adoption or revision of TSIs.

Article 4 (i) *of Regulation (EU) 2016/796 of the European Parliament and of the Council of 11 May 2016*

- The Agency may: … issue guidelines and other non-binding documents facilitating application of railway safety and interoperability legislation pursuant to Articles 13, 19, 28, 32, 33 and 37.

https://www.era.europa.eu/sites/default/files/library/docs/opinion-advice/AMOC_supporting_guidance_v1.0_final.pdf

# 2. Outcome of subgroup Ia
# Action plan into an AMOC (2/4)




An AMOC defines good practices to be used to cover operational risks when these are applicable, in doing so, an AMOC can define the good practice or contain reference to external document that are to be considered as good practice. In the case of the AMOCs to support the TSI OPE this is good practice provided by a number of sector organisations and NSAs.

https://www.era.europa.eu/sites/default/files/library/docs/opinion-advice/AMOC_supporting_guidance_v1.0_final.pdf

# 2. Outcome of subgroup Ia
# Action plan into an AMOC (3/4)

**AMOC on Safety of load – safety requirements**

https://www.era.europa.eu/sites/default/files/library/docs/opinion-advice/tsi_ope_AMOC_safety_of_load_v1_final.pdf

## 2.4. Safety requirements

- The RU should make sure that vehicles are safely and securely loaded and remain so throughout the journey;
- All vehicles that are part of a train including their load — should be compatible with all the requirements applicable on the routes over which the train is planned to operate. This includes respecting the following:
  - the mass limit permitted by the infrastructure manager for the respective lines as part of the route where the train is intended to run;
  - the mass limit permitted by each vehicle of the train;
  - the vehicle-loading gauge permitted by the infrastructure manager for the respective lines as part of the route where the train is intended to run;
- All vehicles that are part of a train including their load should be technically operational taking into account the characteristics of the wagon, the load and the infrastructure and remain so throughout the journey.

# 2. Outcome of subgroup Ia
# Implementation: action plan into an AMOC (4/4)

**Recommendation #1**
Update the current AMOC on safe load with the content of the JNS actions plans

| | | |
|---|---|---|
| How: | ad-hoc expert working group (based on subgroup Ia) | |
| | Coordinator: | UIRR |
| | Associations: | CER – ERFA – UIC – UIP – UIRR |
| | Authorities: | ERA – NSA DK – NSA SE |
| Aim: | prepare a text proposal to be submitted to the ERA WP TSI OPE | |
| Planning: | maximum 6 months | |

# 2. Outcome of subgroup Ia
# Implementation measures: representative bodies (1/2)

**What is a Representative Body ?**

- Article 38 paragraph 4 of Regulation (EU) 2016/796 on the European Union Agency for Railways and repealing Regulation (EC) No 881/2004 provides that the Agency may establish a Network of representative bodies (NRB). The list of those bodies shall be defined by the European Commission.

- The current list is available on https://www.era.europa.eu/agency/stakeholder-relations/representative-bodies_en

- Current NRB members : AERRL, ALE, ALLRAIL, CER, EAL, EIM, EPTTOLA, ERFA, ETF, FEDECRAIL, NB-Rail AISBL, UNIFE, UIP, UITP, UIRR

# 2. Outcome of subgroup Ia
# Implementation measures: representative bodies (2/2)

**Recommendation #2**
Coordination of follow-up activities under the GRB

How: Group of Representative Bodies - https://grbrail.eu/

Tasks:

- Direct dissemination and promotion towards their respective members
- Publication of the JNS outputs on their respective websites
- Organisation of specific internal working groups (monitoring of implementation)
- Awareness campaign towards safe loading and transport of semi-trailers
- Individual and/or joint events/workshops/webinars on safe loading
- Individual and/or joint press releases

In partnership with:

Cluster I: Secure loading

# Subgroup Ib. communication and training related to hitches

Lead: ERFA

Support: UIP, CER, UIC, UIRR

## 2. Outcome of subgroup Ib

# Communication and training related to hitches - Introduction

The aim of this document is to provide a summary and clarification of best practices on the communication and the training related to hitches.

In any case, the railway system works on the basis of the interaction between several actors, each of whom is responsible for its field of activity. Each actor must carry out these in a safe and informed manner. In the case of lack of adequate information/training/documents to carry out his activities correctly, it is the duty of each actor to take the necessary steps to obtain them and to bridge any gap that may affect negatively operational safety.

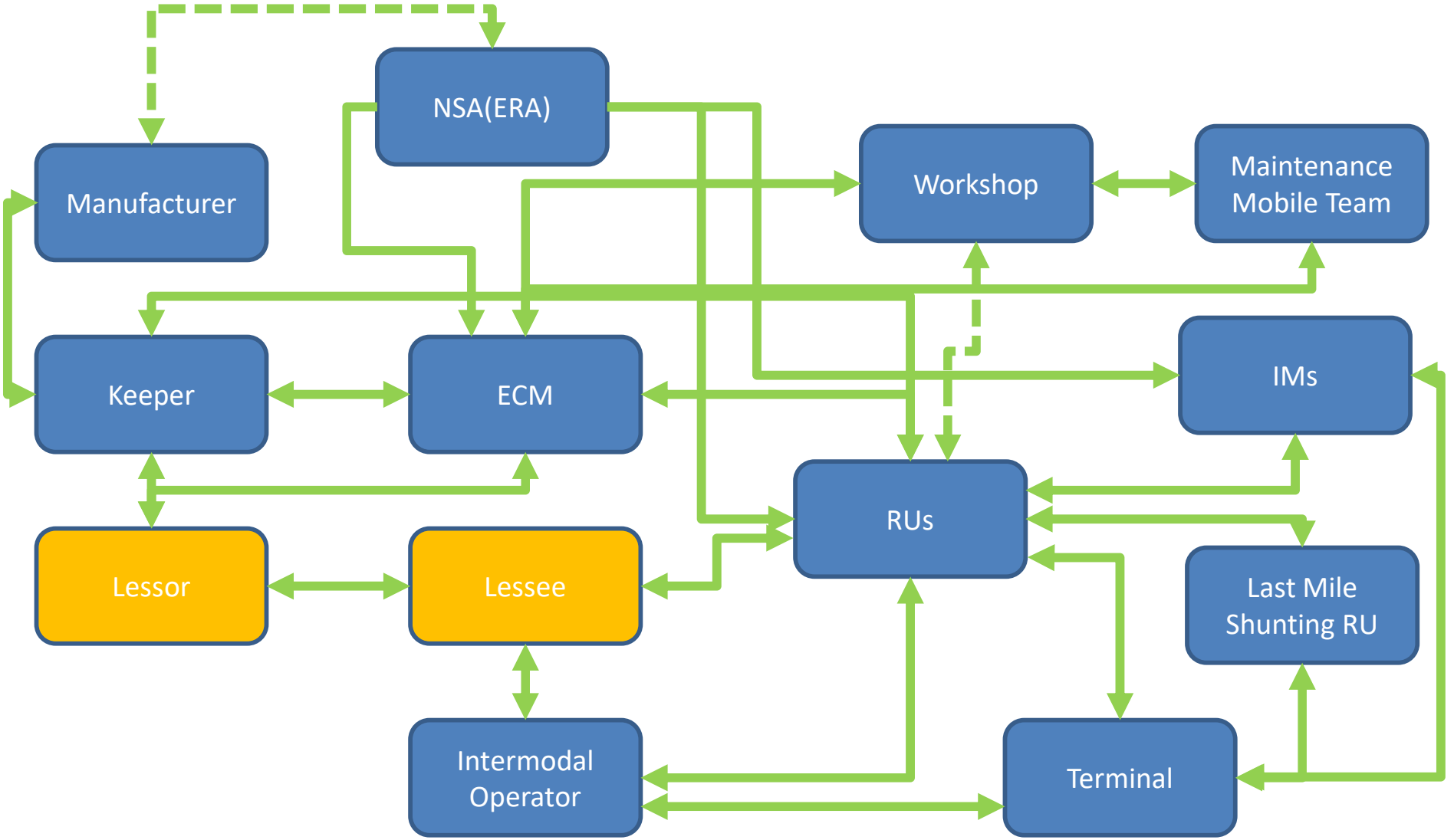
# 2. Outcome of subgroup Ib

## Communication and training related to hitches - Content

1. Communication related to hitches
   - Actors and Links
   - Info Exchange among Actors (preparation for Business)
     - User Manual
     - Maintenance Manual
   - Info Exchange in Case of Damages
   - Info Exchange with Components in Service (Return of Experience)
2. Training related to hitches
   - Training before Business Start
   - Maintaining of Competences (Monitoring & Auditing)

# 2. Outcome of subgroup Ib

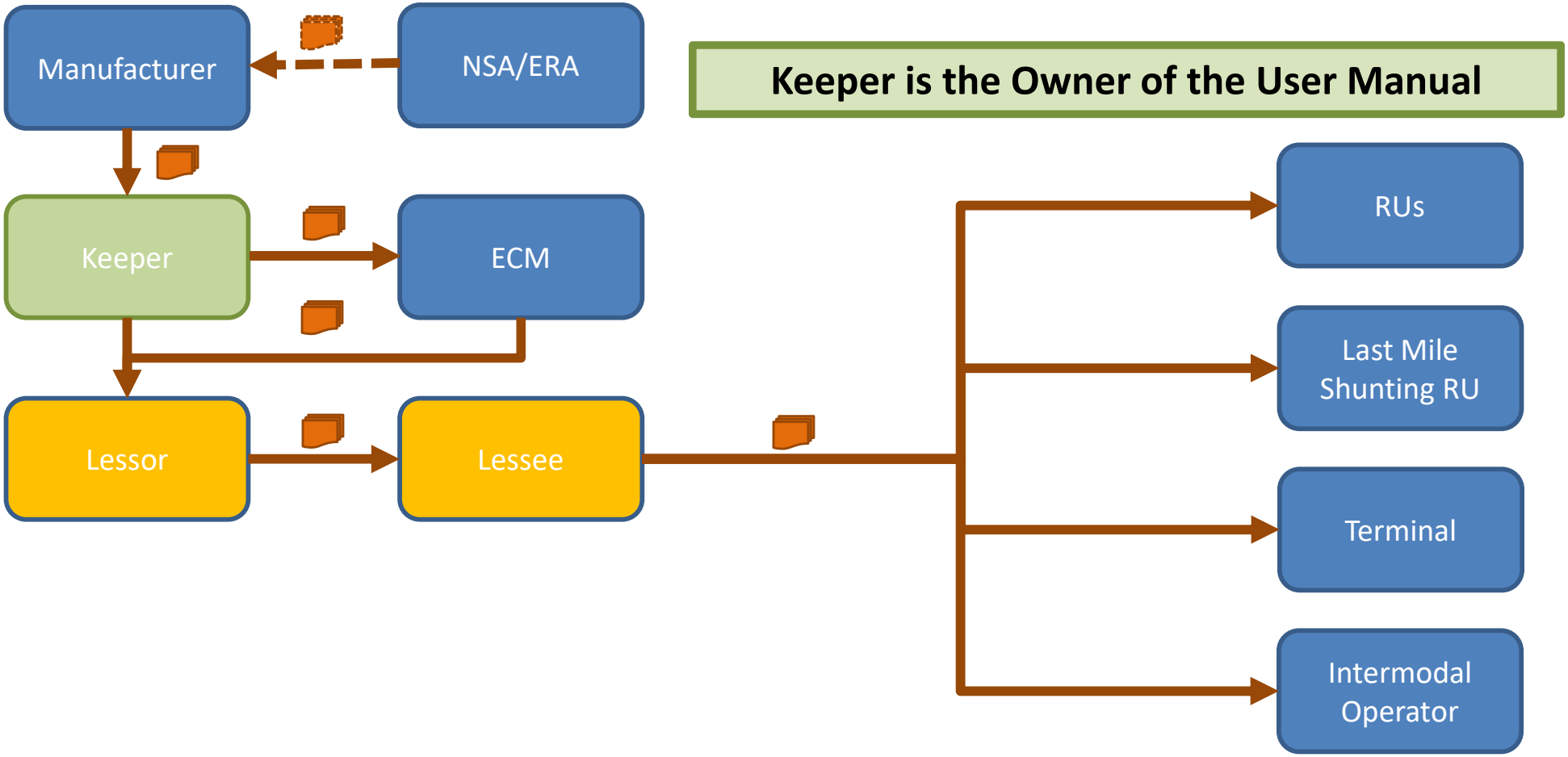
## Communication related to hitches - Actors & Links




**The orange boxes (Lessor/Lessee) represent subjects that may be present in the information flow. If they are not present, the arrows continue to the actors who interface with them, eliminating their presence.**

# 2. Outcome of subgroup Ib

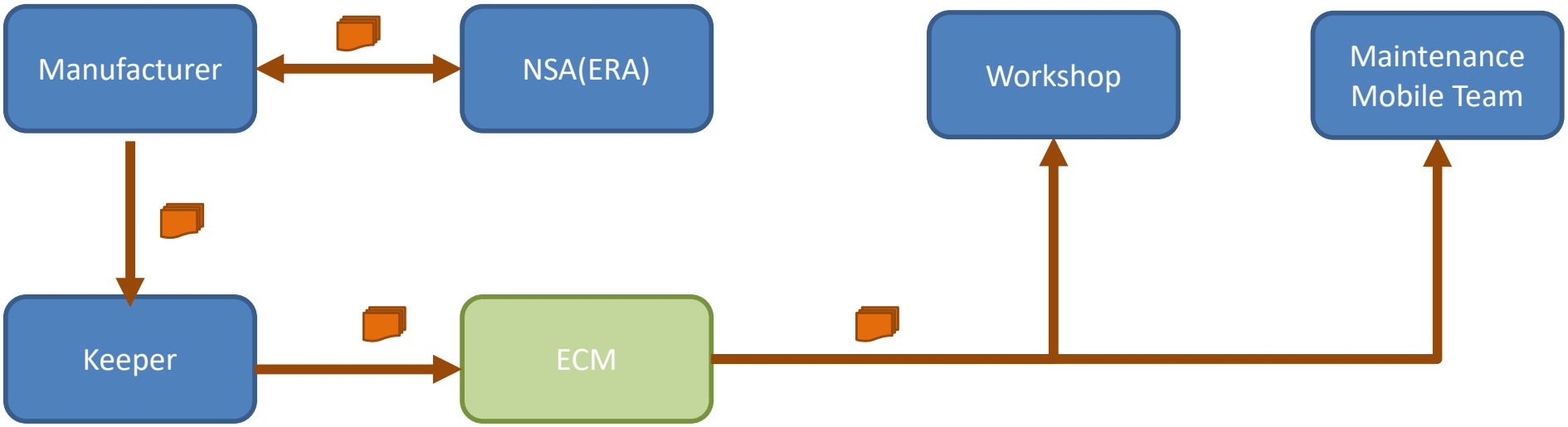
## Communication related to hitches - Focus on User Manual




**The orange boxes (Lessor/Lessee) represent subjects that may be present in the information flow. If they are not present, the arrows continue to the actors who interface with them, eliminating their presence.**

# 2. Outcome of subgroup Ib

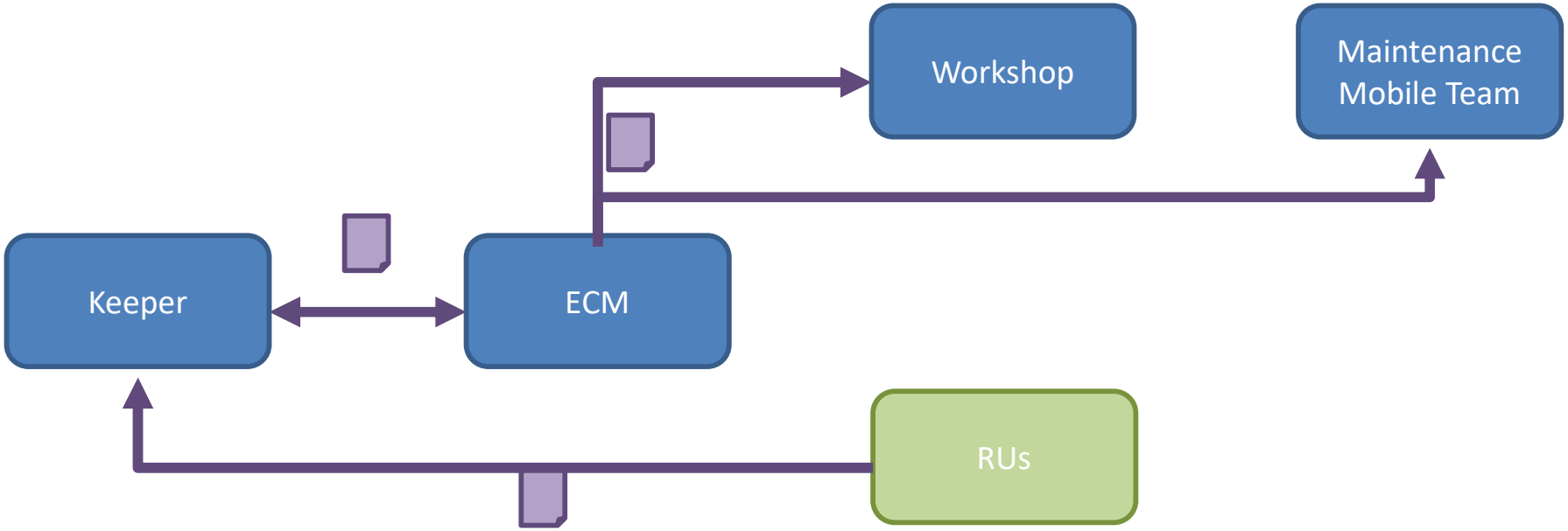
## Communication related to hitches - Focus on Maintenance Manual




**ECM is the Owner of the Maintenance Manual**

# 2. Outcome of subgroup Ib

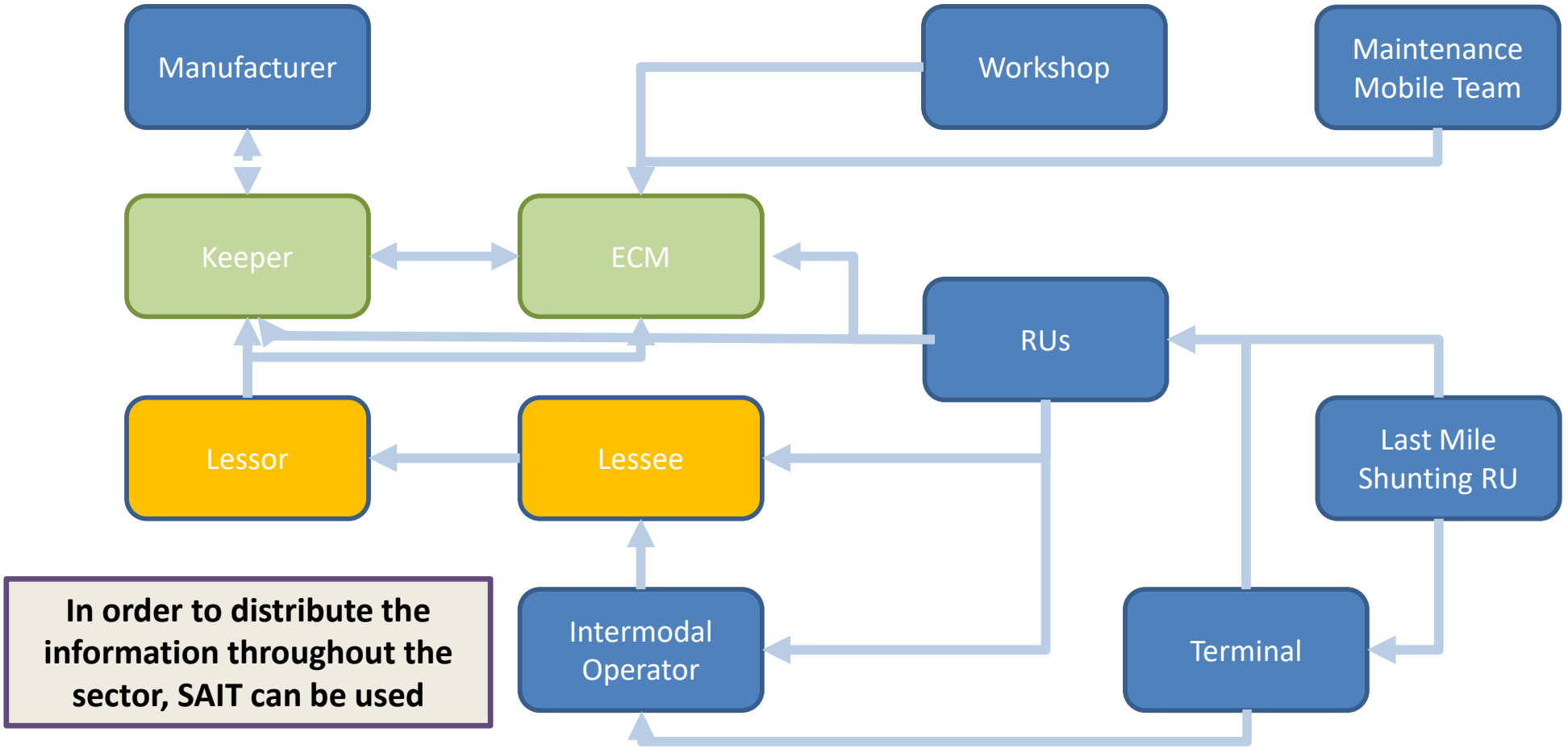
## Communication related to hitches - Focus on Damages




**RU is the Producer of the Damage Report (Appendix 4 – GCU)**

# 2. Outcome of subgroup Ib

## Communication related to hitches - Focus on Return of Experience




**In order to distribute the information throughout the sector, SAIT can be used**

**The orange boxes (Lessor/Lessee) represent subjects that may be present in the information flow. If they are not present, the arrows continue to the actors who interface with them, eliminating their presence.**

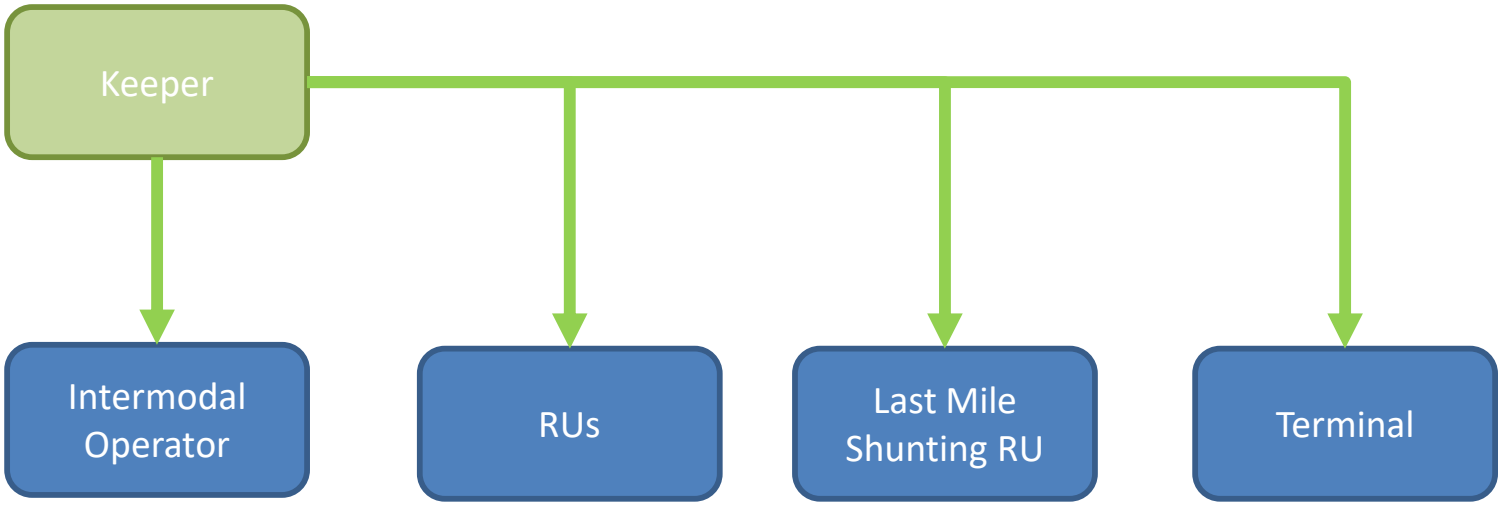
# 2. Outcome of subgroup Ib

## Communication related to hitches - Traceability requirements

- Traceability of the communication among the actors involved and their relevant staff members shall be assured by:
  - Confirmation of receipt by the receiving organization
  - Confirmation/documentation of the distribution to the all the relevant staff members of the receiving organisation
  - Confirmation/documentation of the understanding by all the relevant staff members

# 2. Outcome of subgroup Ib

## Training related to Hitches - Focus 1st Training on Hitch-Use

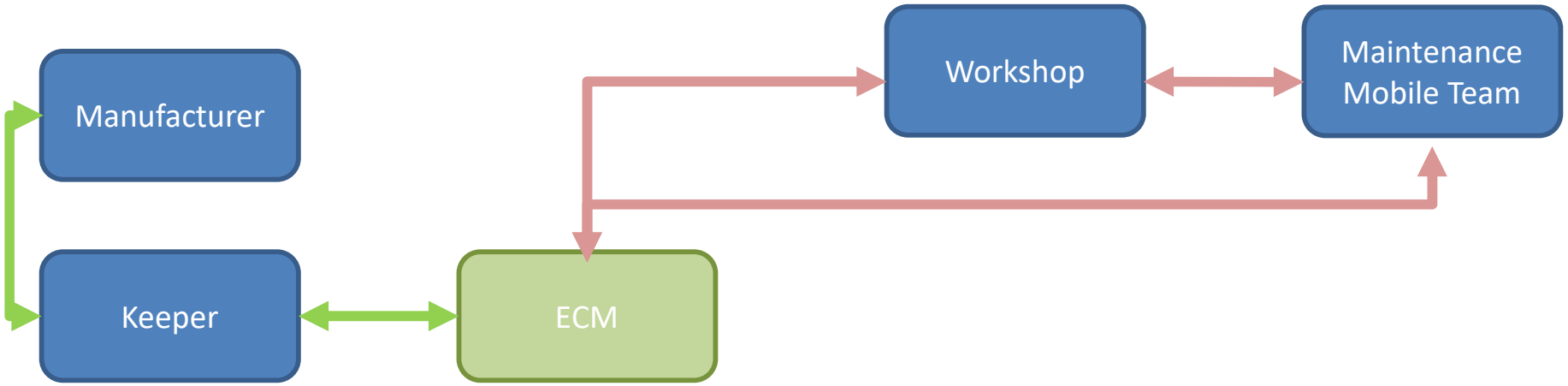



**Audits and Checks shall be performed to monitor the process by interested entities**

The green box highlights the Owner of the User Manual. The Keeper can delegate third parties for the training. In any case the Keeper remains responsible for this task.
The green arrows highlight the training/information flow

# 2. Outcome of subgroup Ib

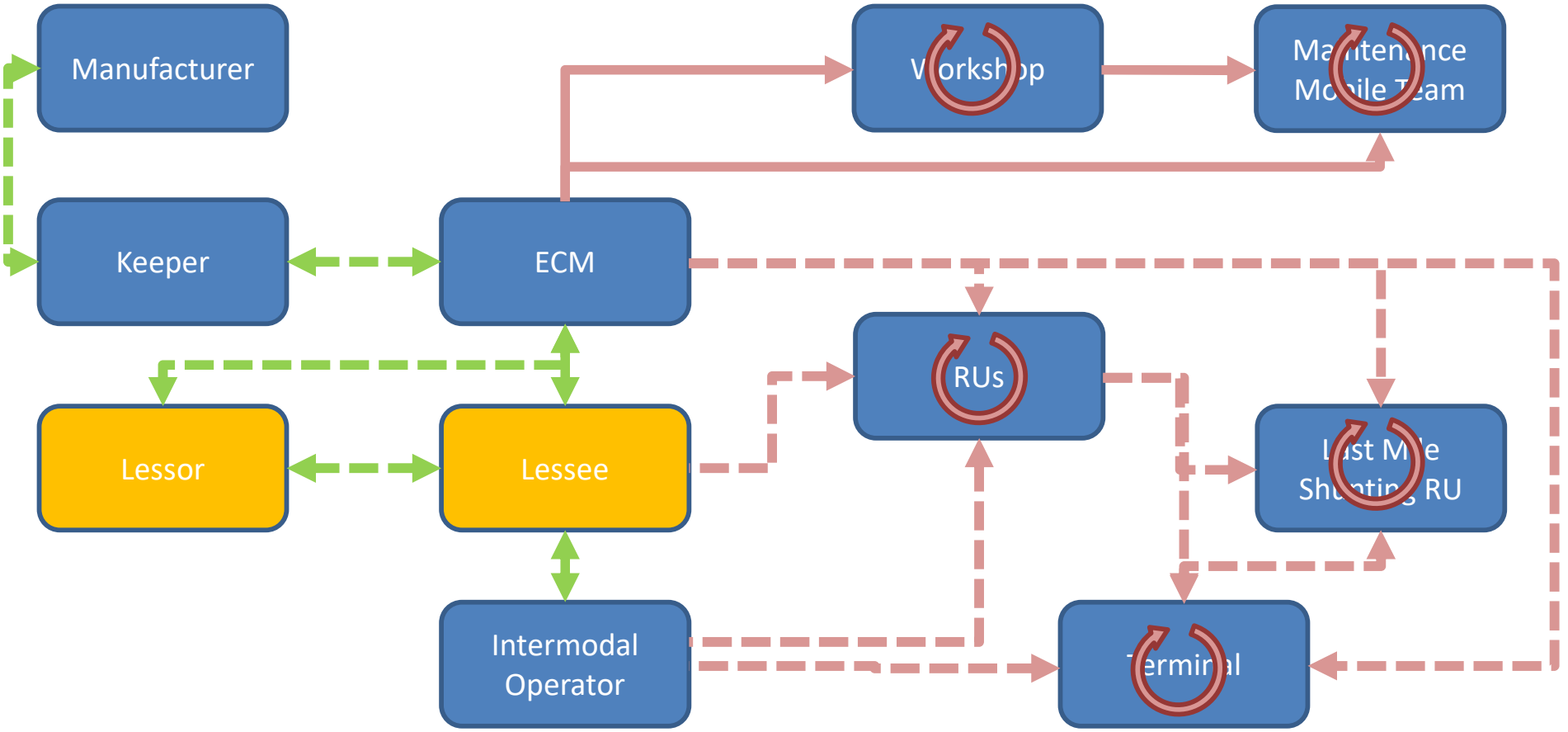
## Training related to Hitches - Focus on Maintenance




**Audits and Checks shall be performed to monitor the process by interested entities**

The green box indicate the Owner of the Maintenance Manual
The green arrows highlight the development flows of the maintenance manual.
The brown arrows indicate the flows of training among the relevant entities.

# 2. Outcome of subgroup Ib
## Training related to Hitches –
## Focus on Self-Maintaining Competences & Monitoring Process




**Audits and Checks can/shall be performed to monitor the process by third parties.**

The green arrows highlight the information flows of the maintenance manual.
The brown arrows indicate the flows of information among the relevant entities.
Straight line indicate the primary flow.
Dotted lines indicate the secondary flow (GCU or special agreement)
Circular arrows indicate self-maintaining processes inside the entities (e.g. SMS)

# 2. Outcome of subgroup Ib

## Training related to Hitches - Traceability requirements and follow-up

First training:

- First training delivery by competent actor (Keeper, ECM…) with traceability

Follow-up

- Maintaining of competences by each actor itself
- Monitoring/auditing by responsible actor (RU, ECM…) with traceability
- Frequency has to be assessed by any relevant actor

# 2. Outcome of subgroup Ib

## Communication and Training related to Hitches - Final Remarks

- In the RU´s SMS requirements must be present about competence management to ensure that own staff, contractors and subcontractors have the right training and knowledge before delivering the services.
- Specific requirements for staff and for training and load securing shall be written in the SMS of the RU.
- The RUs shall check that:
  - contractors fulfil specific requirements and knowledge for safe loading before signing agreements;
  - auditing, where relevant, the continuous fulfilment.
- RU have the full responsibility for cargo during transport.
- For operational safety measures related to loading/unloading of semi-trailers please refer to the outcome of the cluster 1a. These elements shall be integrated into the training materials of the various stakeholders.

Cluster II report : Crosswind Safety

# Subgroup IIa. Crosswind stability of rolling stock
# Subgroup IIb. Measures at infrastructure side

Lead: UIC
Support: CER / EIM, BaneDK, DB Cargo – DB, SystemTechnik - NSA NL
ERA

# 2. Outcome of subgroups IIa and IIb
# Overview

1. Best practices collected from Infrastructure Managers
2. Risk analysis on the Great Belt West bridge done by BaneDanmark
3. Recommended continuation of the activities
4. ERA Cost Benefits Analysis

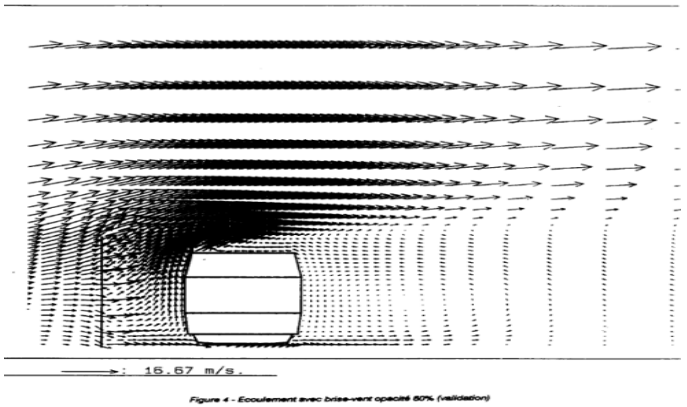
# 2. Outcome of subgroups IIa and IIb

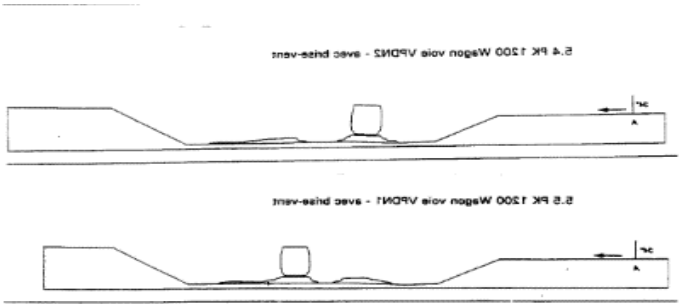
## Best practices collected from IMs : Eurotunnel – Getlink (1/2)

**Systemic risk analysis during the design phase of transportation system + REX**

a. Wind alert system

- Terminals thresholds determined by a safety risks Analysis (part of the “safety case”)
- Hourly weather forecasts
  - Max gusts expected (45 m/s for 3 sec)
  - Max forecast wind speeds (25 m/s)
  - “convective” vs “non-convective” winds
- Connected to Railway Control Centre (RCC with FTP Server)
  - “normal” operations
  - "en tiroir" operations (operational restrictions)
  - “stop” operations



# 2. Outcome of subgroups IIa and IIb

## Best practices collected from IMs : Eurotunnel – Getlink (2/2)

**Systemic risk analysis during the design phase of transportation system + REX**

b. Digital modelling was used to determine locations and types of wind fence requirements

- windbreakers allow operations to continue during periods of strong and turbulent winds.
- are made up lengths of panels stretched between double Masts
- height and porosity of these panels depends on criteria (location, type of rail traffic, speed, etc.)
  - In FR from 4 to 12 m with 50% of porosity
  - In UK from 4 to 6 m with 40% of porosity

# 2. Outcome of subgroups IIa and IIb

## 1. Best practices collected from IMs : SNCF (1/3)

a. SNCF " Crosswind " strategy based on a risk assessment study

1. meteorological data (ground roughness, mean and max wind speeds/directions etc.)
2. line characteristics: orientation/north, cant, curve radius, commercial speed, etc.
3. train sensitivity analysis: speed “domain”, aerodynamic coefficients, vehicle and wind models, railway dynamics safety criterion, etc.

b. Protection strategy

1. Tight monitoring of criteria
2. Operational risk mitigation measures (speed limits, parking of trains, etc.)
3. Infrastructure assets/design (wind fences)

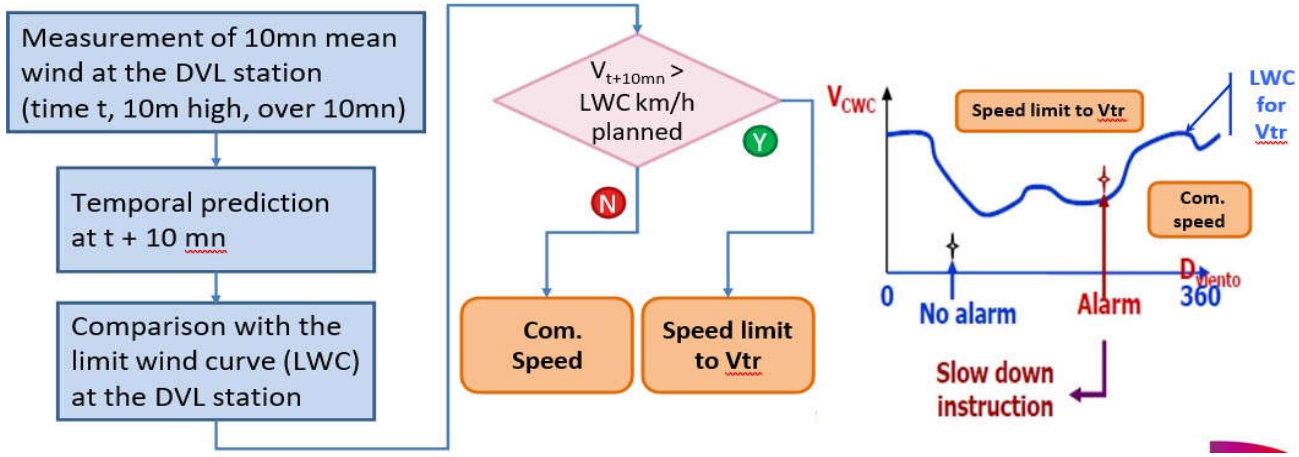
# 2. Outcome of subgroups IIa and IIb

## 1. Best practices collected from IMs : SNCF (2/3)

c. Principles for traffic management

1. Meteorological information and wind speed assessment
2. Meteorological Notice from French weather Office (Meteo France) and/or
3. Wind station Measurement

d. Principle of the automated Wind Alarm system (DVL)



## e. Conclusions

1. Crosswind effect tackled via a systemic risk analysis basis, depending on a large set of parameters (i.e. meteo, infra and vehicle parameters)
2. Wind speed remains one of the major input parameters to be considered and, depending on the situation, wind speed levels that may justify a freight traffic limitation start over 25 m/s, with a complete freight traffic interruption over 38 m/s.
3. Differentiated approaches for conventional rail or high speed trains, lead to either only operational mitigation measures or to highly automated meteo-based traffic regulation stations.

# 2. Outcome of subgroups IIa and IIb

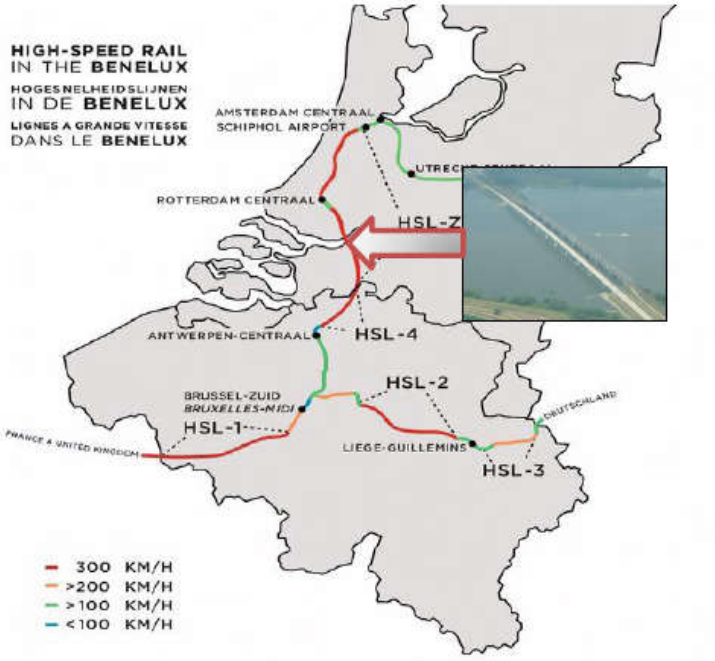
## 1. Best practices collected from IMs : PRORAIL - HSL (1/4)

Only trains which comply with the crosswind sensitivity requirements of the TSI High Speed Rolling Stock (February 2008) are allowed on the HSL

a. Highest risk on bridge over Holland Diep, with extreme cross-winds

b. HSL Crosswind manual warning system

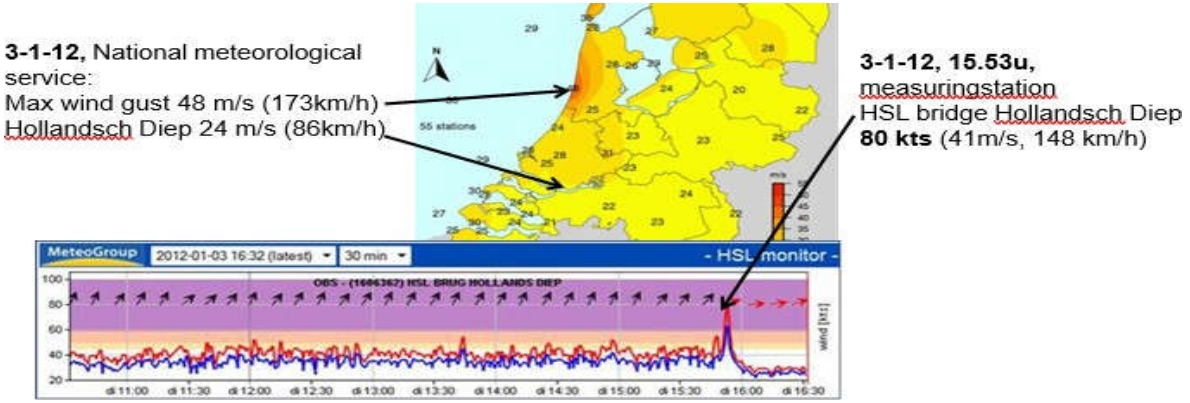
1. "meteoconsult" contracted to continuously predict/check crosswinds
2. Traffic Control advised when max crosswind level expected to be exceeded within 15 minutes



# 2. Outcome of subgroups IIa and IIb
## 1. Best practices collected from IMs : PRORAIL - HSL (2/4)

c. Wind warning system on the Hollandsch Diep Bridge (BHD)

1. Automatic fall-back when manual alarm fails or not in time (on the bridge only)
2. Automatic system predicts exceedance within minutes
3. Alarm via computers MeteoGroup - ProRail
4. Train drivers automatically get speed-limits or STOP via GSM-R.

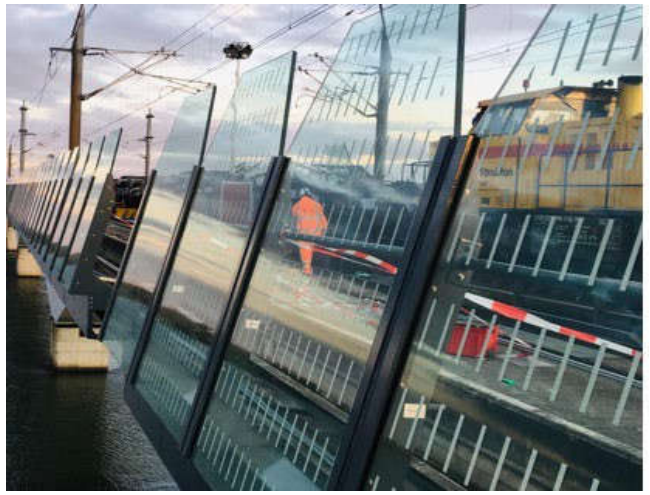


# 2. Outcome of subgroups IIa and IIb
## 1. Best practices collected from IMs : PRORAIL - HSL (3/4)

Since no method is prescribed in the TSI INF, the method used by Deutsche Bahn (DB) in Germany has been chosen as contained in RIL807.04 [4]. This guideline is known within Europe and is often applied.

In order to increase the reliability of the HSL Zuid and its performance and circumvent the risk of errors which are possible in the wind gust warning system, some windscreens have been installed.

Some wind fences have been installed on BHD south



# 2. Outcome of subgroups IIa and IIb

## 1. Best practices collected from IMs : PRORAIL - HSL (4/4)

d. Conclusions

ProRail is going to install the additional screens on the BHD north side of the HSL Zuid. The introduction of these screens, whereby the placement will be combined with a project that places noise screens in order to comply with the noise standards.

Until this realisation (2023-2024), the existing wind gusts monitoring will continue.

More specific measurement on the north section are under investigations.

Monitoring wind condition will stop if the risk of derailment due to gusts of wind is mitigated with the extra screens.

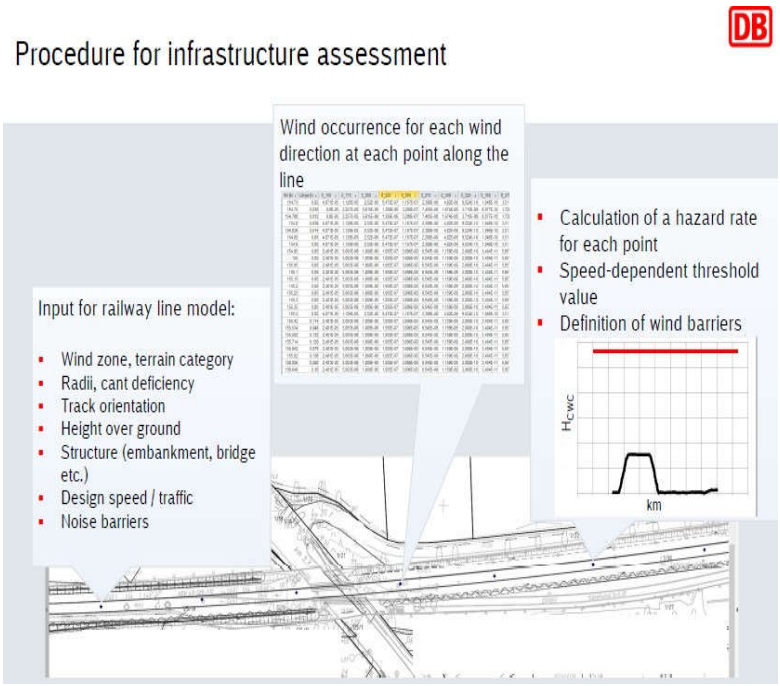
# 2. Outcome of subgroups IIa and IIb

## 1. Best practices collected from IMs : DB (1/2)

**DB - WIND PROTECTION MEASURES FOR RAILWAY LINES**

a. General approach

RiL807.04 deals with the assessment of vehicles and railway lines and goes beyond the scope of application of the TSIs, as it defines an approach of assessing infrastructure with regards to crosswind and it additionally provides reference characteristic wind curves for more vehicle classes having lower maximum speeds than high speed trains.

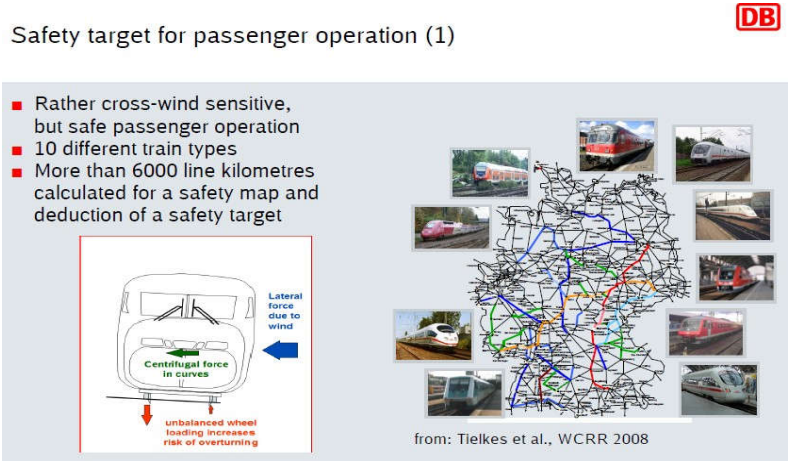



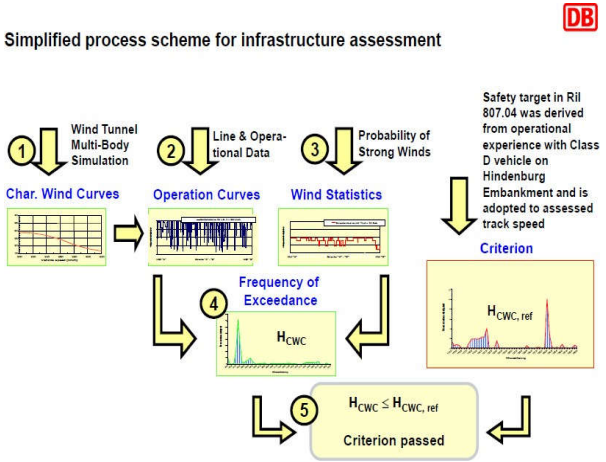
# 2. Outcome of subgroups IIa and IIb
## 1. Best practices collected from IMs : DB (2/2)

**DB - WIND PROTECTION MEASURES FOR RAILWAY LINES**

b. Conclusions

- Comprehensive implementation of crosswind issues in Germany
- Set of consistent methods and a safety target in use since 2006
- Quick and cost-efficient assessment of any railway line based on available infrastructure data
- Network-wide applicability proven, method applied in Sweden and Netherlands
- target oriented and cost-efficient crosswind measures
- Compliance with TSI INF 4.2.10.2 regarding effects of crosswinds.



# 2. Outcome of subgroups IIa and IIb

## 2. Risk analysis BaneDanmark -Conclusions of subgroup (1/2)

Conclusions from all Cluster 2 members, except BaneDanmark (BaneDK)

- In the view of the Cluster II members, the Danish Infrastructure Manager BaneDK report has not been performed with a sufficiently rigorous and recognised methodology that could allow acceptance of the findings.
- What is especially missing, is the fact that BaneDK is lacking to embed the technical results of the investigation in the railway-specific context as it is common practice with other infrastructure managers in other European Member States.

# 2. Outcome of subgroups IIa and IIb

## 2. Risk analysis BaneDanmark -Conclusions of subgroup (2/2)

Conclusions from all Cluster 2 members, except BaneDanmark (BaneDK)

- It cannot be agreed that the GBB is not a special location in the European network, as its exceptional length increases substantially the time of exposure of trains; these are not treated through probable scenarios considering wind directions, wind speeds, wind gusts, etc. (risks exposure).
- This report does not provide any evidence for the necessity for 14 t minimum gross weight for semi-trailers, and it has led to a tremendous shift of transport from rail to road.
- BandeDK report suggests that all additional safety measures need to be ensured by the sector. However, BaneDK does not see the necessity for any substantial and complementary contribution from the infrastructure manager's side, to improve safety on the Great Belt Bridge and to ensure interoperability on the ScanMed Corridor. It is not understandable that all the references that have been made to best practice cases shown during Cluster II activities, on how to improve the wind exposed infrastructure risk in the rest of Europe, (as outlined on the previous pages), is not taken into further consideration by the Danish infrastructure manager. This is even more true after reading the statements that are made by the AIBN investigation paragraph 3.3.

# BDK

Contribution to JNS cluster II presentation

# 2. Outcome of subgroups IIa and IIb

# 2. BaneDanmark contribution (1/3)

## Wind restrictions and critical events on the Great Belt Bridge

No facts has emerged in the JNS proceedings that has given cause to change or modify the conclusions of the report by The Danish Technical University and Banedanmark. The Danish Technical University and Banedanmark published a report on wind on the Great Belt Bridge in July 2021. The report concluded that above 34,9 m/s at speeds of 120 km/h, there is a risk, that an empty trailer on a pocket wagon turns over or derails. However, if the hitch has no or only limited vertical locking force it can be blown out of gauge at windspeeds as low as 19 m/s.

A railway undertaking is responsible for its cargo being securely fastened and its rolling stock being compatible with the infrastructure. The infrastructure manager on the other hand is responsible for the line being interoperable. The report found that a securely fastened trailer on a pocket wagon is compatible with the infrastructure on the Great Belt Bridge.

The report found that on the Great Belt Bridge wind restrictions for securely fastened trailers should be no higher than 26,1 m/s. If trailers are not securely fastened, traffic should be stopped at wind speeds no higher than 14,2 m/s (both ten minutes mean value). The wind restrictions on the Great Belt limits the speed of freight traffic to 80 km/h at windspeeds of 15m/s and stops cargo traffic at 20 m/s (both ten minutes mean value). This leaves a significant buffer to where a pocket wagon with a securely fastened trailer loses running stability. If wind restrictions should ensure safety for trailers that are not securely fastened, they would have to be significantly lower than the existing wind restrictions.

# 2. Outcome of subgroups IIa and IIb
# 2. BaneDanmark contribution (2/3)

## The two critical events under consideration

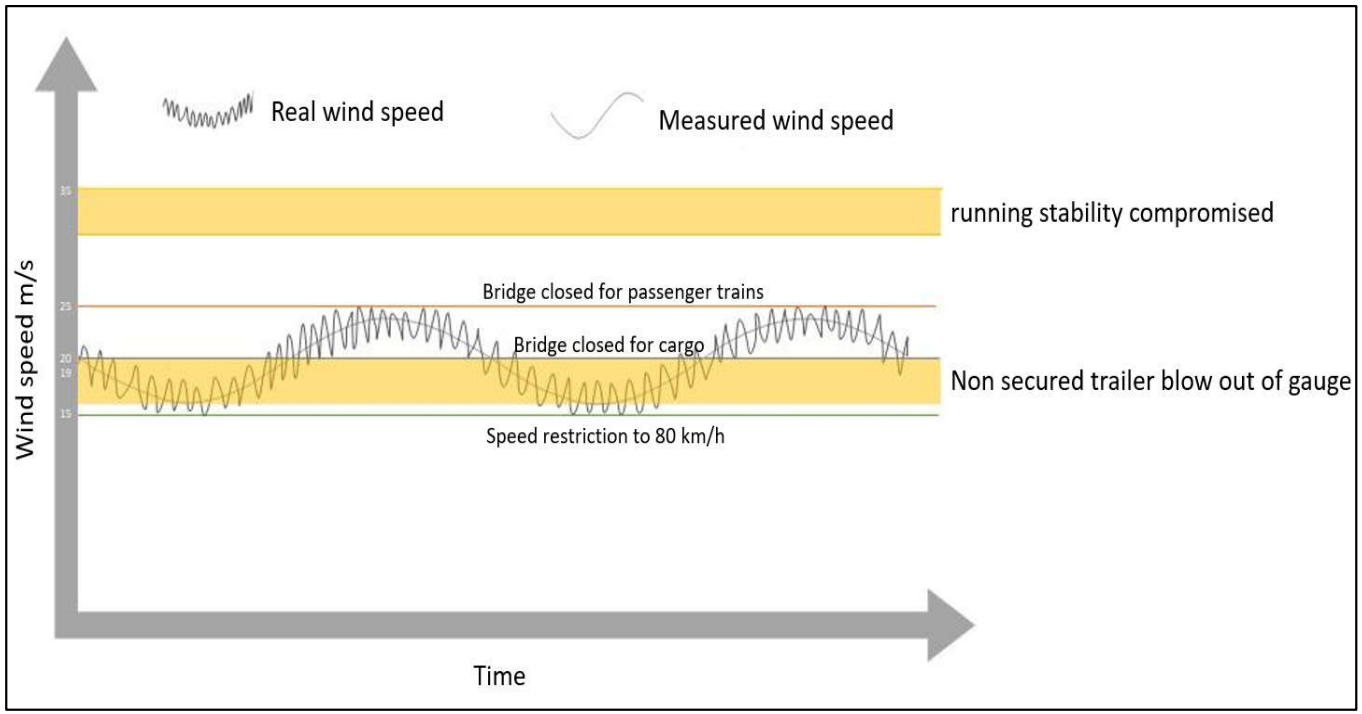
**Running stability Compromised**

Critical event occur around 35 m/s (3 sec. peak )

Wind restrictions can be no higher than 26 m/s (10 min mean) to ensure that running stability will never be compromised in a gust.

Actual wind restrictions on GBB for freight (10 min mean)

- Speed restrictions to 80 km/h at 15 m/s.
- Bridge closed 20 m/s.




The figure above illustrates the two critical events under consideration as yellow bars. The top yellow bar, that running stability of a pocket wagon is compromised, and the bottom yellow bar, that a trailer, which is not securely fastened to the pocket wagon blows out of gauge. The two critical events are illustrated as bars to underline that we must leave a safety margin.

The infrastructure manager ensures that the trains are not exposed to winds compromising running stability – the top yellow bar. The RU makes sure that cargo is securely fastened – rendering the bottom yellow bar irrelevant.

# 2. Outcome of subgroups IIa and IIb
# 2. BaneDanmark contribution (3/3)

**Can the accident happen again on the Great Belt or on other European Infrastructure?**

The accident in January 2019 where eight people were killed and the incident in 2021 - that could have resulted in an equally serious accident - happened because of the simultaneous occurrence of three factors (the bottom yellow bar on the previous slide):

A. The hitch attaching the trailer to the pocket wagon had no or negligible vertical locking force,
B. the trailer was empty, and
C. there were wind speeds of at least 19 m/s from an approximately 90° angle for at least 3 seconds.

Today a number of barriers are in place on the Great Belt Bridge, ensuring a locking force of 85 kN and requiring a minimum weight of 14 tons on the trailer – thus rendering another similar accident on the Great Belt Bridge extremely unlikely.

One likely contributing factor to why we have seen an accident and a serious incidents on the Great Belt Bridge is that the Railway undertaking that was involved in both, transport 14 times more empty trailers in this traffic than what we generally see in Europe.

The three factors that led to the accident on the Great Belt Bridge could occur on other European Infrastructure.

- No European requirements for locking force as of yet – despite recommendation by AIB Denmark (non-binding UIC loading guidelines does require vertical locking force).
- No restrictions on transport of empty trailers.
- Wind restrictions in Europe are above the threshold where an empty trailer with no vertical locking force can be blown out of gauge.

# 2. Outcome of subgroups IIa and IIb
# 3. Focus on UIC – SAFIRST project

The SAFIRST project (Sidewind Assessment For Infrastructure and Rolling STock) was approved by the UIC Rail System Forum Steering Group in October 2018. That decision was taken, mainly inspired by the conclusions of the UIC/Systra report 2014 on strong wind hazard, to homogenize and standardize methods of integration of the Reference Characteristic Wind Curves (RCWCs) in the TSIs, and to bring coherence in the protection strategies with an international methodology, summarised underneath.


Illustration 35. A financial balance to assess different types of protection strategies against strong wind (reference : SYSTRA)

Three WP (Work Package) related:

WP1: vehicle assessment
WP2: assessment of line exposure
WP3 : application of RCWC's

# 2. Outcome of subgroups IIa and IIb
# 3. Focus on UIC – SAFIRST project – WP1

WP1 – Vehicle Assessment

The aim of WP1 is to develop reference characteristic wind curves (RCWC) for trains with speeds between 140 km/h and 250 km/h, and to comply with the methodology requirements in the LOC&PAS TSI (specified also in EN14067-6).

The tasks were to identity potential European reference vehicles that must have:

a. Complete aerodynamic data, measured with STBR in low turbulence wind tunnels tests, meeting requirements of EN14067-6
b. Fully validated MBS models
c. Appropriate operational experience.

# 2. Outcome of subgroups IIa and IIb
# 3. Focus on UIC – SAFIRST project – WP2 (1/2)

WP2 – Assessment of line wind exposure

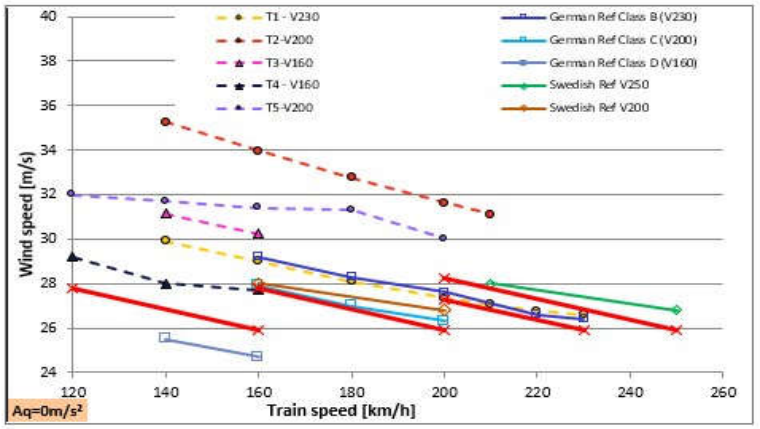
The aim is to develop method(s) of assessing the wind exposure along a line, considering railway-specific infrastructure types, e.g. embankments, viaducts, cuttings. It will give the frequencies of different wind speeds being exceeded at each site along a line, and identify where mitigation may be required.

The steps are:

1. Description of infrastructure => line database requirement described in EN14067-6:

a. Plan profile (orientation, curve radius
b. Vertical profile (level, embankments, viaducts, etc.)
c. Altitude a.s.l.
d. Track design speed
e. Protective walls/wind barriers.

- Four train classes proposed: V<160 km/h, 160 km/h<V<200 km/h, 200 km/h<V<230 km/h, 200 km/h<V>250 km/h



# 2. Outcome of subgroups IIa and IIb
# 3. Focus on UIC – SAFIRST project – WP2 (2/2)

2. Description of meteorology => an integrated database structure also described in EN14067-6:

- Terrain roughness to right and left of line.

3. Integration described and required accuracy/resolution defined.

The tasks performed were to:

- Understand different national methods, existing standards
- Agree hierarchy of wind assessment methods for IMs
    - Initial assessment, assessment for different routes types, HS/freight/conventional/mixed
    - Detailed assessments using wind maps, atmospheric simulation, local meteorological records
    - Consideration of mitigation
    - Use of wind assessment for other infrastructure, e.g. OLE
    - Proportionate costs and practicality considered
- Treatment of viaducts/bridges, embankments, cuttings
- Climate change effects for resilience.

The report permits map-based or simulation methods, depending on lines topographic complexity, cost and practicality, mitigation method. Both map-based and simulation methods require special consideration of infrastructure usually factors based on modelling.

Findings:

- each method is comparable in terms of uncertainty and bias in estimated extreme wind speeds ;
- Map-based methods can be easily applied by good engineers and IMs
- Simulation methods require inputs from meteorologists or wind engineering academics

- Mitigation methods
    - Speed reductions – lead to increases in critical wheel unloading wind speeds for the reduced train speed, with lower risk of occurrence. May be:
    - procedural,
    - based on meteorological station forecasts,
    - local track anemometry,
    - nowcasting wind alarm systems,
    - BUT, problems with false service interruptions, missed high wind conditions.
- Infrastructure measures – physical barriers providing shelter from side winds.
    - Wind fences/acoustic barriers, solid or porous
    - Cuttings, bunds
    - BUT, problems with costs and long term maintenance.

# 2. Outcome of subgroups IIa and IIb
# 3. Focus on UIC – SAFIRST project – WP3

WP3 – application of RCWC's

The aim was to develop a process for IMs to use RCWCs and the wind exposure along the line to assess the safety of line. This entails developing a risk calculation, detail mitigation measures. The impact of national safety principles and Common Safety Method for Risk Evaluation and Assessment were considered.

The tasks achieved were:

- Review of national approaches, including mitigations
- Develop risk assessment methodology process
- Assess mitigation methods
- Cost benefit assessment
- Determine basic method of applying RCWCs for IMs

The main conclusions can be found hereafter

# 2. Outcome of subgroups IIa and IIb

# 3. Focus on UIC – SAFIRST project – application of RCWCs (1/2)

Principles of applying RCWCs for IMs:

- Inputs: integrated infrastructure database + terrain roughness, RCWCs according to line speed, risk method, risk target
- Evaluate extreme wind speeds for sites along the line for all wind directions
- Required: gust wind probability model, e.g. $P(v_w > V_x) = \exp\left(-(V_x / A)^k\right)$ †

→ Evaluate probabilities that RCWCs are exceeded at each location along the line, considering:

- line speed, train class, uncompensated lateral acceleration, local extreme wind gust speeds, wind direction.

Identify high risk locations

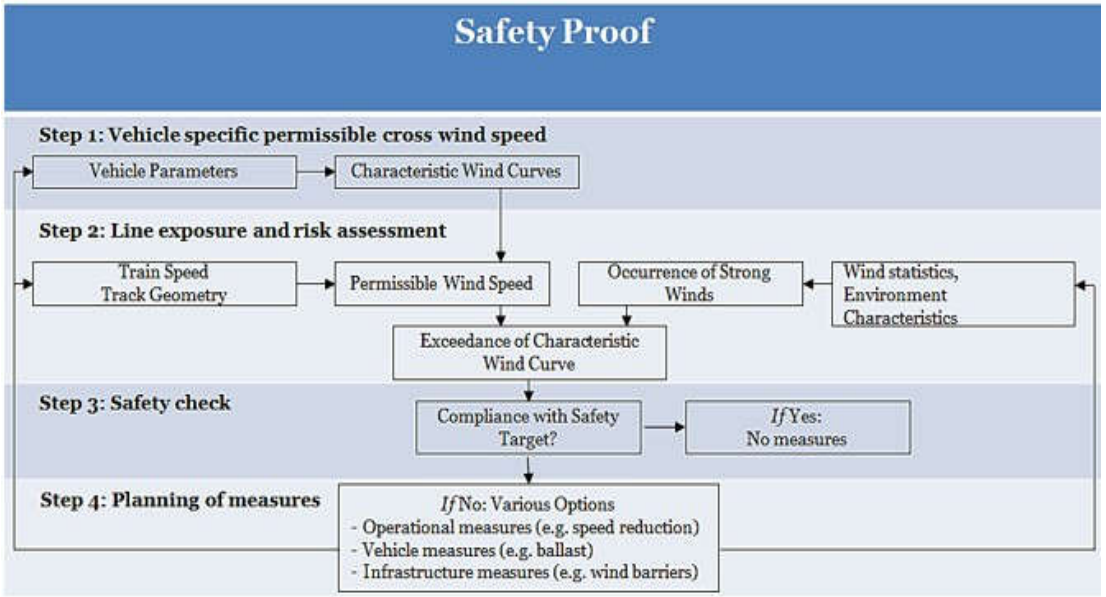
Apply the risk target and compare against exceedance probability for the line/locations

Introduce mitigations at high risk locations and re-evaluate RCWC exceedance probabilities, and repeat as necessary.

*†Climate change effects will impact on wind probability model*



Principles of applying RCWCs for IMs



# 2. Outcome of subgroups IIa and IIb

# 3. Focus on UIC – SAFIRST project – application of RCWCs (2/2)

Deeper assessment of mitigation methods and application

*(Key: €€€: P ≥0,5 M€; €€: 0,1 < P < 0,5 M€; €: P ≤0,1 M€)*

| Measure | | Installation | Maintenance |
|---|---|---|---|
| Active | External weather stations | € | - |
| | IM weather stations | €€ | € |
| Passive | | €€€ | € |

| Aspect | Active measure (external) | Active measure (IM) | Passive measure |
|---|---|---|---|
| Infrastructure modification | - | Medium | High |
| Impact on operations | High | High | Low |
| Prediction time | High | Medium | - |
| Local wind speed/direction accuracy | Medium | High | - |
| Economic cost | Low/Medium | Medium | High |



Risk assessment methodologies:

- Minimum Endogenous Mortality – MEM (Germany): Calculation of acceptable risk based on the lowest rate of mortality for human individuals I in the general population. The reference risk is the risk to an individual.
- Globalement Au Moins Equivalent/Aussi Bon – GAME/GAMAB (France): Comparison of two systems; the new system has to be globally as safe as or safer than the existing one. The reference risk is some reference system.
- Mediatric Method (France): Used when no suitable reference comparator system can be chosen, e.g. for a completely novel system. It needs the new system's absolute risk to be acceptably.
- ALARP/SFAIRP (UK): Imposes a duty to apply safety measures that will reduce risk ALARP. If the are judged to be not disproportionate to safety benefit, the measure is judged to be necessary to reduce the risk ALARP. The reference risk is change in collective risk associated with each safety measure.
- CSMRA (TSI): staged process to harmonise compliance with safety levels at European level, accepting different national approaches.



Postscript:

Is there a quick way to identify critical sites?

DB use a pre-assessment procedure to remove line sections for which the crosswinds can be considered sufficiently low as not to require further analysis. Based on extensive analysis of routes, which have shown that some line section characteristics lead to low RCWC exceedance probabilities.

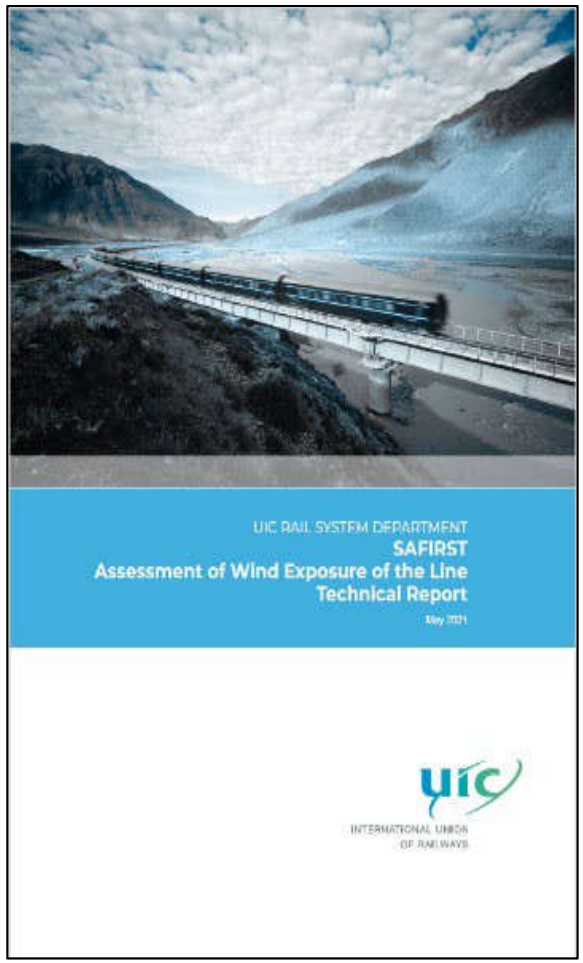
SAFIRST looked at four national lines, site characteristics and exceedance probabilities.

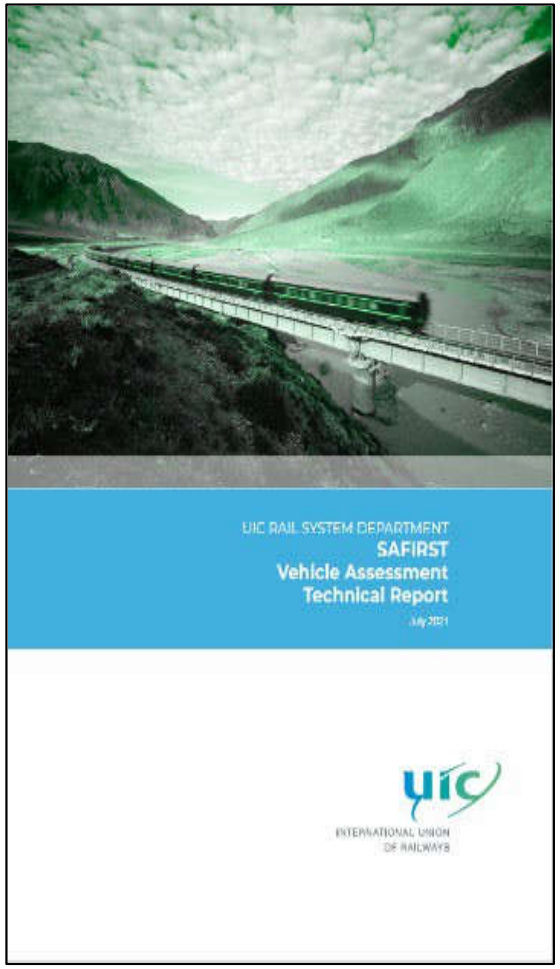
- In general, all at grade sites may be ignored if the site terrain roughness is low, i.e. corresponding to farmland with hedges and occasional buildings or lower.
- Sections of routes in tunnels may be ignored altogether, by definition. Cuttings with depths greater than 2.5 m can be ignored as well.
- For some lines, some rules can be proposed for viaducts and embankments, but the analysis suggest that these are not universal for all lines. It is due to the relative distribution of probability values for sites along the route.

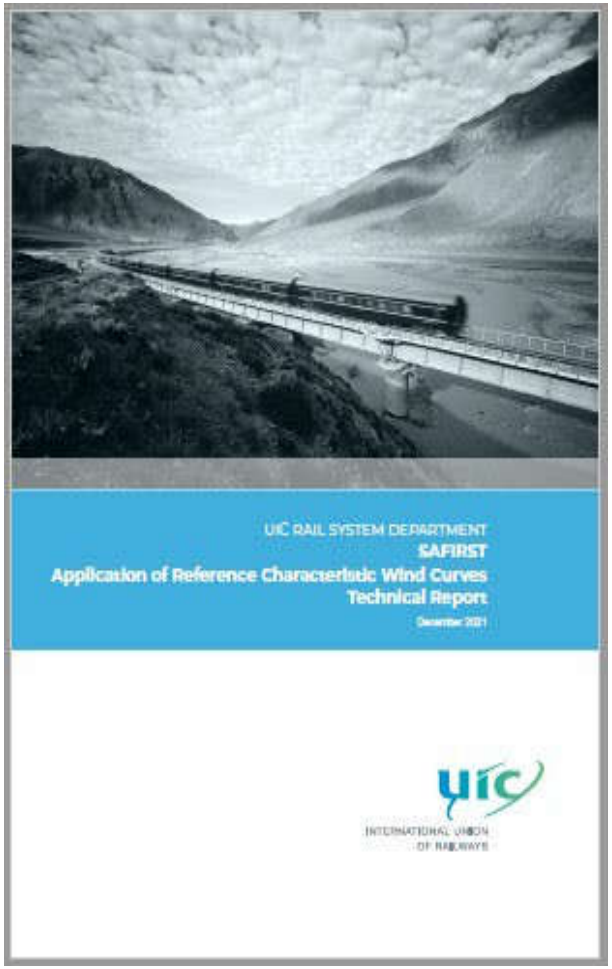
## 2. Outcome of subgroups IIa and IIb

## 3. Focus on UIC – SAFIRST project – final technical reports

The final technical reports are all available on the UIC website - ETF



# 2. Outcome of subgroups IIa and IIb
# 3. Recommended continuation of the activities - Next steps

I. The BaneDanmarks risk analysis should be updated, taking into account all the relevant engineering material (technical, scientific, etc.), through a systemic and global approach, via the application of a recognized methodology onto related risk scenario with pocket wagons running on the GBB. This will answer the question, if a vertical locking force is necessary on pocket wagons hitches for running on the GBB. If this is approved, it will also give an answer, how much this vertical locking force must be.
The methodology could be one of the before presented approved and acknowledged methods (EN 14067-6) or the new SAFIRST-report.
In all cases it is proposed to check whether the methods of EN14067-6 should be enlarged to cover design loads for hitches on pocket wagons in the near future.

II. This approach will lead to an example of using existent or new methods for the cross-wind risk analysis. It provides also the possibility to use it in the case of a changed railway system to apply the risk management process along the CSM RA.
By using DVL, SAFIRST, Ril 807.04 or other methods, it would also be able to clarify the interfaces/burdens between Rolling Stock and infrastructure regarding “cross-wind safety”.

III. ERA is asked to assess the conditions for an “AMOC” on Cross Wind Safety, in order to provide the railway freight sector applicable European/International methodologies for assessing and evaluating risks, coping with the objectives of Safety and Interoperability Directives.

As it is not reasonable for the sector to wait any longer for facilitating the railway traffic on the GBB, the Danish NSA should be asked to withdraw the minimum gross weight requirement of 14t and to accept wagons with hitches which have a proven vertical locking force of at least 85 kN.

Nota Bene: The UIC loading guidelines Vol. 1&2 are since December 2021 part of the AMOC “safety of loads”, developed by ERA.

## 2. Outcome of subgroups IIa and IIb
## 3. Conclusions and remarks

a. The systemic risk analysis, called for by the sector, is not intended to reduce or mitigate the responsibility of RU's, especially regarding the responsibility for the safety of loads that are clearly stated in the TSI OPE.

b. The systemic risk analysis is the mean for establishing the right socio-economic and competitive balance for permanent mitigation measures, so that the "GBB event" risk can be accordingly assessed and covered.

c. It is common practice in EU that fees and charges for accessing specific categories of infrastructures and certain lines, are different depending on the level of equipment and services that are provided by the IM.

# 2. Outcome of subgroups IIa and IIb
# 4. ERA Cost-Benefit analysis

## Summary of Impact Assessment

| 2.1. Recommendation |
| --- |
| The suggested approach put forward by Subgroup 2a/b is appropriate by ensuring a robust decision-making basis for selecting efficient and effective measures within a holistic perspective. However, this holistic view should not be limited to the identified risk that «semi-trailers on pocket-wagons move outside the gauge during transport» (on the GBB), but should in addition cover all possible rail traffic throughout Europe.<br><br>With specific reference to the Great Belt Bridge context this approach could confirm whether, with existing operational and rolling stock related risk control measures, additional risk control measures are still needed. This shall also consider potential issues linked to the existing wind measurement on the GB west bridge. |
| **2.2 Follow-up information** |
| The information provided in the final reporting is comprehensive. It should be considered whether there are any methodological issues to be resolved prior to update the SAFIRST project to consider cross wind safety to freight wagons including pocket wagons loaded with semi-trailers. Moreover, it would be important to ensure that any further / complementary risk analysis linked to the Great Belt Bridge context would be put in place based on consensus and the overall shared aim of increasing the available knowledge among the stakeholders to identify and implement efficient and effective solutions. |

For more information : see “IA Summary Perspectives - Cluster 2”

## Cluster III: reliable king-pin locking

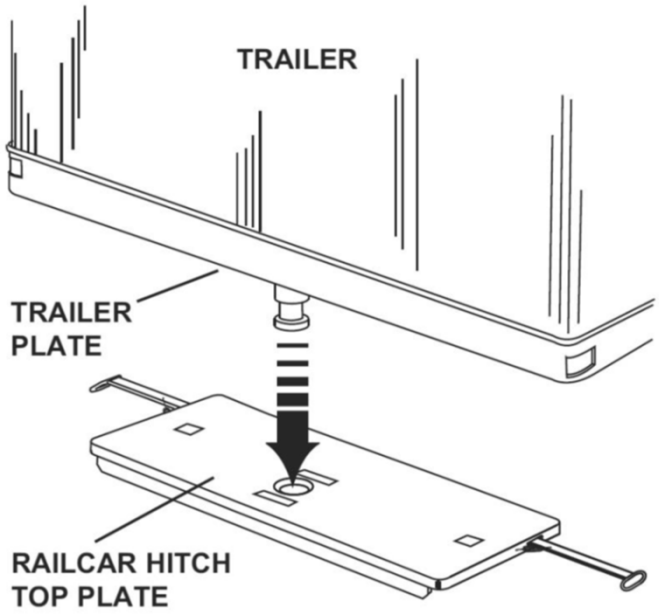
# Subgroup IIIa. Hitch sensor

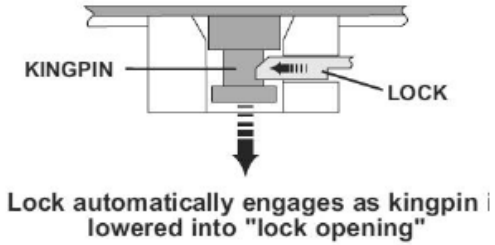
Lead: UIP

Support: ERFA, UIRR, CER (CFL), UIC

# 2. Outcome of subgroup IIIa
# Introduction

The Subgroup develop the basic prerequisites and functional requirements for sensors at hitches of pocket wagons transporting road trailer. This sensors indicate at least the position status (correct position / wrong position) of the road trailer king pin in the funnel of the hitch and the locking status (locked / not locked) of the king pin in the hitch. The indication must be explicit. Wrong indication should be excluded by the design of the sensor system.




For further development of data exchange also the interface standards and minimum data sets are defined.

# 2. Outcome of subgroup IIIa

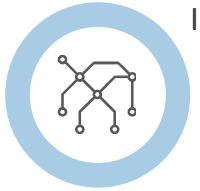
# Different solutions for hitch sensors – one set of requirements

## Basic Prerequisits

- **Compatibility:** no negative interference with the hitch mechanics (e.g. king pin locking or the height adjustment) and other indications/signals during operation
- **Reliability:** Full resistance against all operational conditions (snow, rain, hail, dirt, …) and possibility to easily check the correct function of the system (e.g. through a restart)
- **Fail Safe:** in case of defects (e.g. broken cable, short circuit, reverse polarity) no positive signaling

## Functional Requirements

- **Clear indication of the right king pin position**
  yes / no
- **Clear indication of the king pin locking**
  yes / no



### Interface standards

- ITSS2 (between sensor and telematic / transmission device)
- ITSS1 (between telematic / transmission device and user)

## Minimum Information to be transmitted to Data Systems

- Status of king pin position
- Status of king pin locking
- Time stamp of the transferred information

The information / indication on the wagon shall be mandatory and unambiguous. It is not possible to define one solution, because both functional requirements can be met by either two separate indications or by one single summarising indication:
**Transport allowed when both criteria, the right king pin position and the king pin locking, are indicated as fulfilled.**
**Transport forbidden when at least one of the two criteria is indicated as not fulfilled.**

Red (=not ok) and blue (=ok) as color of the indication light seem sufficiently different from other indications/signals during operation. An unfiltered / unmodified green light* (=ok), should not used due to the existence of small green ground signals in the terminals.

To avoid confusion with other indications/signals during operation the indication light should be off during the transport of the wagons. However, whenever needed during operation, the indication shall be available e.g. automatically during loading/unloading and by temporary activating the indication manually.

* To avoid that the green light is seen by Loco-driver and interpreted as operational relevant signalization, other measures like using green light with polarization filter or other technical solution, after a specific risk assessment, could be possible.

# 2. Outcome of subgroup IIIa
# Risk Assessment

**General:** The sensors are not an additional Safety barrier. It is necessary to control the condition and function of the hitch, as described in the manuals of the producer of the hitch / keeper of the wagon. Railway Undertakings should consider this in their safety procedure guide.

The sensors are auxiliary means.

**2018/545 (EU)**

The sensors should not be a relevant change at authorized vehicle types or authorized vehicles. The design of the vehicles or parts of the vehicles is not changed by mounting the hitch sensors. The function and maintenance of all parts of the wagon is not changed by the mounting of sensors. The only difference is a signaling or transmitting of information. The responsible entity has to check, if the sensor system is complying to this.

**Sensor's don´t change Function, Checks and Maintenance of the hitches. The responsibility for load securing is unchanged.**

**The sensors have no negative impact on the safety level of the hitch system. With the signaling there is a positive effect on the loading process / the handling of the trailer and a complementary load-information to the mechanical indication is available**

Cluster III: reliable king-pin locking

# Subgroup IIIb. Locking force

## Better understand the locking system as a safety barrier

Lead: UIRR
Support: CER, ERFA, UIP

# 2. Outcome of subgroup IIIb
# Scope

a) What is to be understood under ‘safety barrier’ (first, second…) ?

b) What are the functions and roles of the hitch (interface, IC)?

c) What are the current requirements and rules related to the pocket wagons, hitches and locking mechanism?

d) How is a system approach applied to pocket wagons and hitches ? What should be assessed ?

e) Which methodologies could be proposed in case of wagons under the effect of lateral winds?

f) Which kind of tests have been performed so far? Which are the results? Is is possible to define a possible locking force?

g) What are the current best practices from the hitch manufacturers ?

# 2. Outcome of subgroup IIIb Content

a) **Railway safety (product and operations) in a system approach**

b) **Safety barriers**: definition, classification and performance criteria (literature review)

c) **Hitch & Pocket wagons**: standards, rules and safety barriers

d) **System approach** for designing pocket wagons

e) **Locking mechanisms**: best practices, locking forceds, tests, recommendations

# 2. Outcome of subgroup IIIb
## Safety culture – system approach for freight wagons

### Safety culture in a system approach

**PRODUCT**

*ability of a product to be safe for intended use, as determined when evaluated against a set of established rules.*

**Purpose**: design, innovations and technical improvements are guided by the safety requirements of:

- Manufacturer
- Keeper
- ECM

**Basis**: EU regulations, return of experiences and the CSM 402/2013.

**OPERATIONS**

*absence of unreasonable risk under the occurrence of hazards resulting from functional insufficiencies of the intended functionality, operational disturbances (e.g. environmental conditions) or by reasonably foreseeable misuse/errors by humans*

**Purpose:** ensuring the safety in operations by all railway stakeholders involved

- Route comptability checks
- ILU/wagon compatibility checks
- Fulfill the transport conditions (e.gI infrastructure rules) and safety requirements (e.g. dangerous goods, waste…)

**Basis**: Safety Management Systems (SMS), TSI OPE, GCU, UIC loading guidelines

Focus of Cluster IIIb

# 2. Outcome of subgroup IIIb
# Safety barriers: definition, classification and performance (1/3)

## EU REGULATIONS AND DIRECTIVES

- Safety barriers is not defined in in any Regulations and Directives related to Railway

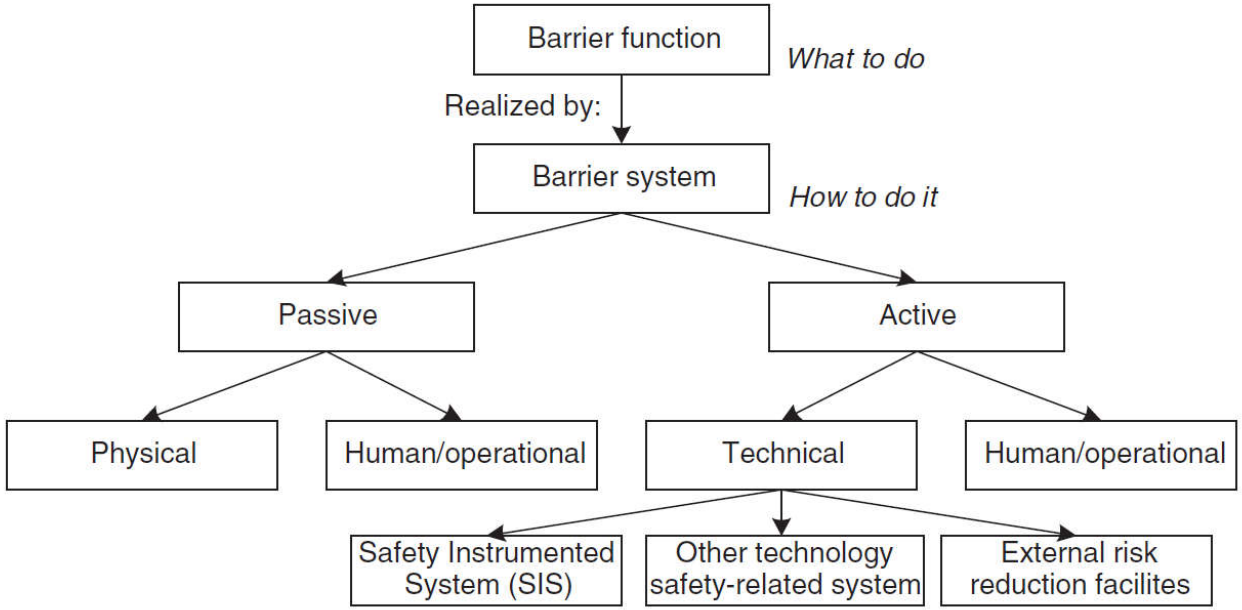
## LITERATURE REVIEW

- **Safety barriers** are physical or non-physical means planned to prevent, control, or mitigate undesired events or accidents.
- **A barrier function** is a function planned to prevent, control, or mitigate undesired events or accidents
- **A barrier system** is a system that has been designed and implemented to perform one or more barrier functions

# 2. Outcome of subgroup IIIb
## Safety barriers: definition, classification and performance (2/3)

- Classification of barrier functions
  - Standards: prevention, control and mitigation
  - ARAMIS project: four main categories described by the action verbs to avoid, to prevent, to control, and to protect
  - Railway Industry: primary, secondary and tertiary safety critical functions (very rarely)

- Classification of barrier systems



# 2. Outcome of subgroup IIIb
## Safety barrier: definition, classification and performance (3/3)

- **Performance criteria** of safety barriers

(a) **functionality/effectiveness**: ability to perform a specified function under given technical, environmental, and operational conditions

(b) **reliability/availability**: ability to perform a function with an actual functionality and response time while needed, or on demand

(c) **response time**: the time from a deviation occurs that should have activated a safety barrier, to the fulfilment of the specified barrier function

(d) **robustness**: ability to resist given accident loads and function as specified during accident sequences

(e) **triggering event or condition**: the event or condition that triggers the activation of a barrier

# 2. Outcome of subgroup IIIb
# Interoperable constituents (ICs) vs Interchangeable parts

**PAST (RIV Rules)**

- RIV chapter 23.7: different components to be used and interchanged among railways
- These components were marked with (U) and sometimes with the name of the railway undertaking.
- The presence of (U) is enabling use of components by different sources as interchangeable.
- Most of interchangeable parts were derived by the same ERRI or UIC drawing;

**CURRENT (TSI WAG)**

- By the first TSI-WAG L344/2006 a new definition was stated : "Interoperable constituents", that were meant to be components fulfilling the interoperability specification TSI-WAG.
  - A lot of IC were initially introduced, with different certification possibilities.
  - The introduction was really unlucky, since these were interpreted to be the "new interchangeable parts" (justified by the fact that most of "old" interchangeable parts were stated as new "interoperable constituent").
  - The meaning is different - the ICs are not necessarily interchangeable - huge formal problems constituted from 2007 clear handicap to get new certificates TSI-WAG (i.e. weight of screw couple stated in TSI-WAG was a criteria to scrape some of them, because no tolerance was not agreed).

- By new TSI-WAG L103/2013 (EG 321/2013) the list of ICs was drastically limited in order to reduce the problems (bogie, wheelset, wheel, axles, brake blocks, automatic wheelset changing system). Only these IC are stated and are possible.

# 2. Outcome of subgroup IIIb
# Hitch - what is the exact role ? (1/2)

**Possible functions of the hitch**

(1) interoperability constituents (ICs) ? YES or NO ?

(2) interface of the wagon to the loading ? YES or NO?

- **Railway Interoperability Directive**
  (1) Article 2 defines interoperability constituents (ICs) as 'any elementary component, group of components, subassembly or complete assembly of equipment incorporated or intended to be incorporated into a subsystem upon which the interoperability of the rail system depends directly or indirectly.'
  (2) Article 4b points out that each TSI should lay down essential requirements for each subsystem concerned and its interfaces in relation to other subsystems
  (3) Article 5c: the list of regulatory, technical and operational conditions to be harmonised at the level of subsystems and at the level of the interfaces between subsystems and their expected level of harmonisation;

# 2. Outcome of subgroup IIIb
# Hitch - what is the exact role ? (2/2)

- **TSI WAG**
  - (1) Article 4.3 on functional and technical specifications of the interfaces (infrastructure, operation and traffic management, control, command and signaling system)
  - (2) Article 5: list of ICs (running gear, wheelset, wheel, axle, rear-end signal, friction elements for wheel tread brakes and automatic variable gauge system)

- **General approach and spirit of TSI WAG**
  - (1) Hitch as IC (yes/no): IC limited in number, deeply discussed in the first issue of TSI WAG + all revisions
  - (2) ICs are not interchangeable parts
  - (3) Only limited number of ICs - promote innovations

⇒ The hitch shall always be considered as an interface between the loading unit and the wagon.
⇒ The hitch is not to be considered as an IC in the TSI WAG (final decision of the sector and authorities during previous revision of the TSI WAG)

# 2. Outcome of subgroup IIIb
# Pocket wagons – list of standards and rules (1/4)

## UIC IRS (International Railway Solutions)

- **50571-4 - Wagons for combined transport - Vertical transhipment - Characteristics**
  - Chapter 1.5: loading diagram with visible seating device height (marking)
  - Chapter 3.2: position of the king pin
  - Chapter 3.4.1: loaded centrally and secured
  - Chapter 3.4.2: type of king pin – automatic locking mechanism + unlocking manually
  - Chapter 3.4.5: dimensions according to Regulation 661/2009

- **50596-6 - Conditions for coding intermodal loading units in combined transport, combined transport lines and wagons**
  - Chapter 2.2.1: loading of semi-trailer
  - Chapter 3: table 1 with compatibility code (P marking)<br>table 2 with characteristics (tolerance centering of 10 mm)

# 2. Outcome of subgroup IIIb
# Pocket wagons – list of standards and rules (2/4)

## Pocket wagon

**Conceived to respect IRS 50596-6 Criteria**

INTERNATIONAL RAILWAY SOLUTION

Table 2 : Characteristics of Combined Transport wagons and bogies used in bimodal systems

| | Bogie carrier wagon | Carrier wagon for roller units for horizontal transhipment | 2-axle carrier wagons for swap bodies and roller units | ST on bogies Kombirail system RoadTrailer system Transtrailer system |
|---|---|---|---|---|
| Code letter[1] | P / N / C / ISO | (B) | B / C | K / R / T |
| Total lateral play of the wagon | 11,5 mm | 11,5 mm | 23 mm | 11,5 mm |
| Distance between bogie pivots or wheelbase for 2-axle wagons | (see points A.1 and A.3) | (see point A.1) | (see point A.2) | (see Appendix F) |
| Bogie wheelbase | (see points A.1 and A.3) | (see point A.1) | | (see Appendix F) |
| Height of reference plane in relation to rail level | 330 mm | 330 mm | 330 mm | 330 mm |
| Maximum overhang of the ILU in relation to bogie pivots and in relation to axles for 2-axle wagons:<br>a) STs<br>b) SBs<br>c) Roller-Units<br>d) ISO | a) (see points A.1 and A.3)<br>b) (see points A.1 and A.3)<br>d) see point A.3 | ) (see point A.1) | b) (see point A.2) | Negligible for the calculation of reductions |
| Maximum off-centre position of the ILU as a result of centring tolerances<br>- near the tyres<br>- near the seating or bearing device<br>- for STs on bogies<br>- For SBs, ISO and roller units | 10 mm<br>10 mm<br>10 mm | 10 mm | 10 mm | 2 mm |

1. See table 1 in point 3.1. In the above table, P includes P and P followed by the envelope compatibility code.

# Pocket wagon

## Conceived to respect IRS 50596-6 Criteria

### A.1 - Bogie wagons for the conveyance of swap bodies and roller units

- **Swap bodies which can be grab-handled and suitable for wagon compatibility code C**
- **Horizontally-transferred roller units suitable for affixing with wagon compatibility code B (valid for SBs and Roller Units up to 2 600 mm maximum width)**

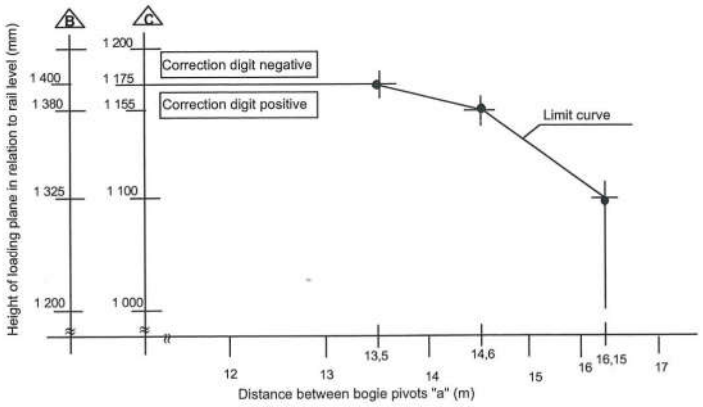



*Fig. 2 -*

This limit curve may be applied under the following preconditions:

- reduction of $E_i > E_a$ [1]
- compliance with the conditions in Table 2 - page 14 [2]
- maximum bogie pitch 2 000 mm

1. $E_i$ in relation to wagon centreline - $E_a$ in relation to end of loading plane.
2. For new or modified wagons with a play in the side bearer play of $9^{+2}_{0}$ mm, the conformity assessment bodies may use the agreement plate to indicate an improvement in the profile.

### A.3 - Bogie wagons for the conveyance of semi-trailers

**Semi-trailers suitable for affixing with wagon compatibility code P (valid for STs up to 2 600 mm maximum width)**

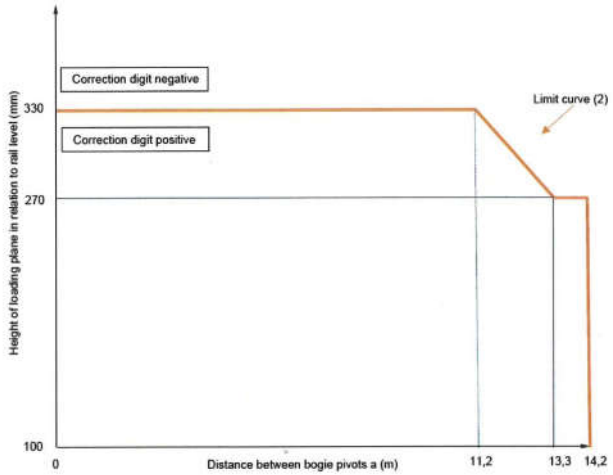



*Fig. 4 -*

This limit curve may be applied under the following preconditions:

- ST centring using centring gear identical or similar to reference recess wagon
- total maximum lateral play: 11,5 mm
- Bogie wheelbase: 2 000 mm maximum
- reduction $E_i > E_a$ [1 2]

1. $E_i$ in relation to wagon centreline - $E_a$ in relation to end of loading plane.
2. the lower gauge of wagons as per UIC Leaflet 505-1 must be observed.

# 2. Outcome of subgroup IIIb
# Pocket wagons – list of standards and rules (4/4)

- Cargo Load Securing - UIC Loading Guidelines (section 9)

  *(Goods loaded in intermodal transport units)*

**Stresses during transit/ relevant accelerations**

| Securing in | Acceleration values | | | | |
|---|---|---|---|---|---|
| | $c_x$,longitudinal | | $c_y$, transverse | $c_z$, Minimum value vertically downwards | |
| | slipping | tilting | | slipping | tilting |
| longitudinal direction | 1.0 | 0.6 | --- | 1.0 | 1.0 |
| transverse direction | --- | --- | 0.5 | 0.7 | 1.0 |

**Method of loading = EN 12195**

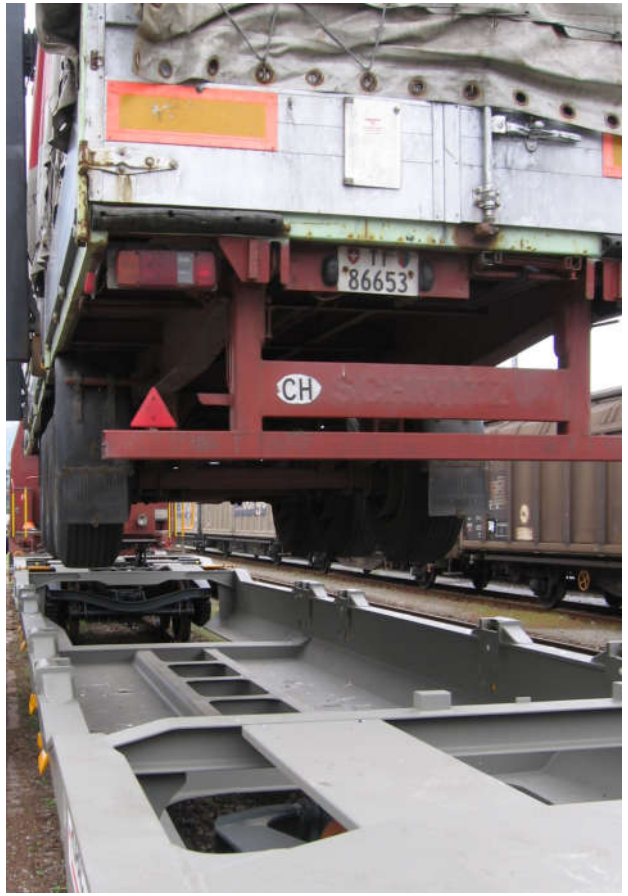
# 2. Outcome of subgroup IIIb
# Pocket wagons- standards – conclusions

**List of <u>safety barriers</u> according to 'rules':**

- The pocket wagon comply with **TSI-Wag requirements** *(Interoperability)*
  *Notice: new Annex H for CT wagons ERA TWG CT)*
- The pocket wagon comply **IRS-UIC requirements** including locking mechanism *(safety)*
- The wagon is loaded and transported correctly according to **best practices** *(UIC loading guidelines, GCU contract and terminal instructions, RU SMS)*

# 2. Outcome of subgroup IIIb
# System approach for designing pocket wagons

- Design of the pocket wagons to accommodate the semi-trailers (limiting the lateral movements)
- Centrally-loaded semi-trailer with a minimum tolerance
- Last axle: fitted into wheel wedges and hitch position to be adjusted (when no crash element)
- Fixed hitch and crash elements to prevent damages on the king pin and no wheel wedges




- Freight wagons: assessed by a NoBo and authorised by ERA based on the requirements and standards as defined in the TSI WAG
- Consequence: no need for an additional third-party assessment of each component of the wagon (already performed by the manufacturer of the component) and checked by the NoBo/ERA

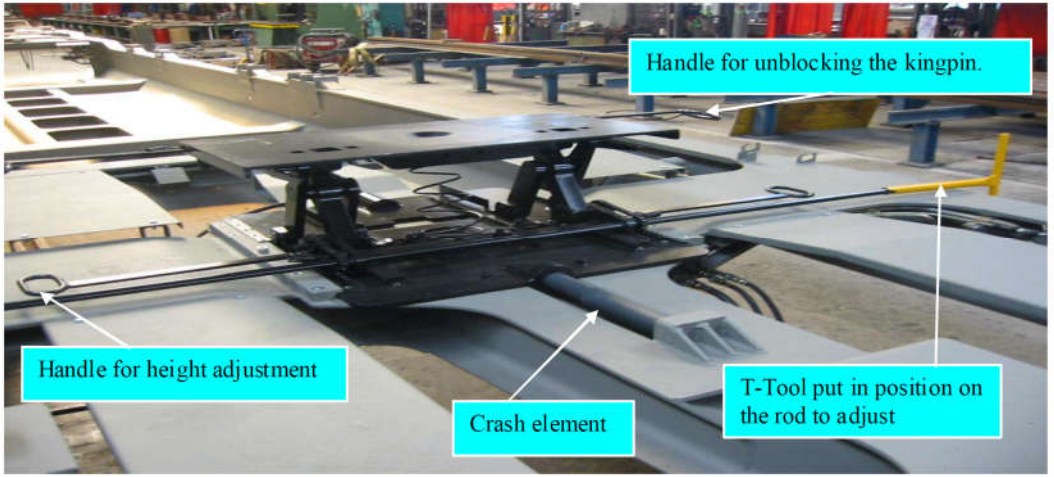
# 2. Outcome of subgroup IIIb
# Locking mechanism – basic requirements

## UIC IRS 50571-4 – chapter 3.4

*applicable for wagon with P markings*

**3.4.2** – The seating device is to be configured for H-type 2" kingpins compliant with *Regulation (EC) No. 661/2009* (see Reference documents - page 5), and shall be fitted with a simple device which locks the fifth wheel pin automatically in the slot and can be unlocked manually from either side.

**3.4.3** – It shall be possible for the train inspector to confirm that the kingpin is correctly locked in the seating device, from a standing position at ground level from either side of the wagon. It shall be possible for the kingpin to be relocked without having to lift the semi-trailer again.




# Locking mechanisms in general and particular cases

- General Case (e.g. without critical wind)
  The wagon and loading (SR) undergo nowadays specific tests following TSI-Wag, EN12663-n, IRS/UIC, NTTR, …
  => locking effect is checked, without stating an explicit locking force value

  *Note: lifting force of ILU : containers, swap bodies and semitrailers are transported on dedicated wagons (IRS50571-4) with standardised interfaces*
  *=> no lifting force is stipulated (general case)*

- Particular Cases (e.g. with critical wind): specific solutions /measures might be implemented.
  ⇒ Collection of evidences are needed
  ⇒ Identification of the main parameters (running speed, wind speed, wind direction, uncompensated acceleration,…)

⇒ Even if the TSI WAG does not require an analysis of running behavior under the effect of lateral winds, a conservative calculation could be made based on the EN14067-6.

# 2. Outcome of subgroup IIIb
## Pocket wagons: running behaviour under lateral winds

**Particular case – Example of application**

- **EN14067-6:** rough calculation for a T3000e pocket wagon on the Great Belt Bridge
- Max. wind speed (30.8 m/s) and train speed (80 km/h) with an empty ST of 5.5t

| FERRIERE CATTANEO SA | Oggetto/ Betrifft: **Running behaviour under the effect of lateral wind following EN14067-6:** Main results of calculation for Sdggmrss pocket wagon | 02/03/2021 Seite 1/1 |
|---|---|---|
| | Autore/ Verfasser: E.Moro / A/An: J N S | Commessa/ Auftrag: --- |

### 1 Introduction

Even if no analysis of running behaviour under the effect of lateral winds is mandatory for a freight wagon (according to TSI-Wag or applicable NNTV), it is possible to perform a conservative calculation for a freight wagon according to **EN14067-6**.

### 2 Details about calculation procedure

The calculation will be performed following **Sections 5.3.2 and 5.4.2 of the EN14067-6**: this norm permits to perform conservative simple calculations to have a clear indication of running behaviour under lateral winds.

In particular, following parameter, as defined in **EN14067-1**, will be used for the calculation:

1. **lateral wind** will be considered, thus $\beta_w=90°$
2. an angle **β** among train speed (**Vtr**) and wind speed (**Vw**) greater that **β > 40°** will be considered, as relevant to the case under examination;
3. to fulfil the conditions of section 5.3.2. the wagon **T3000e will be reduced to an equivalent 4 axle wagon** (very similar to Sdgnss Wagon T5) and thus all conditions given here are fulfilled;
4. the calculation will be performed with the not compensated lateral acceleration $a_q$ **= 0,85 m/s²**

### 3 Data considered for calculation

The quasistatic calculation uses the simplified 2-Dimensional Vehicle model (Model with 3 masses) for a as quoted in **EN14067-6 Section 5.4.**

For the calculation, the parameter of T3000e loaded with an empty semitrailer are used.

The lateral displacements $y_1$ **= 0,012 mm** and $y_2$ **= 0,042 mm** are considered both from gauge calculation of T3000e and from loading tolerances, as allowed by EN14067-6.

In particular, for the semitrailer a weight of **5,5 t** is considered.

### 4 Results of the calculation

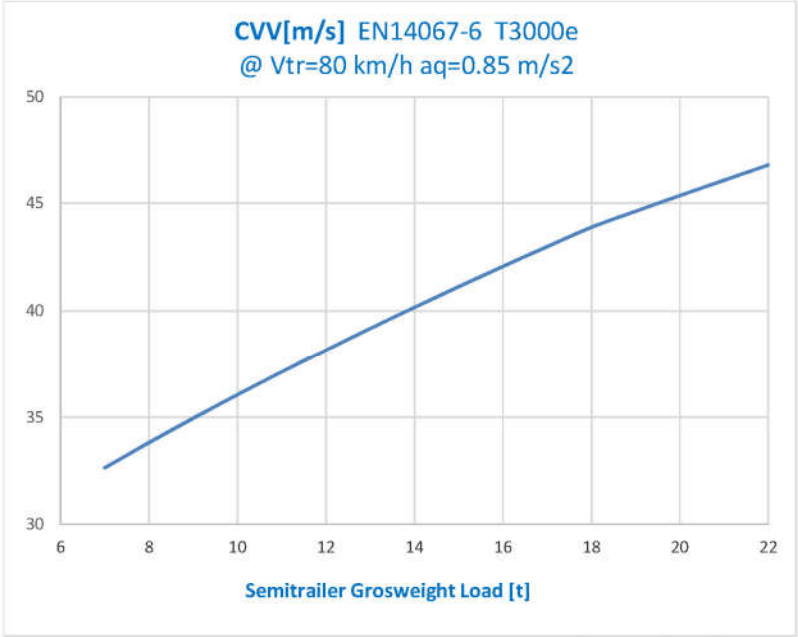
As results of the calculation, the maximum wind speed is calculated

| $a_q$=0,85 m/s² – $\beta_w$=90° – β> 40° | |
|---|---|
| Train Speed Vtr[km/h] | Wind Speed Vw[m/s] |
| 80 | 30,8 |

# 2. Outcome of subgroup IIIb
## Pocket wagons: running behaviour under lateral winds

**Particular case –**
**Example of application**

- **EN14067-6:** rough calculation for a T3000e pocket wagon on the Great Belt Bridge
- Max. wind speed and Loaded ST




Running safe behaviour subject to lateral winds according to EN14067-6

E.Moro 31.03.2021 FC SA

| SR Load [t] | CVV[m/s] |
|---|---|
| 7 | 32.63 |
| 8 | 33.81 |
| 9 | 34.95 |
| 10 | 36.05 |
| 11 | 37.12 |
| 12 | 38.16 |
| 13 | 39.17 |
| 14 | 40.16 |
| 15 | 41.12 |
| 16 | 42.07 |
| 17 | 42.99 |
| 18 | 43.89 |
| 19 | 44.63 |
| 20 | 45.36 |
| 21 | 46.08 |
| 22 | 46.78 |

# 2. Outcome of subgroup IIIb
## Calculation of static wind loads and overturn limits for loaded trailers

- **Aim:** determine the wind speed required to blow the trailer off the pocket wagon in case of a king pin not locked assuming that the trailer is overturned around a line going through the king pin and the front rear wheel contact point with the bottom of the pocket wagon.
- **Who:** Analysis performed by the Danish Transport University (March 2021)
- **Facts:** empty trailer (weight: 6.500 kg) on a pocket wagon with the king pin not locked

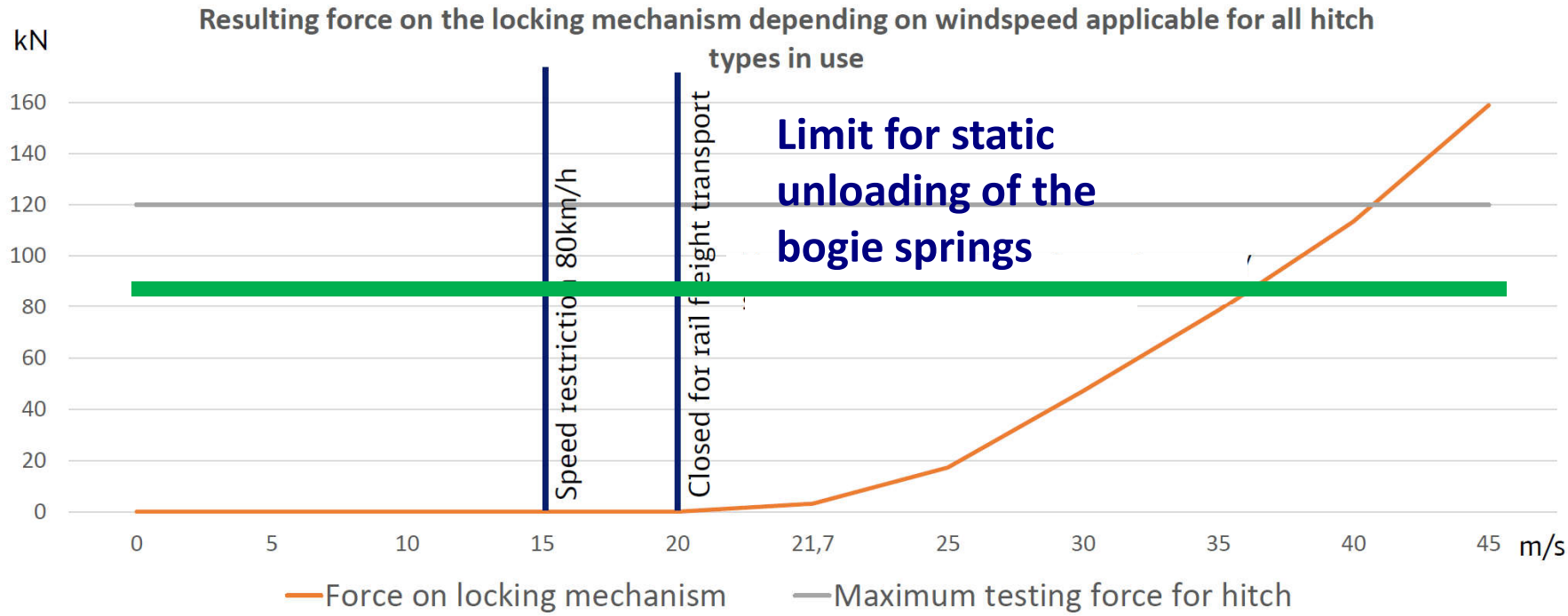
| Total weight (tons) | Wind speed (m/s) |
|---|---|
| 7. | 22.4 |
| 8. | 23.7 |
| 9. | 25.0 |
| 10. | 26.2 |
| 11. | 27.3 |
| 12. | 28.5 |
| 13. | 29.5 |
| 14. | 30.6 |
| 15. | 31.6 |
| 16. | 32.5 |
| 17. | 33.5 |
| 18. | 34.4 |
| 19. | 35.3 |
| 20. | 36.1 |
| 21. | 37.0 |
| 22. | 37.8 |

### Conclusions

1. **The theoretical analysis shows that a wind speed of 21.8 m / s will be enough to overturn an empty trailer, provided that the king pin is not attached.**
2. When the trailer is loaded evenly, the weight of the cargo will contribute positively to preventing the trailer from overturning.
3. The calculations are illustrated with different curves for determining the critical wind speed as a function of the weight of an evenly loaded cargo.
4. Wind limits as function of gross weight are determined and tabulated.

# 2. Outcome of subgroup IIIb
## Particular case on GBB: resulting force on the locking mechanism

- **Aim:** Does the hitch system release the trailer before the wagon system becomes unstable?
- **Who:** Analysis performed by VTG with 3dr party experts
- **Facts**: The static tests has show that the tested hitch systems withstand more than 110-120kn holding force and from 85kn holding force the spring system of the wagons begin to lift up. After this test we found nothing damages inside the locking hitch system.
- **Result: before the hitch system releases the trailer, the wagon becomes unstable; 85 KN should not be exceeded.**

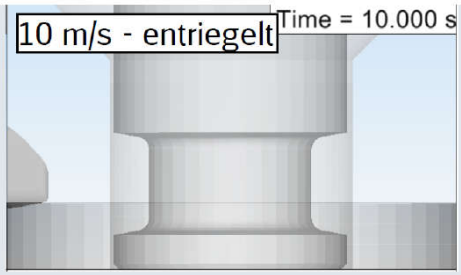


# Particular case on GBB: forces resulting on locking mechanism from wind speed

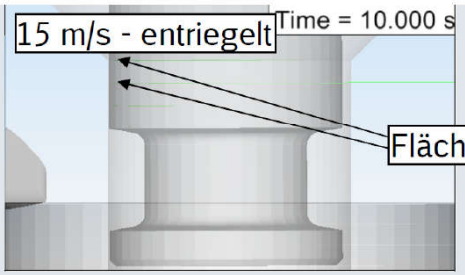
- **Aim:** Detailed, independent simulation of aerodynamics on the Great Belt as input to obtain resulting forces on locking mechanism
- **Who:** Analysis performed by DB system Technik
- **Facts:** results based on 10s gust wind

## Forces resulting from wind speed show a sufficient locking of the hitch within the operational restrictions of the Great Belt

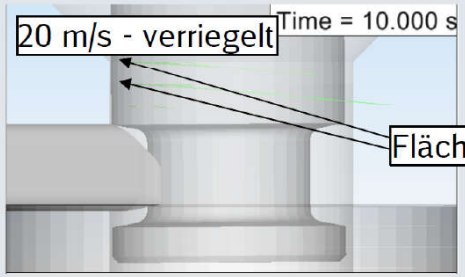
Wind peaks not mean values




➢ Keine nennenswerte Bewegung




➢ Rutschen auf der Stützbockplatte bis zum Kontakt zwischen KöZ und Führung

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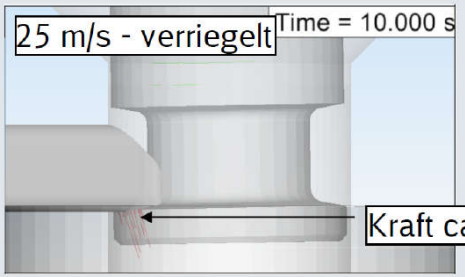
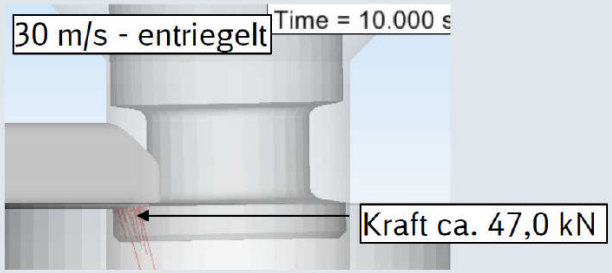



➢ Anheben/Kippen des Trailers mit Kontakt zwischen KöZ und Verriegelung

## Particular case on GBB: forces resulting on locking mechanism from wind speed

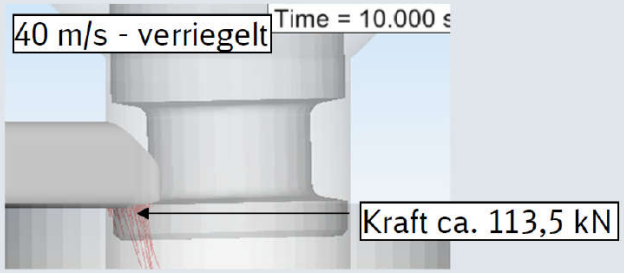
**Forces resulting from wind speed show a sufficient locking of the hitch within the operational restrictions of the Great Belt**

Wind peaks not mean values

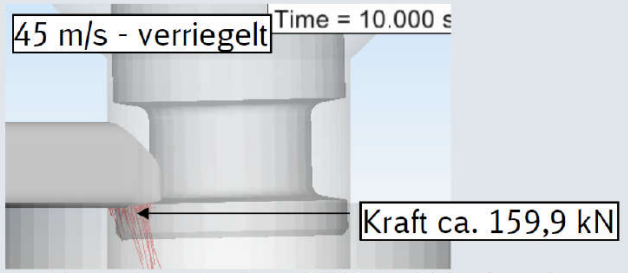



- Kontakt zwischen KöZ und Verriegelung


- Kontakt zwischen KöZ und Verriegelung u. Rutschen des Trailerreifen (μ=0,8) möglich




- Kontakt zwischen KöZ und Verriegelung u. Rutschen des Trailerreifen (μ=0,8) möglich




- Kontakt zwischen KöZ und Verriegelung u. Rutschen des Trailerreifen (μ=0,8) möglich

# 2. Outcome of subgroup IIIb
# Hitch design: best practices – SAF Holland

- **SAF Holland**: leading manufacturer  of chassis-related systems and components (axle, suspension systems, fifth wheels, kingpins, landing gears)

- **Design of different hitch models**: FW6170 – FW6160-A

- **Design requirements and implementation**:
  - No existing field data, no legislation, no specifications from wagon manufacturer
  - Own specifications based on Regulation UNECE R55 (type of approval of fifth wheel)
  - Missing elements:
    - Wagon requirements under extreme conditions (worst case scenario for rail to be developed – is the safety indicator for rail similar to road?)

# 2. Outcome of subgroup IIIb
# Hitch design: best practices – SAF Holland

- UNECE R55
  - Regulation No 55 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of mechanical coupling components of combinations of vehicles (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A42010X0828%2801%29)
  - Test requirements: **overturning test or static lifting test** (ensuring that the trailer does not separate from the truck and both units stay together even in an extreme overturning event of the trailer
  - The test is performed to **1x imposed load with no permanent deformation of the coupling device.** The test is then continued to **1,6x (or 2,5x for Class G50 Fifth Wheels) imposed load.** In this stage of the test permanent deformation is permissible, but the lock must not separate from the Kingpin.

3.7.2.2. A static lifting test shall be performed on all fifth wheel couplings. Up to a lifting force of $F_z = g \times U$ there shall not be any major permanent bending of the coupling plate over more than 0,2 per cent of its width.

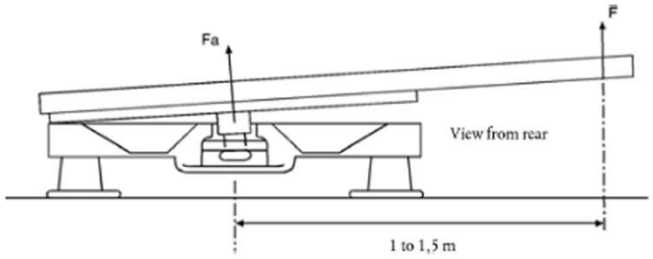
In the case of Class G50 standard fifth wheel couplings and comparable couplings for the same coupling pin diameter, there shall not be any separation of the coupling pin from the coupling with a lifting force of $F_z = g \times 2,5\ U$. In the case of non-standard couplings using a pin diameter greater than 50 mm, for example 90 mm pin diameter couplings, the lifting force shall be: $F_z = g \times 1,6\ U$ with a minimum value of 500 kN.

The force shall be applied by means of a lever bearing on the coupling plate at one end and being raised at the other end at a distance of 1,0 to 1,5 m from the centre of the coupling pin — see Figure 24.

The lever arm shall be at 90° to the direction of entry of the coupling pin into the coupling. If the worst case is obvious, this worst case has to be tested. If the worst case is not easy to determine, the Type Approval Authority or Technical Service shall decide which side to test. Only one test is necessary.

*Figure 24*

**Lifting test on fifth wheel couplings**

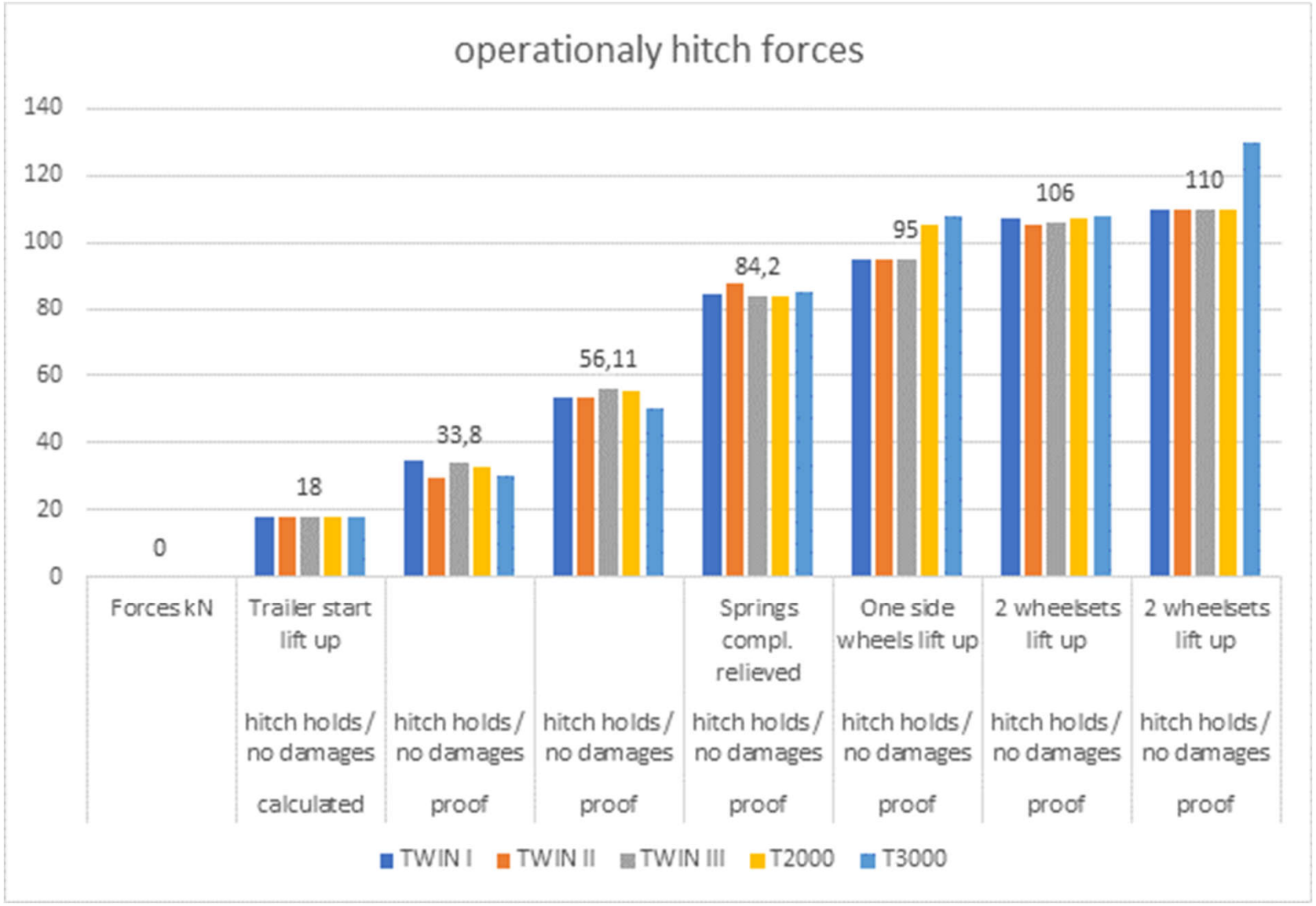


# 2. Outcome of subgroup IIIb
# Locking mechanism – Tests (VTG)

- The objective of the static tests was to determine:
  1. at which tensile forces the hitches hold the king pin securely
  2. at what force the pocket wagons lose their driving stability
  3. at what force derailment of the pocket wagons can occur
  4. whether the hitches are free from damage after the respective tensile forces have been applied to the king pin test specimen

- Test performed in 2021 on pocket wagons fitted with different hitch types (SAF, MAZ, PVF) in cooperation with an expert organization to determine at which impact a safety hazard can arise.

# 2. Outcome of subgroup IIIb
# Locking mechanism – Tests (VTG)



# 2. Outcome of subgroup IIIb
# Locking mechanism – Tests (VTG)

| Wagon Type | UIC Code | Hitch Type | Hitch manufacturer | Test point 1. + 2. static holding force | Test point 3. static holding force | Information from hitch manufacturer (static holding force) |
|---|---|---|---|---|---|---|
| **T2000** | Sdggmrs(s) | FW6160 + FW6150, no self-release function | SAF Holland GmbH | >100kn | >110kn | >117,7kn |
| **TWIN-I** | Sdggmrs(s) | FW6170, no self-release function | SAF Holland GmbH | >95kn | >110kn | >150kn |
| **TWIN-II** | Sdggmrs | TWIN II, no self-release function | PVF Schienenfahrzeuge s.r.o. | >95kn | >110kn | >120kn |
| **TWIN-III** | Sdggmrs | TWIN III, no self-release function | PVF Schienenfahrzeuge s.r.o. | >95kn | >110kn | >120kn |
| **T3000** | Sdggmrs | MAZ80800M, no self-release function (after modification) | MAZ GmbH | >100kn | >120kn | >120kn |

*Note: the information received from the hitch manufacturer was (1) either already available long before the JNS Task Force or (1) was provided after the incident of 2021 based on several static tests carried out in 2021 by the manufacturers.*

⇒ *The tests and the documentation provided by the hitch manufacturer are sufficient, to ensure a safe transportation of semi-trailers on pocket wagons.*

# 2. Outcome of subgroup IIIb Conclusions

- The undefined concept of ‘safety barrier’ should be replaced by ‘**safety measures’ or ‘safety requirements**’ as defined in the CSM Regulations.

- **Hitch is an interface of the wagon to the loading**, not an IC.

- Regulations and standards are in place for different safety barriers related to the design of pocket wagons. **Locking device is one of the safety components, not the only one.**

- **A holistic system approach is mandatory**: infrastructure (activities of cluster 2), wagons, hitches and loading units.

- **Wind speed remains the key factor in wagon running behavior and should be further investigated after the JNS** (holistic approach with dynamic tests to be foreseen – application of EN14067-6 to evaluate the behavior of the wagons under lateral winds and a possible application of EN14363 – running safety).

- **The determination of a minimum threshold value of locking force shall be the outcome of a transparent and sectorial common risk assessment.** It should also be evaluated if for example the Great Belt Bridge is to be categorized as special or general case.

- If a minimum threshold value of locking force is fixed**, there is absolutely no need for supplementary safety barriers such as additional weight of the semi-trailer currently implemented on the Great Belt Bridge.** In any case, it is recommended to carry out an analysis on the wagon running stability under critical windy conditions in order to guarantee a constant running behavior of the wagon on the GBB.

- **After the results of the holistic analysis and risk assessment** (precondition), additional specifications could be added in the TSI WAG and in the EN standards and/or UIC-related IRS.

# 2. Outcome of subgroup IIIb
# Recommendations

**Recommendation #1**
According to current knowledge and return of experiences, the seating device fitted on a pocket wagon should not be integrated as an IC into the TSI WAG.

**Recommendation #2**
The wagon running behavior under critical windy conditions shall be further investigated based on a commonly-agreed methodology (liaison with conclusions from Cluster 2 members, except BaneDanmark). Dynamic on-field tests shall be undertaken with the support of EU funding program (Rail JU).

**Recommendation #3**
As the systemic risk analysis (as referenced by the EU regulation) has not demonstrated its pertinence so far, the current temporary mitigation measure (14t additional weight) shall be immediately removed after the closure of this JNS.

**Recommendation #4**
The respective TSIs and standards shall be only adapted when the results of the common risk assessment on the GBB will be available. This assessment shall consider all possible cases that might occur on the GBB: from (1) best case: semi-trailer perfectly locked and secured with different seating devices and vertical forces to (2) worst case: semi-trailer not locked and secured at all.

END