WP22 NOVEL RAIL FREIGHT VEHICLES
FFE (Madrid, Spain) – 21 September 2017

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WP 2.2. Leader
General map of WP22 activity

- Penetration in New Market segments
  - Connectivity
  - Wagon design
  - Operational changes
  - Train changes
  - Infrastructure changes

Increasing Network capacity

- Competitiveness
- Reliability
- Flexibility
- Information

Capacity for Rail
WP 2.2 Conceptual achievements

New Wagon designs matching the objectives
Better use of Train length, More payload, More flexibility

New Equipments on these wagons
EP braking, Automatic couplers, E.O.T

New trains with these wagons and equipments
Longer safe trains more flexible, maneuverable

<table>
<thead>
<tr>
<th>The operational</th>
<th>The infrastructure changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated brake tests, use of railroad Tractors;</td>
<td>Better use of infrastructure gauge for P400 loading gauge; 25T per axel</td>
</tr>
</tbody>
</table>

On Train and Train to ground connectivity
Sensors, Detectors, Wireless or Wired connectivity, Positioning
Design and Equipment Innovations

Multi-body wagons connected by Jacobs bogies and/or draw bars instead of UIC couplers

Automatic couplers

End of Train device: EOT

Extension over buffers

Blocks of 3 wagons with UIC couplers

Rail-road tractor
How to win the challenge of saving energy but communicate

Less Data but long range and low energy
Concentration in a smart box before sending informations to the locomotive by a mesh communication
Keep GPS positioning for sensitive points
Each innovation or integrated innovation developed in WP22 has impacted the Reliability, the Flexibility, the Competitiveness, the transport capacity, the quality of the service and the attractiveness of the rail freight transport.

Defining KPIs appeared the next essential step to measure the impacts on the efficiency:

- The percentage of usable length to place cargo
- The ratio between the payload and the gross weight of the train measured in percentage
- The average number of loaded kilometers per year of the wagons
- The average number of empty kilometers per year of the wagons
- The average commercial speed of the train divided by the maximum speed allowed of the train
- The cost of wagon maintenance per kilometer and the cost of maintenance per ton-km transported
- The Reliability is measured by the average delay per train
Methodology of selection of Innovations

- For each new design or each new equipment, in a cost-benefit analysis, the impact on competitiveness has been compared with the increase of the wagon cost of utilization taking into account the possible increased availability, but also the cost of a standard new built wagon for the comparison.

- At the same time, short term implementation of a design increasing the efficiency more than the cost of utilization as explained here above are not decided because of availability of fleets of largely amortized wagons.

- Innovations have also been examined in light of the potential need of a TSI modification for its introduction on the network.

- According to the various market segments the priorities are different.
Innovations selected for further analysis

- The main interesting topics resulting from the criteria quoted above are:
  - Sensors enabling the brake test done from drivers cabin
  - Wireless connectivity for in-wagon and on-train connectivity
  - Lengthening the train with an EOT or by coupling two trains
  - EP brakes
  - Automated couplers
  - 25T per wagon axle
  - Multi-body Wagons
  - Extension over buffers

- A table shows according the segment of the market the possible timing of introduction in the market if a positive business case may be set up:

<table>
<thead>
<tr>
<th>Type of traffic</th>
<th>Block trains: bulk</th>
<th>Wagon load</th>
<th>Combined transport</th>
<th>Car carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connectivity</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>EP Braking</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-Body</td>
<td>X</td>
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<tr>
<td>EOT</td>
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</tr>
<tr>
<td>25T</td>
<td>X</td>
<td></td>
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<tr>
<td>Automatic couplers</td>
<td></td>
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<tr>
<td>Extension over buffers</td>
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</tbody>
</table>

- Possible timing for market uptake:
  - Short term
  - Medium term
  - Long term
## Relation with the market needs

<table>
<thead>
<tr>
<th>KEY FACTOR -&gt; Market Segment</th>
<th>Competitiveness</th>
<th>Reliability</th>
<th>Transit Time</th>
<th>Connectivity</th>
<th>Automation</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Transport by block trains</td>
<td>++</td>
<td>++</td>
<td>N</td>
<td>+</td>
<td>At loading/unloading points</td>
<td>Flexibility in Volumes</td>
</tr>
<tr>
<td>Combined transport</td>
<td>+++</td>
<td>+++</td>
<td>Equivalent to road or better</td>
<td>+++</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Wagon load transport</td>
<td>+++</td>
<td>+++ Punctuality +++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>Flexibility in Volumes</td>
</tr>
<tr>
<td>Rolling Motorway</td>
<td>+++</td>
<td>+++</td>
<td>Better than road</td>
<td>++</td>
<td>+++</td>
<td>Capacity to transport P400 SemiTrailers</td>
</tr>
</tbody>
</table>

Key Factors by Market segment defined by type of Transport
Real business case for a car carrier transport

- Assumptions: 3 flows of finished car traffics on 900km across 3 countries by trains of 500m to 600m and weight from 600T to 900T. Some segments are single track lines with sometimes short by-pass loops.
- New buildings has been excluded as large fleets of amortized wagons are available. Trains are relatively light but steep gradients (up to 26%0) on the route in both directions justify an EOT device. Limited length of tracks at both ends impose a very flexible road rail tractor remote controlled to enable quick maneuvers. For a longer trains an upgraded positioning will help acceptance of some derogations. Gaining time at departure with devices for a brake test from the drivers cabin is compulsory.
- The major potential obstacle is the capacity to be overtaken by quicker trains on a double track line or crossing a long train on a single track section.
- Newopera has conducted this feasibility study only with the public documents analyzing the path schedule of STVA trains with all passenger trains on all critical points. At terminals Newopera has explained the train movements to insure the effective possibility of operating such two trains both ways.
STVA business case: the itinerary

Example of a critical section study from Maribor to Sentilj (single track line)
Terminal Analysis

Koper

Luka Koper Tracks — Kope Tavorna Tracks

Tyniste

Nosovice
Business case: financial study

- The feasibility study showing that for these flows, according to the nature of the traffic the path drawn could support with only one light modification the extension of the train up to 700m and the terminals study showing also such a possibility, the business case analysis should be set up.
- No major investments are involved: 4 EOT and a 130 equipment of wagons in sensors and radio as well as the ten locomotives used for all STVA traffic flows.
- The cost increase for a 20% lengthening the train with EOT are in proportion of the full present traction cost of the existing train:
  - Traction cost +1,5%
  - Cost of wagons +2,4%
  - Cost of EOT +4%
  - Cost of the Toll +2,2%

- The road rail tractors are not an extra cost compared to shunting locomotives but produce immediately an improvement. Their positive contribution has not been counted to remain on the safe side.
- The increase of the length without any impact on the asset rotation but increase the number of wagons taken into consideration already in keeping the ratio of the global cost.
- The increase of the revenue is 20% leaving and added value of 10% to be shared between the investors, the operator and the customers.
Beyond the previous investments quoted:

• Heavier investments are essential for wagon load activity like:
  • Automated couplers
  • Automated trains
  • Automatic couplers and un-couplers

• For heavy bulk traffics and in general heavy stuff:
  • Increasing axel load to 25T per axel
  • Coupling two trains with distributed traction

• For combined transport
  • EOT for longer trains
  • Devices for a high reliability
  • Develop wagons for P400 transport and rolling motorways

• S2R has already started to work on some of these topics
Thank you for your kind attention

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