

# CEF PSA UBS ACTION PROJECT

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## 1ST TRAINDY STUDY RESULTS AS AN OUTPUT OF THE PROJECT



# AGENDA

01.

SITUATION AT THE BEGINNING OF THE PROJECT

02.

NEED

03.

DESCRIPTION OF UIC 421 METHODOLOGY USED (I.E. IRS40421)

04.

RESULTS

05.

CONCLUSION



# RULES : SITUATION BEFORE THE PROJECT

A high discrepancy between operators and countries on the quantity of P wagon and unbraked wagons in G trains

Timetabled braking behaviour of train: G		
RU (colour code indicates info status: <b>green</b> = verified, <b>yellow</b> = available, <b>red</b> = not available)	Maximum allowance of brake position P	Maximum allowance of non-braking vehicles
<b>DBC DE</b>	12 axles, for the rest turn brakes off	n/a Das erste und letzte Fahrzeug muss in der Regel eine wirkende Bremse haben. Es darf ein Fahrzeug ohne wirkende
<b>Fret SNCF</b>	200t	10 successive vehicles
<b>DBC NL</b>	12 axles, for the rest turn brakes off	n/a

Timetabled braking behaviour of train: G		
RU (colour code indicates info status: <b>green</b> = verified, <b>yellow</b> = available, <b>red</b> = not available)	Maximum allowance of brake position P	Maximum allowance of non-braking vehicles
<b>Rail Cargo Austria</b>	<b>not allowed</b>	
	P is forbidden, turn brakes off if G not possible^	N/a but the last wagon must be braking
<b>SBB Cargo</b>	P is forbidden, turn brakes off if G not possible	n/a but the first and last vehicle of the wagon rake must have functional brakes (+ the consideration of Teilbremsverhältnis)
<b>DBC CH</b>	P is forbidden, turn brakes off if G not possible	n/a

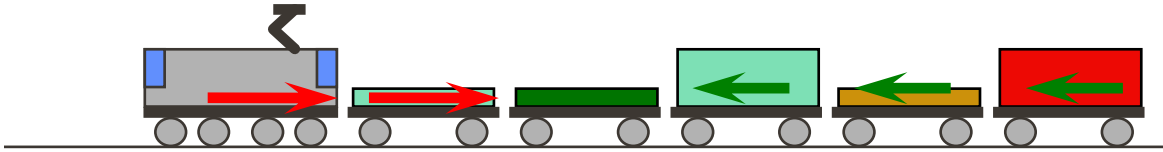
# NEED ENTRUSTED FOR THE ROLLING STOCK ENGINEERING CENTER OF SNCF STUDY

Following scenarii to be analysed

Scenarios	
1.	G braked trains are proposed to be allowed to have up to 12 (for the test consecutive) axels in a train P-position is allowed. Every other vehicle without G brake position must be isolated. The hauled mass must not exceed 4000t. A check needed whether this can be regarded sufficiently safe.
2.	A check needed how many consecutive non-braked wagons can be allowed in P- trains of up to 4 000 t in hauled mass but by applying the following minimum weight limits: <ul style="list-style-type: none"><li>o In the range of 1601...2500 t hauled mass no wagon may be lighter than 32 t.</li><li>o In the range of 2501...4000 t hauled mass no wagon may be lighter than 40 t.</li></ul>
3.	A check needed how many consecutive non-braked wagons can be allowed in G-trains of up to 4 000 t in hauled mass.

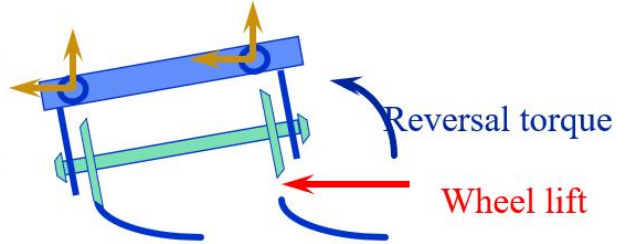
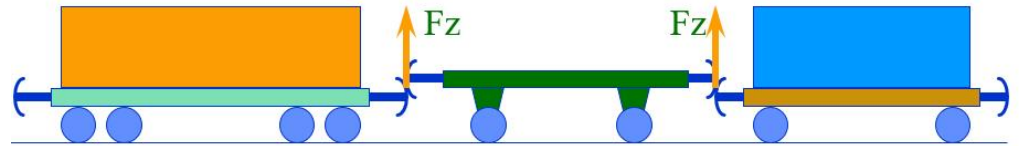
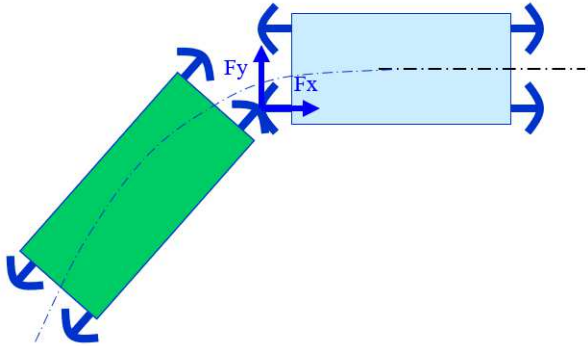
# DESCRIPTION OF UIC 421 METHODOLOGY USED (I.E. IRS40421)

This methodology aims at evaluating the risk of derailment due to LCF



Brake forces

Inertia of wagon not braked yet



# DESCRIPTION OF UIC 421 METHODOLOGY USED (I.E. IRS40421)

Methodology used : A mix between Fig 3 and 4 of §B.4.3 of Appendix B in IRS40421 “Composition and braking rules for freight trains in international traffic”

Fig 3 because

The goal is to replace the entire system by a new one allowing new rules

Fig 4 because

The reference offer used to make the comparison of existing system with new one consists of 2959 trains considered as a reference by French NSA EPSF

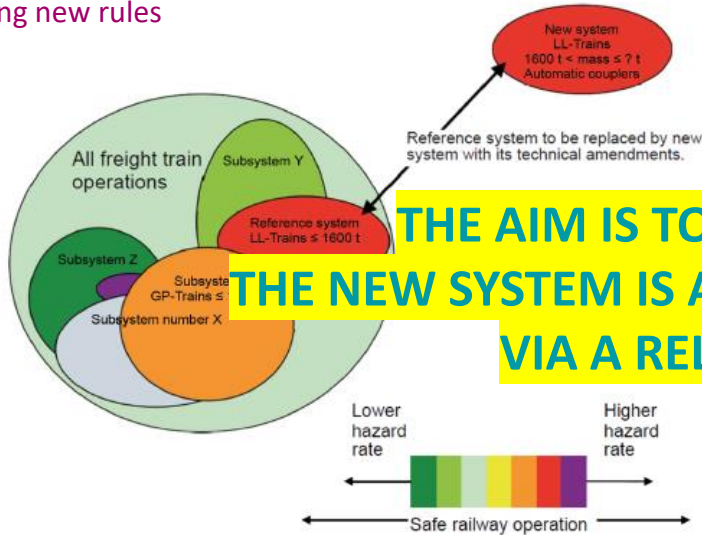


Fig. 3 - Partial modification of a system

**THE AIM IS TO DEMONSTRATE THAT THE NEW SYSTEM IS AS SAFE AS THE EXISTING ONE VIA A RELATIVE APPROACH**

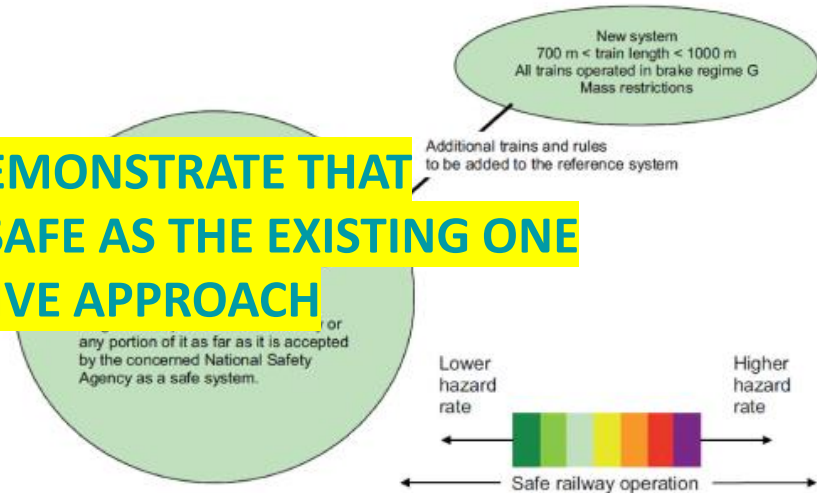


Fig. 4 - Enlarging system by adding new train offers

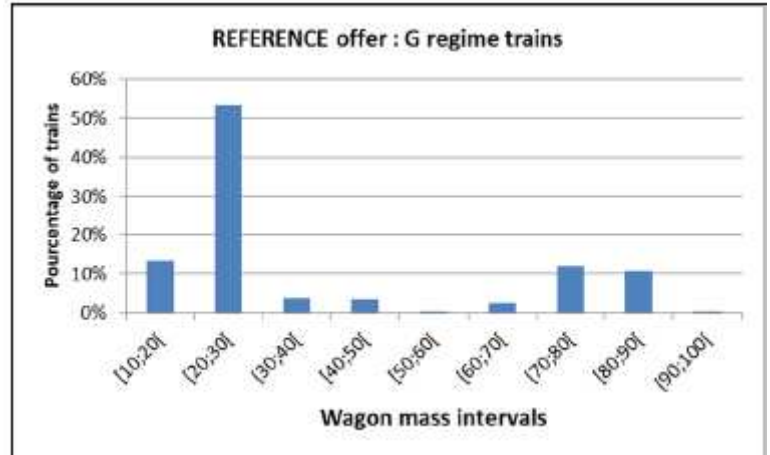
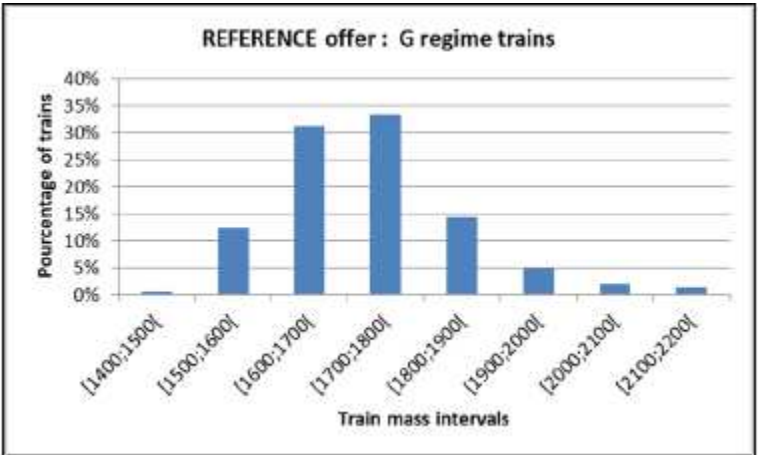


# METHODOLOGY : REFERENCE CASES

## The original reference case :

2.959 trains with a length from 650m to 750m and a linear mass from 2.2 t/m to 3 t/m (~1500 t to 2200 t) were operated from January 2012 to June 2014 by SNCF under G regime. The trains belonging to this transport offer are heterogeneous and consist of various wagons (2 axes and 2 bogies wagons) from different holders. They are considered as representative of nominal freight trains shape and composition.

This reference case is the one used during UIC421 project to validate the IRS40421 and more particularly the statistic tool (added value to use IRS40421 methodology)

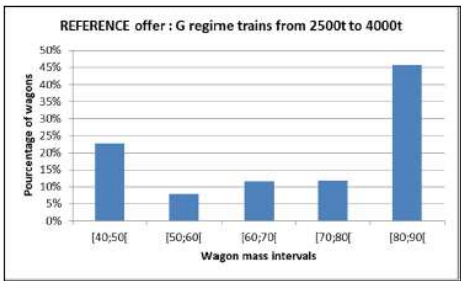
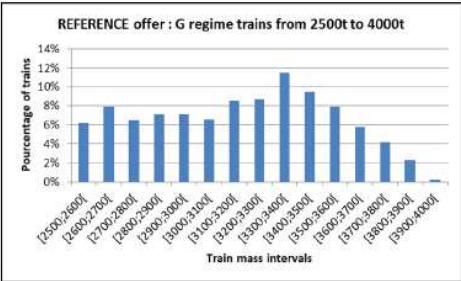
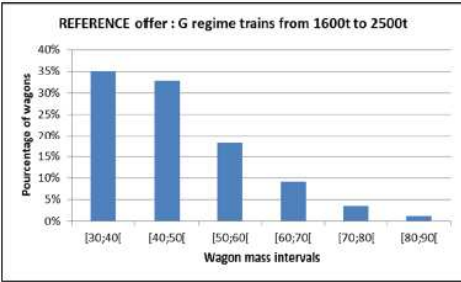
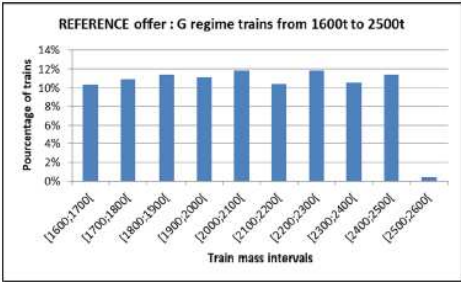


# METHODOLOGY : REFERENCE CASES

## The artificial reference cases :

From the original reference case it was necessary to build 5 other reference cases in order to apply the methodology as it is necessary to compare similar traffic.

Programs developed with Matlab® were created to extrapolate the original reference case using the same wagons but modifying their mass in order to achieve heavier trains belonging to [1600-2500t] and [2500-4000t] intervals





# METHODOLOGY : NEW CASES

## The new cases :

The new cases correspond to the needs of scenario 1, 2 and 3 described above and are compared with reference cases :

SCENARIO	Reference cases		New cases
1	Regime G, original reference case [1500t-2200t]	↔	Regime G, original reference case [1500t-2200t], 200 t max in P Regime G, original reference case [1500t-2200t], 12 axles max in P
	Regime G, artificial reference case [1600t-2500 t]	↔	Regime G, artificial reference case [1600t-2500 t], 12 axles max in P
	Regime G, artificial reference case [2500t-4000 t]	↔	Regime G, artificial reference case [2500t-4000 t], 12 axles max in P
2	Regime LL, artificial reference case [1200t-1600 t]	↔	Regime LL, artificial reference case [1200t-1600 t], 1 wagon unbraked Regime LL, artificial reference case [1200t-1600 t], 3 consecutive wagons unbraked
	Regime LL, artificial reference case [1600t-2500 t], 32t/wagon minimum	↔	Regime LL, artificial reference case [1600t-2500 t], 1 wagon unbraked Regime LL, artificial reference case [1600t-2500 t], 3 consecutive wagons unbraked
	Regime LL, artificial reference case [2500t-4000 t], 40t/wagon minimum	↔	Regime LL, artificial reference case [2500t-4000 t], 1 wagon unbraked Regime LL, artificial reference case [2500t-4000 t], 3 consecutive wagons unbraked
3	Regime G, original reference case [1500t-2200t]	↔	Regime G, original reference case [1500t-2200t], 1 wagon unbraked Regime G, original reference case [1500t-2200t], 3 consecutive wagons unbraked
	Regime G, artificial reference case [1600t-2500 t]	↔	Regime G, artificial reference case [1600t-2500 t], 1 wagon unbraked Regime G, artificial reference case [1600t-2500 t], 3 consecutive wagons unbraked
	Regime G, artificial reference case [2500t-4000 t]	↔	Regime G, artificial reference case [2500t-4000 t], 1 wagon unbraked Regime G, artificial reference case [2500t-4000 t], 3 consecutive wagons unbraked

# METHODOLOGY : TOOLS USED AND MANOEUVRES ANALYSED

## Calculation made with TrainDy :

Use of the statistic tool developed by Tor Vergata during UIC421 project to build 1000 trains for reference cases and new cases

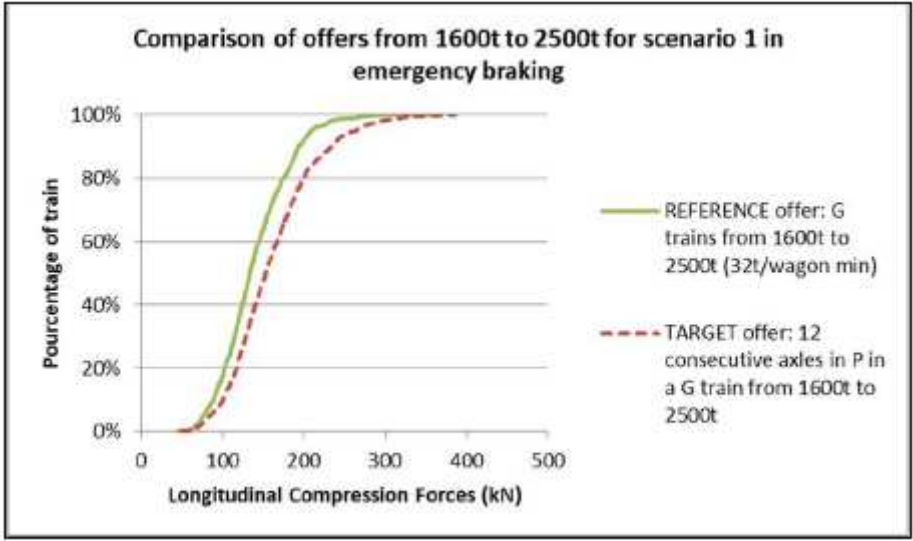
Maximum LCF per train are calculated for 2 brake manoeuvres on each 1000 trains :

- Emergency brake
- Service brake (Delta P = 1 bar)



# RESULTS : COMPARISON OF REPARTITION FONCTIONS

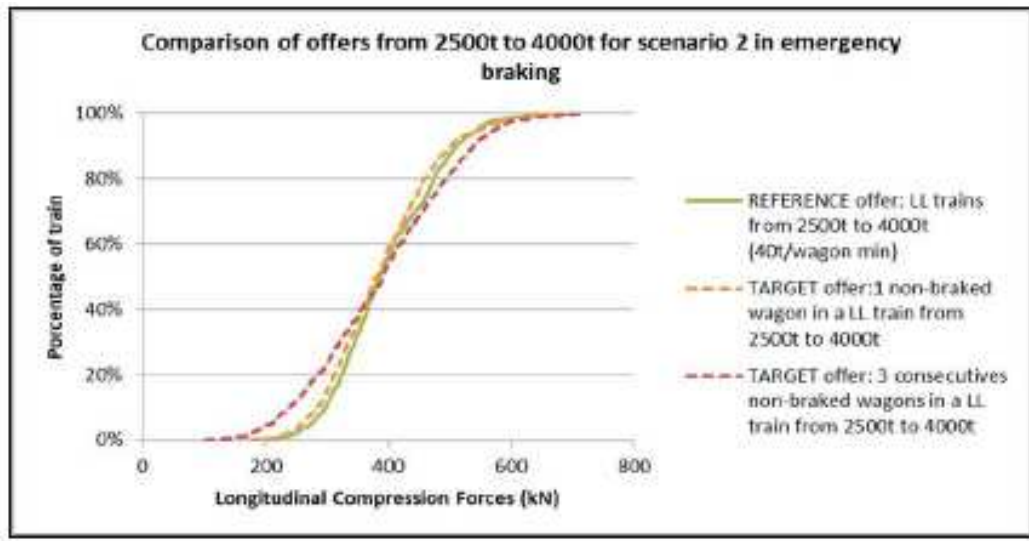
Scenario 1 : example for [1600-2500t]



P wagons in G trains increase the risk but but the increase remains low. The target offers are accepted and authorized in the national rules of many European countries.

# RESULTS : COMPARISON OF REPARTITION FONCTIONS

Scenario 2 and 3 : example for [2500-4000t] in LL



The target case (3 consecutive unbraked wagons in the train) is presented globally as more risky with regard to the LCF but the increase is very low and the LCF decreases also for many trains..



# RESULTS : CALCULATION OF DERAILMENT PROBABILITY ACCORDING UIC421

## Use of tolerable LCF assumptions

*Chapter n°B.3.4.2 of UIC-421 leaflet is used to define the admissible LCF for each wagon.*

*The 240 kN value is used as the characteristic value of the eligible LCF from the reference offer. This LCF is the minimum allowable LCF for a two-axle wagon on a 190m radius curve and a reverse curve. In the same configurations, and for a four-axle wagon, this characteristic admissible LCF value is estimated at 320 kN according to the extrapolation rules defined in UIC-421.*

*Thus, for each wagon's admissible LCF on a 190 m curve and a reverse curve, the criteria used are as follows:*

- Admissible LCF for an empty axle wagon: 240 kN*
- Admissible LCF for an empty bogie wagon: 320 kN*

*In addition, depending on the wagon load (available on built trains), the extrapolation used is to add 8 kN of admissible LCF per tonne of load.*

*Whatever the mass of the wagon, the admissible LCF is limited to:*

- 400 kN for an axle wagon*
- 600 kN for a bogie wagon*



# RESULTS : CALCULATION OF DERAILEMENT PROBABILITY ACCORDING UIC421

Analysis made for G trains only :

We consider a train derails when at least the 10mLCF generated on one wagon of the train exceeds its tolerable LCF

Scenario 1	adm LCF - 50
<b>Emergency braking</b>	<b>Probability of derailment estimated</b>
<i>REFERENCE offer : G trains (REFERENCE of the UIC421 project)</i>	0,027
<i>Target offer : 200 tons of consecutive wagons in P randomly in a G train</i>	0,081
<i>Target offer : 12 consecutive axles in P randomly in a G train</i>	0,057
<i>Target offer : 1% of French trains have wagons in P mode in a G train</i>	0,028
<i>Target offer : 1% of German trains have wagons in P mode in a G train</i>	0,027
Scenario 3	adm LCF - 50
<i>Target offer : 1 unbraked wagon randomly in a G train</i>	0,015
<i>Target offer : 3 consecutive unbraked wagons randomly in a G train</i>	0,028

# CONCLUSION

## With respect to LCF risk :

The study cannot conclude to a null risk but shows that it is possible to operate :

- 12 consecutive P axles in a G train
- 3 consecutive unbraked wagons in a G or a LL train

Globally the potential increase of LCF, which is very low, is balanced by the quantity of trains which are concerned by this issue.

## With respect to the amount of energy that can be borne by the wheel :

New rules aiming at generalising the possibility to have wagons in P in a G train are acceptable with respect to the amount of energy that can be borne by the wheels of the wagon during a braking under the condition that these wagons are equipped with kink valves to limit significantly this amount of energy and make it secure in any configurations



# INTEGRATION IN IRS40421

## 3.1 – G-braked trains

However up to 12 axles are allowed to be P-braked. For any further wagons that cannot be G-braked the brakes are to be isolated, anyway in that case no more than 3 consecutive wagons can be unbraked (according to *technical report B 177.4/RP 5* - see *Reference documents - page 5*).

## 3.2 – P-braked trains

If braking regime G (see *Abbreviations and Symbols*) is not possible or permitted on one of the first five vehicles, the brake of this vehicle shall be isolated. Even if one of the first five vehicles does not have a functioning braking system it shall nevertheless be considered as LL.





# THANK YOU - QUESTIONS

