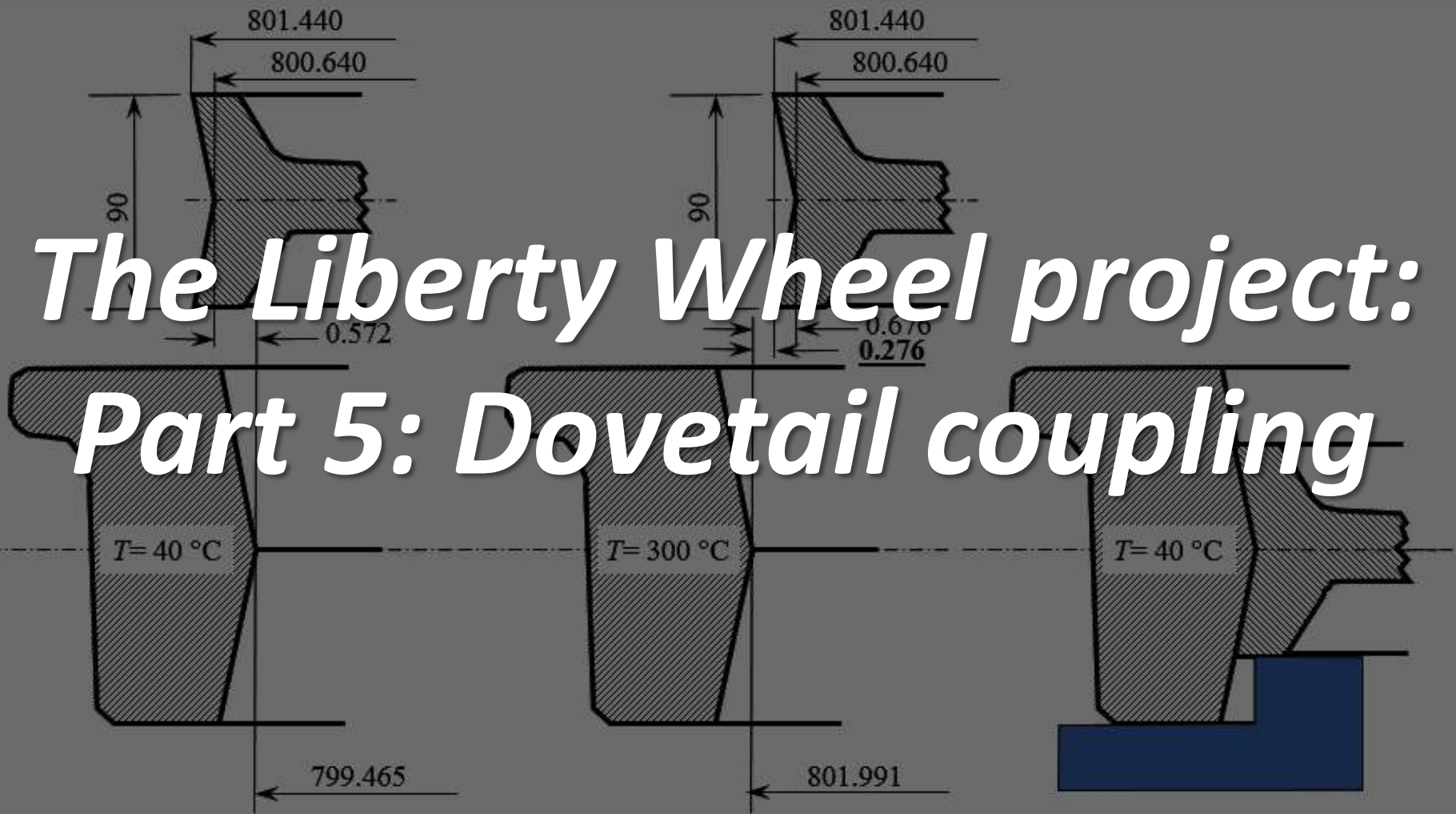


# *The Liberty Wheel project: Part 5: Dovetail coupling*



## Targets

### Elimination of thermal input

- Up to 300 km/h: regional, commuter, metro, trams, locomotives, high speed...
- «Positive» tyre – wheel centre coupling with several possible geometries (NO FRICTION!)
- Elimination of retaining ring --- not needed anymore (see later)

### Different overhaul strategy

- Tyre removal by induction or laser heating --- no damage to the wheel centre!
- Fully machined tyres shrink fitted on accurately machined wheel centres

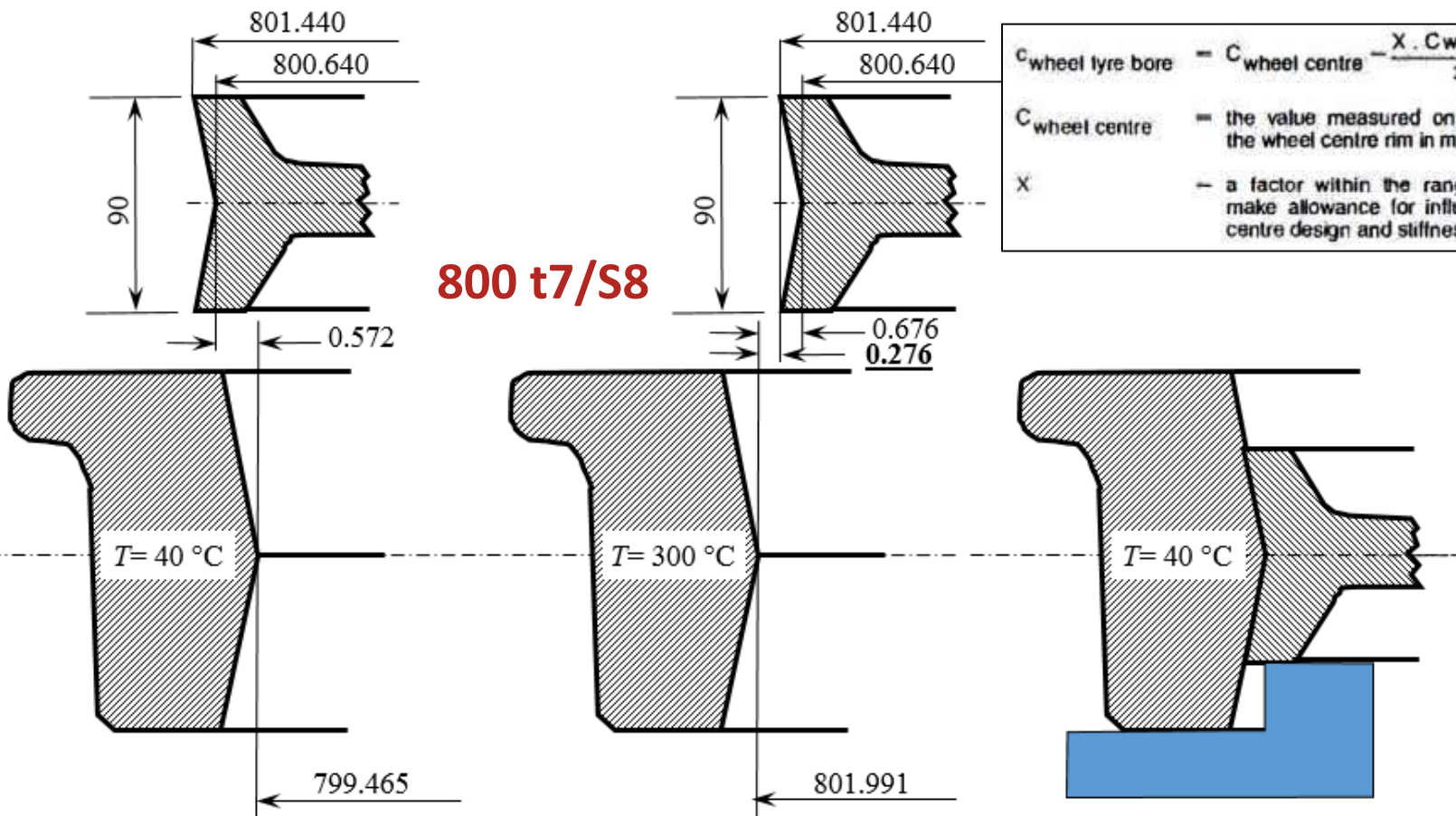
**If the retaining  
ring is  
withdrawn, any  
tyre can be  
removed in 20  
minutes with a  
very simple and  
low-cost  
induction  
heating system  
...**

**ALWAYS  
AND  
EVERYWHERE**

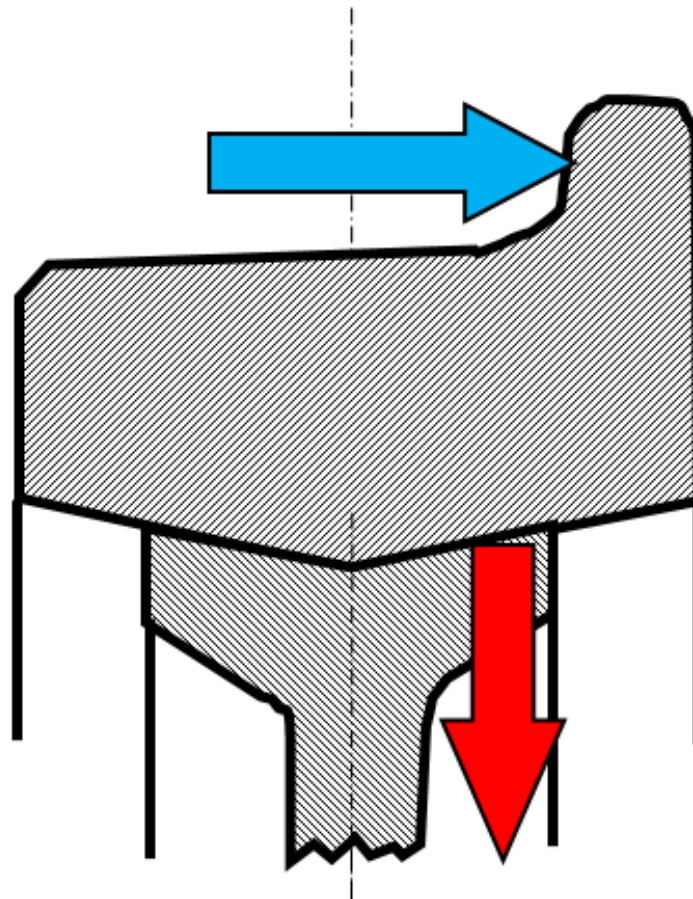


Requires some basic explanation on interference, thermal expansion and general tolerancing... 800 t7/S8 (ISO 286)

**FULLY MACHINED TYRES!!!**

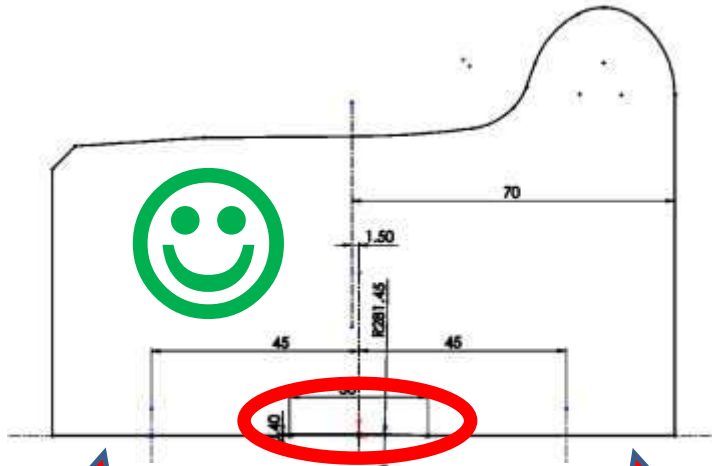


**Low radial stiffness of the outer parts of the mating surface  
Reduced safety under lateral forces (when interference is =0)**



High radial stiffness of the wheel web under the mating surface  
High safety under lateral forces (when interference is =0)

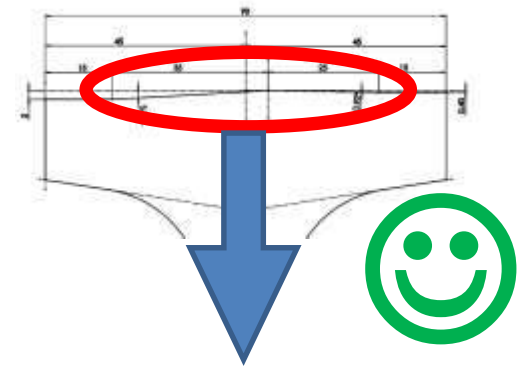
Option 1: toroidal  
(symmetric) coupling



**NO  
ABUTMENT !!!**

**NO  
RETAINING RING!**

Option 2: dovetail  
(asymmetric) coupling

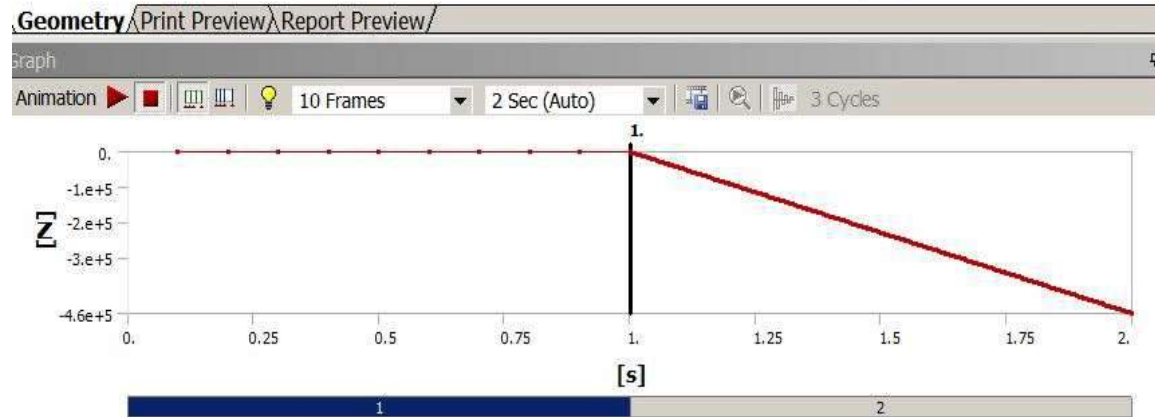
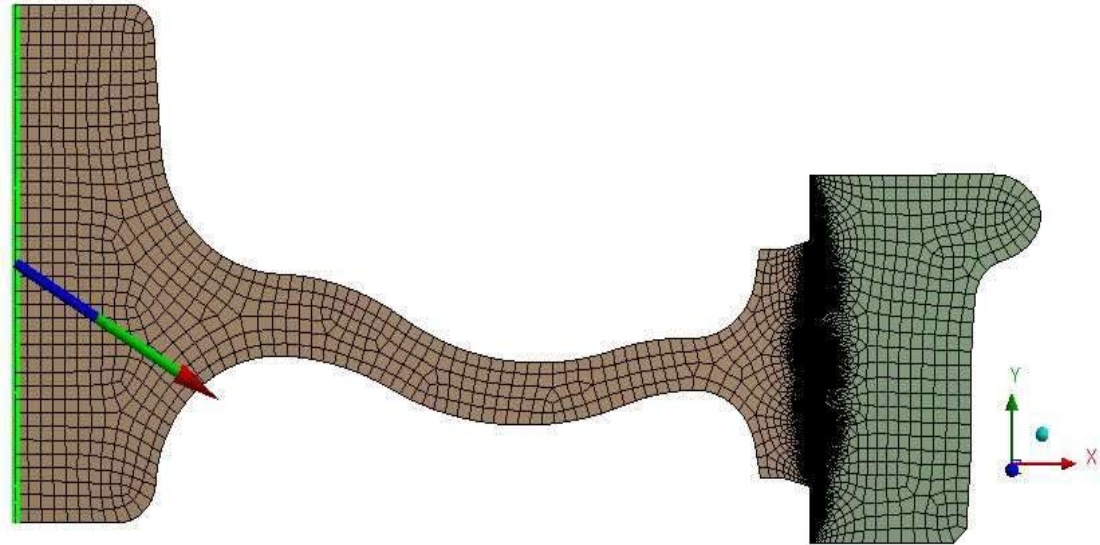




## But... is it safe???

- Finite element calculation in the elastoplastic domain
- Lateral force needed to loose the tyre bigger than the shear force to cut the retaining ring
- YES, IT IS SAFE!!!
- *Note: calculation performed without interference!!!!*

K: Toroidal plastic p0  
Force Reaction  
06/03/2019 17:26



# Was all this destined to remain just an academic exercise?



**No, thanks to a couple of colleagues that believed in our idea...**



**Machining  
(coffee  
machine...)  
and checking**

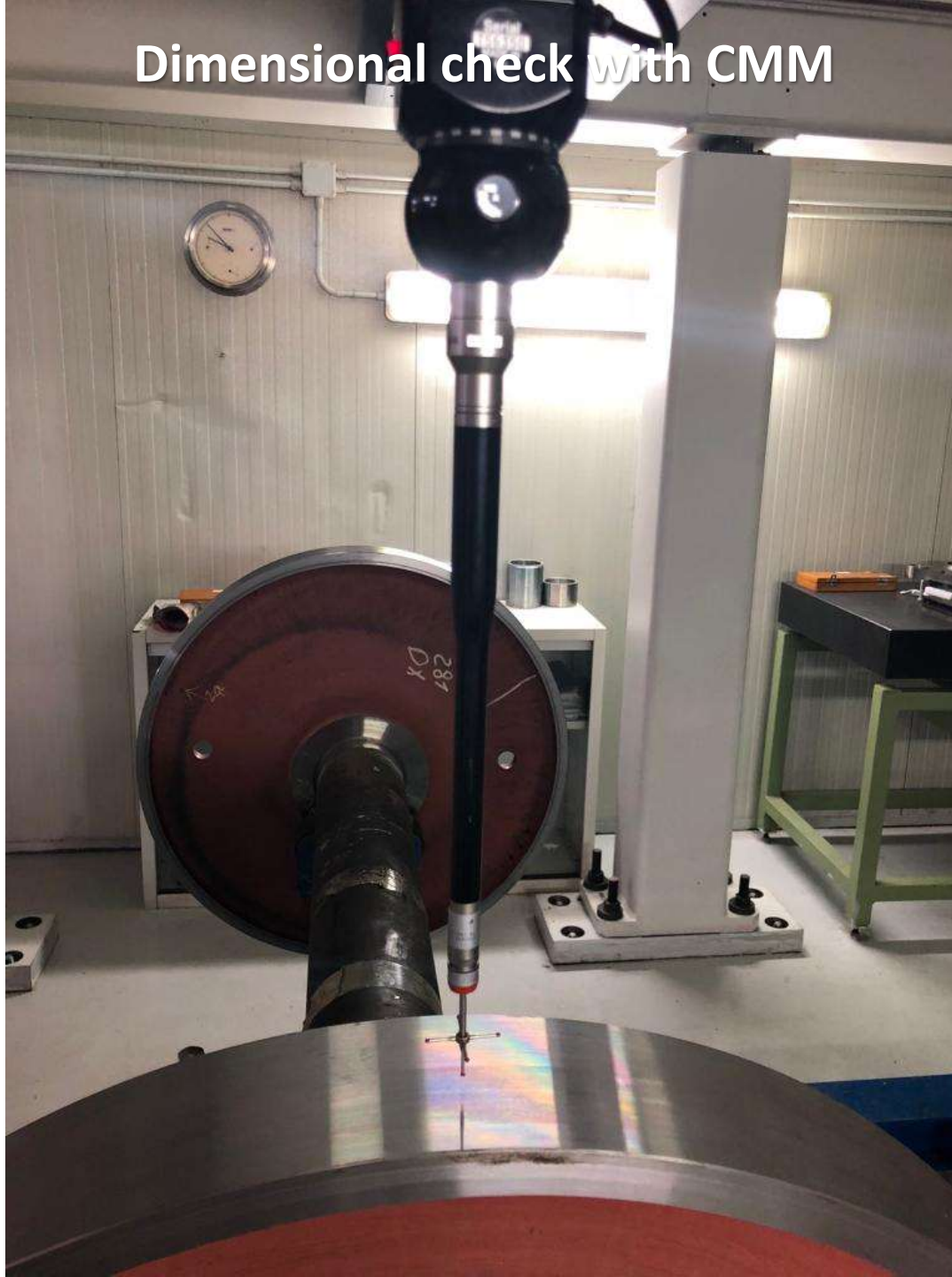


**Machining the  
components for  
the asymmetric  
dovetail  
coupling**





# Dimensional check with CMM





**Dovetail (asymmetric) coupling on a trailer axle  
of a FIAT ALn668 DMU**

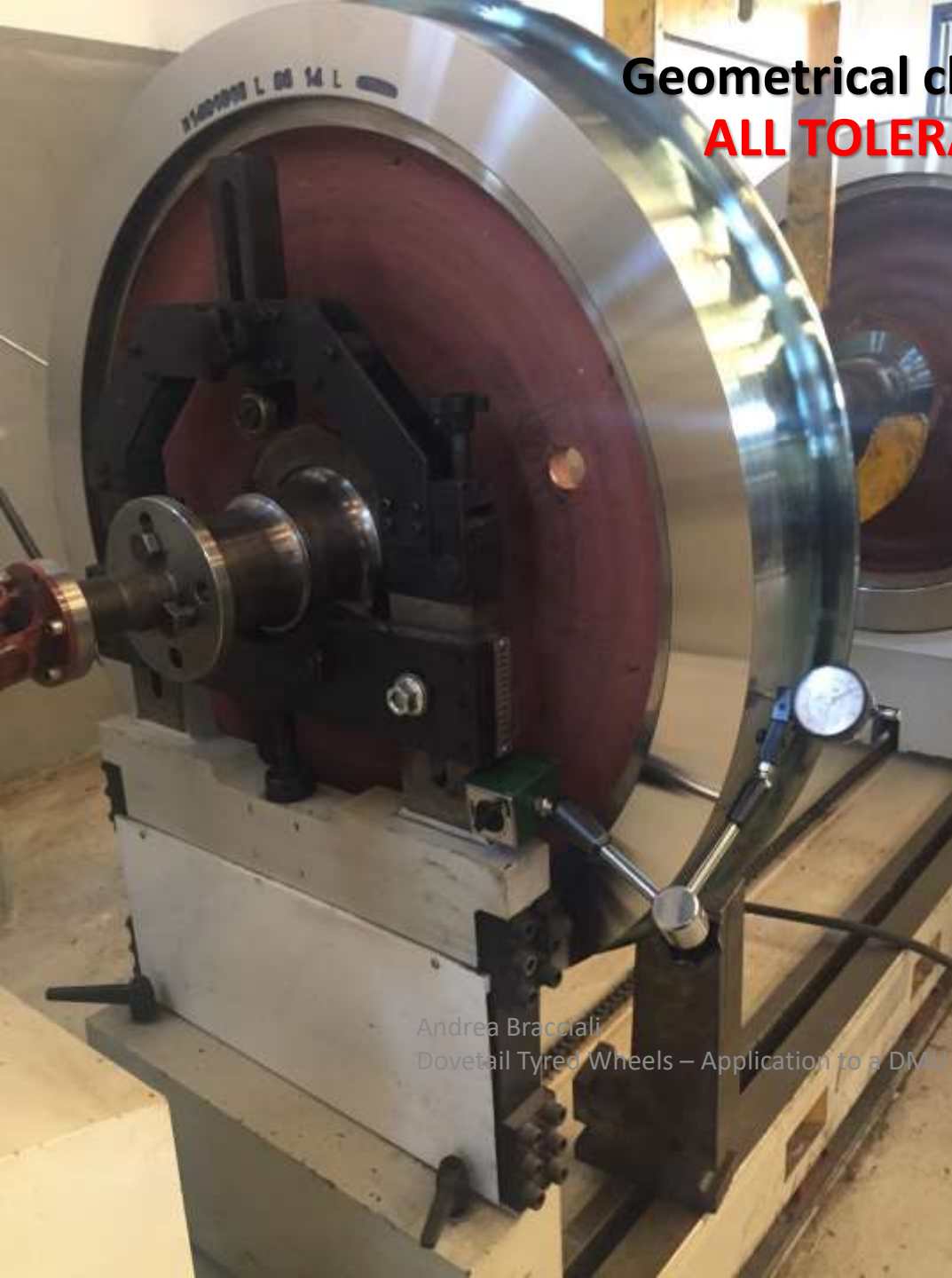


## Lowering the wheelset on the hot tyre (300 °C)

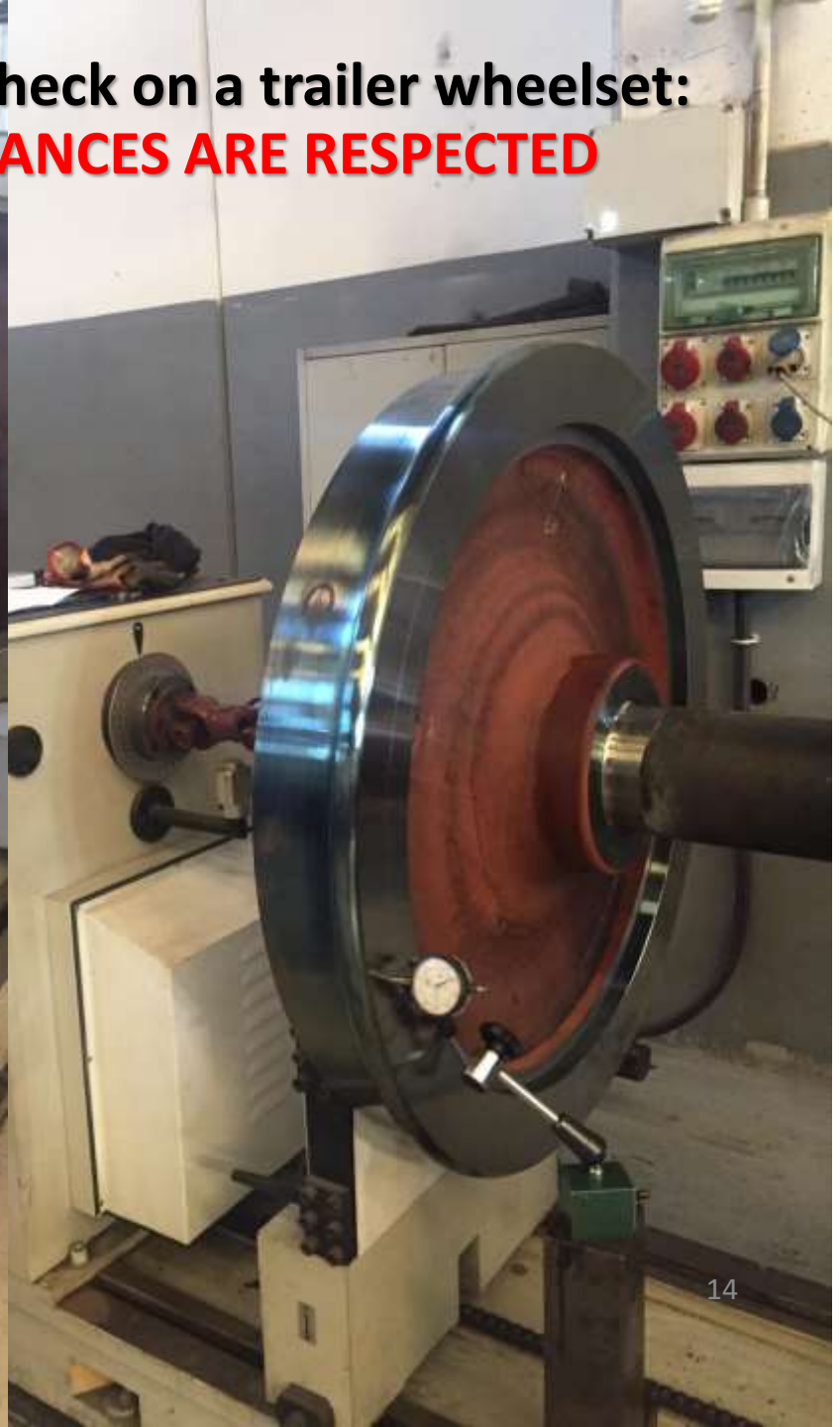




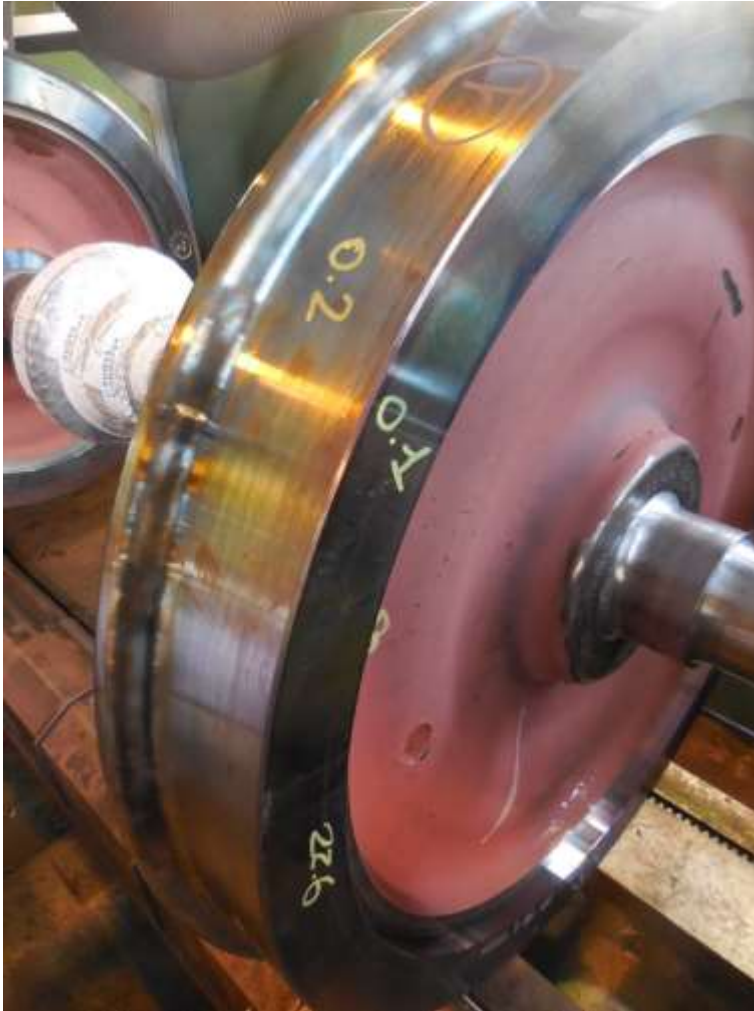
**Geometrical check on a trailer wheelset:  
ALL TOLERANCES ARE RESPECTED**



Andrea Bracciali  
Dovetail Tyred Wheels – Application to a DMU

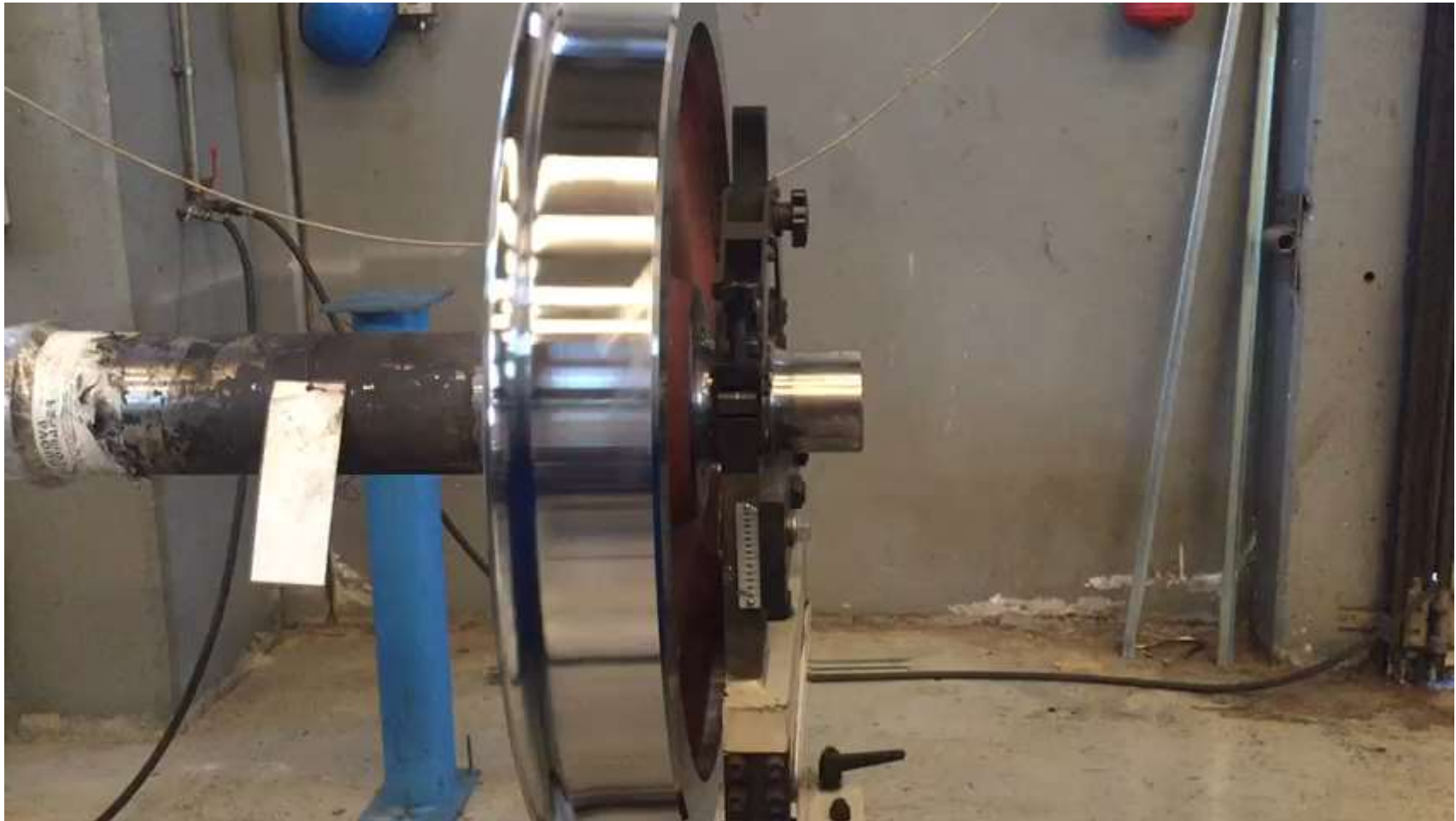


# Geometrical check on a trailer wheelset: **ALL TOLERANCES ARE RESPECTED**





**Dynamic check on a driven wheelset:  
RESIDUAL UNBALANCE IS WELL WITHIN THE LIMITS  
THE WHEELSET IS READY FOR USE WITHOUT ANY  
FURTHER MACHINING/OPERATION**



Here come the wheelsets ready to test...





**The first wheelsets in the history of the mankind that have NEITHER ABUTMENT NOR RETAINING RING are ready to run...**





# Tests performed on 21-23 November 2018 on the Brescia-Edolo line (Northern Italy)

**ALn668.1036 DMU with**

- 2 trailer wheelsets with dovetail coupling
- 2 motor wheelsets with toroidal coupling





TRENORD

ALn 668 1036

TRENORD

**TYRED WHEELS  
OF THE FUTURE  
ON TEST HERE!**

NUOVA EDITORIA AB Consulting



# The “crazy test”: 7 (seven!) emergency brakes one after the other



***Thanks guys for your marvelous job...***





Several hundreds km run  
No problems after heavy braking

**FULLY SATISFACTORY BEHAVIOUR  
TESTING PHASE POSITIVELY  
CONCLUDED!!!**



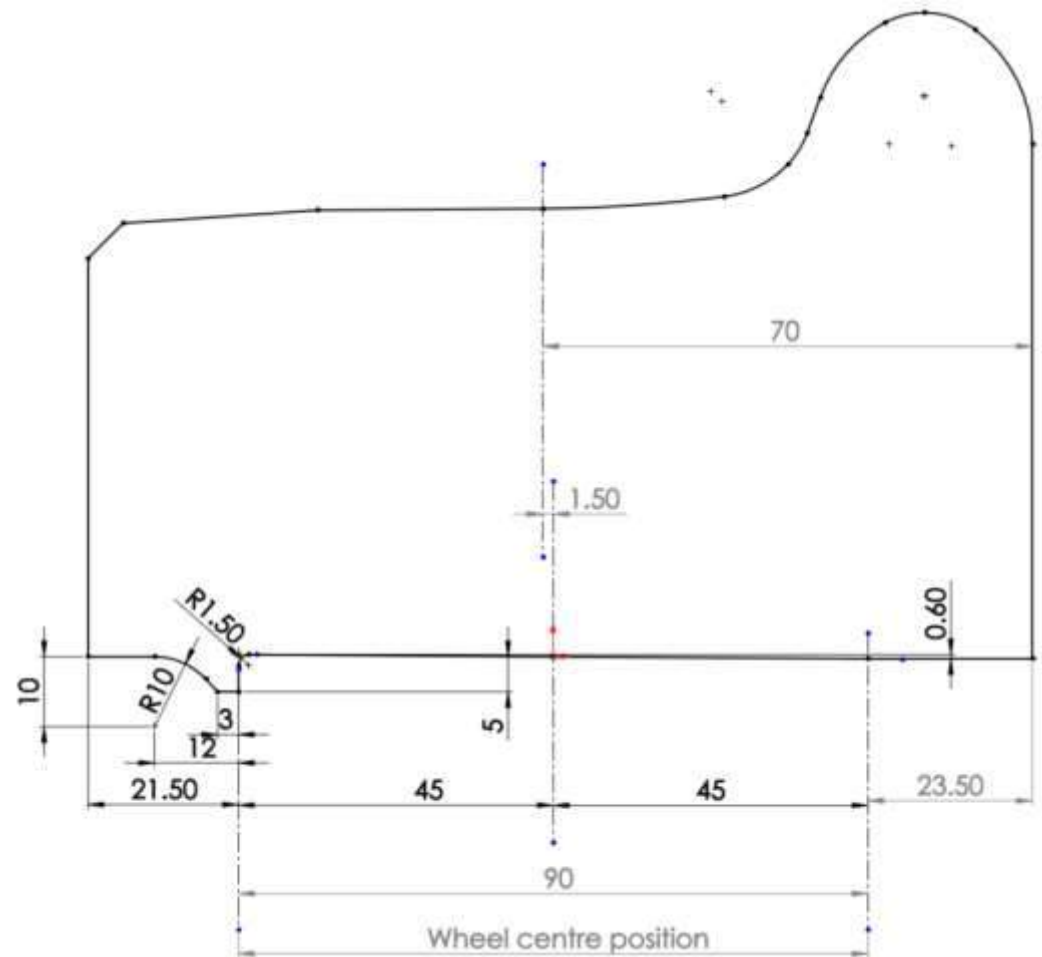


# But there is always something to learn: always listen to the workshop...

- The absence of an abutment forces to vertical mounting...
- Machining toroidal surfaces may be complex...

## Solution:

a 1:75 tapered surface with  
a small abutment just for  
mounting reasons



Does the future belong to inboard bearings bogies???







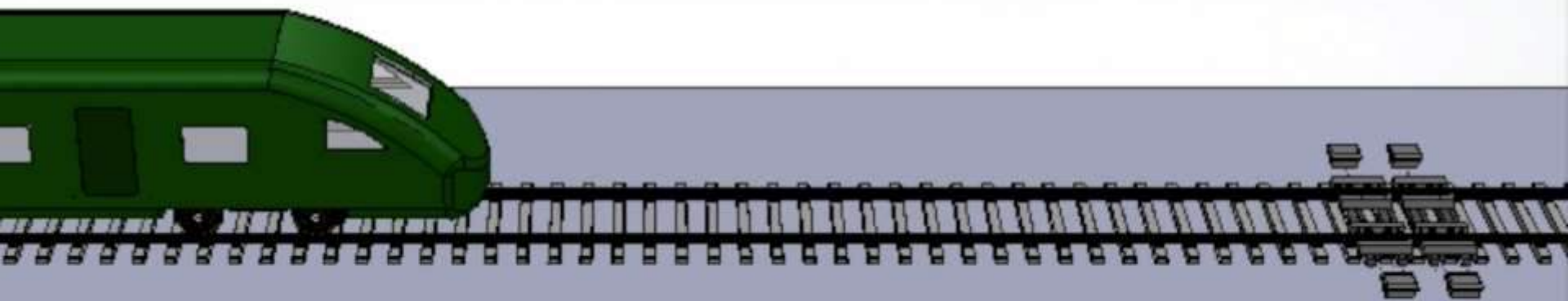
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## A fully automated robotized station for inboard bearings...

- **With this geometry, a fully automated tyre change station is conceivable**
- **Project with several industrial partners**
- **Feasibility study completed**

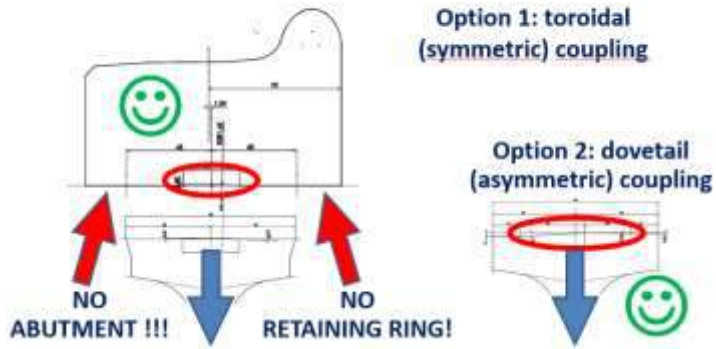


***AB Consulting***





High radial stiffness of the wheel web under the mating surface  
High safety under lateral forces (when interference is =0)



# What about developing this solution?

- A wheel centre with one web is not the best option...
- Two webs would be better...
- How can we solve the problem????

