OUTPUT FACT SHEET 2

Pilot actions (including investment, if applicable)

Version 2

Project index number and acronym	**CE1044 - TalkNET**
Lead partner	**North Adriatic Sea Port Authority**
Output number and title	O.T 3.11 PA for ECO-innovations on energy efficiency deployment: test on rail transport operations.
Investment number and title (if applicable)	
Responsible partner (PP name and number)	PP13 Lokomotion
Project website	https://www.interreg-central.eu/Content.Node/TalkNET.html
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Summary description of the pilot action (including investment, if applicable) explaining its experimental nature and demonstration character

Lokomotion and stakeholder Rail Traction Company operates a locomotive fleet which consists of several different types. Newer series (BR 185, BR 186, BR 187 BR 193, EU 43) from about year 2000 are largely compatible with each other, that is, several locomotives can be controlled by one locomotive driver from a driver cab.
As there are older locomotives from the 1950s in the inventory (BR 139), it was natural to establish their compatibility with the rest of the fleet.
These are locomotives that are now 60 years old. Its technical status has been overhauled many times. However, they still have a market authorization and are often used by smaller RU's. The special feature is that technical upgrades can now be implemented by making these older series compatible with locomotives of more recent year of construction. At the same time, they also partially open up an economic advantage. In this way, price-sensitive traffic can be supported.
The locomotives of the series were equipped with the ZMS / TMC components. This enables a more efficient use of these vehicles as they are compatible with other modern series. They can be controlled together by a driver's cab and a train driver. This enables the saving of personnel resources and a more energy-efficient driving style, since demand-based energy consumption is now possible. For this, the conversion had to be technically approved. There was a delay in this regard (see following paragraphs). Until the final acceptance by the supervisory authority EBA, a test run could be carried out on the Austrian infrastructure with a special permit. At the same time, a video was also made within the TalkNET project to show the technical implementation and operational use.

Homologation process with German Rail Safety Authority (EBA) started in 2017.
Planned certification: Originally planned to start in April 2019

Update at project closure (August 2020):

1. Ongoing waiting for approval of German Rail Safety Authority (EBA) due to new formal rules and a gap of knowledge to upgrade an old locomotive with new digital functions on locomotion holders` and authorities' side. From September 2020 responsible authority will change from EBA to the European Rail Agency (ERA). If the project is not finished until this date, a new approval process has to be started. This will end in a completely new preparation of documents and tests, which is, under the aspect that the system is working well from the technical side, not acceptable.

2. Technical wise the system is working – Lokomotion is "ready to go". This was presented by a video which was made as a substitute to a live presentation for the audience. It shows the concept of the Master Slave Modus (single control) of an older locomotive combined with technical new multi system locomotives.

The video / film introducing the pilot P.A. 3.2.11 shows the following operating procedures:

Since a freight train on the level generally requires less locomotive capacity than on an incline, a combined transport freight train (1,600 tons) with a locomotive (class 139) drives into the border station Kufstein (Germany-Austria) in our video. Three locomotives are now required to ensure a continuation of the journey over the alps region "Brenner-Pass" to Italy. In the conventional method (without multiple traction with a locomotive 139), two locomotives would be coupled at the front of the train and an additional locomotive (as a pushing locomotive) would be coupled at the rear end. In addition, two engine drivers would now be necessary (front and rear) who, in constant mutual exchange, pull or push the freight train over the mountain slope. This procedure ties up more resources than necessary. In addition, the energy consumption tends to be rated higher than in the new process with ZMS / TMC mode. Because here the 3rd locomotive (formerly a push locomotive) is coupled to the front position of the train. The train is now operated in master-slave mode and one engine driver now controls all three locomotives at the same time. The 3rd locomotive is now used as a demand locomotive. Its additional service will only be used when required and ideally in terms of energy.

The following process steps to save energy are (not part of the film):
Further energy saving potential results from the general combination in multiple operation. So far, a class 139 locomotive (age approx. 50-60 years) could not be combined with more modern locomotives. The technical equipment of the newer locomotives allows for power recovery options. In the example of a descent (South-Nord route) from the border station Brenner (Italy) to Kufstein (Austria), an average of 20-25% of the conventional energy consumption can be fed back into the power grid with the electric brake. In the case that, for operational reasons, the leading locomotive, a class 139 locomotive, is coupled to the train set, the power recovery can now be guaranteed despite all of them. So far this has not been possible.

Another side effect of this upgrade is that a diesel shunting locomotive can now be dispensed with when shunting work is necessary on the Italian infrastructure. The reason for this is that a locomotive 139 (no country configuration Italy) can now shunt itself independently (from the Italian power grid to the Austrian power grid) in ZMS / TMC mode combined with a multi-system locomotive (with country configuration Italy). However, a meaningful energy efficiency assessment requires a longer series of measurements. The background to this is the very variable contribution parameters of a freight train. This starts with the weight, route section, use of locomotives, and drivers through to external influences such as the weather and use of the infrastructure.

However, with regard to energy efficiency, this must always be observed.

In railway operations, the principle applies: **Safety first - punctuality - economy** (energy consumption)

Update after the project closure (February 2021):

3. Test period under commercial conditions is now planned (est.) for 2021
-Test runs and extension of train length and train weight to optimize the capacities of locomotives.

The Lokomotion company received its approval for the ZMS / TMC on the locomotives of the 139 series on October 31, 2020 by the German supervisory authority EBA. Test operation has meanwhile started. Two fully equipped locomotives of the class 139 were used, which also meet the required equipment for occupational safety (additional running boards and handrails) when used in multiple operations. During the test drives, initial operational experience in the operation, control and functional testing of the ZMS / TMC was gained.

-The next steps are trainings by e-learning.

The development of an e-learning platform announced under point 3 will be further developed on this basis. There is close cooperation with Hochschule München University of Applied Sciences in the conception and technical implementation of training videos. The focus of the training video for the ZMS / TMC with the 139 series is on refreshing knowledge and on-site troubleshooting, which can be accessed at any time on the move. In addition to this, a practical form of training, which is aimed at a duration of two training days, is also being prepared. So far, two trainers have been trained for this purpose (2nd trainer in the period October-November 2020). Practical training is currently only possible to a limited extent due to COVID-19. While the number of trainees is usually a maximum of 4 people per group, currently only up to 2 trainees would be possible. On the 1st day, the practical training conveys the technical basics for commissioning, operation, troubleshooting and new equipment components.

Example learning objective for operation:
Dealing with different locomotive combinations and tractive forces / electric brakes.
Matrix from locomotive BR 139; Multi-system locomotive (MS with power recovery):

1st position (master)	2nd position (slave)	3rd position (slave)
MS	BR 139	BR 139
MS	BR 139	MS
MS	MS	BR 139
BR 139	MS	MS
BR 139	MS	-
BR 139	BR 139	MS
BR 139	MS	BR 139

On the 2nd day, the implementation and testing of the learning content takes place in full operation. In it, the new operating procedures is rehearsed in the master-slave mode as in the video documentation under item 2. During the initial test operation, technical behavior of the ZMS/TMC control was monitored. The first findings from this are now being incorporated into the maintenance manuals. This requires training of the workshop staff as well as continuous engineering. This process is expected to continue for at last 3 months. After this measure, another test run (up to nine locomotives 139) in full operation is possible.

NUTS region(s) concerned by the pilot action (relevant NUTS level)

Germany-Austria (NAPA and Danube region)-Northern Italy (border station)

Investment costs (EUR), if applicable

Expected impact and benefits of the pilot action for the concerned territory and target groups and leverage of additional funds (if applicable)

Main results:

No more extra locomotive driver for trains from border stations Kufstein (Germany-Austria) to Brenner (Austria-Italy) and v.v.
-> savings of working hours of loco-drivers

More energy effective operational steering of the train due to single control of (only) one loco-driver and a (now) synchronous action of (up to) 3 locomotives in the trainset

Picture: Locomotives class 139 of Lokomotion

Further investments:
Update February 2021
To improve energy requirements, the total number of nine locomotives type 139 is to be converted to LED lighting. The total costs are around 45 K€.
Through the collaboration with the Hochschule München University of Applied Sciences to create an e-learning platform for ZMS/TMC, around 24 K€ is invested.

Sustainability of the pilot action results and transferability to other territories and stakeholders.

This action is working for all other class 139 locomotives (of other railway undertakings) on the rail infrastructure of Germany and Austria and dedicated border stations of Italy.

Instruction/e-learning of own staff and service providers. This is followed by test runs on designated short and long distances.

Gathering experience and acquiring risk profiles. Expansion of manuals.
Lokomotion ready to share know-how for approval processes. Involved stakeholders have acquired special technical know-how. Recommendation to set up a monitoring system for similar investments.

Lessons learned and added value of transnational cooperation of the pilot action implementation (including investment, if applicable)

The type of locomotive (class 139) is over 50-60 years and still useful under commercial and technical conditions as booster.
The train drivers are very impressed by the possibility, precisely because the pushing process of a train set has become relatively boring and also very uncomfortable due to the many tunnels, e.g. pressure in the ear when 2 trains pass in one tunnel.
In addition, Lokomotion can counteract the problem of the lack of a train driver as a resource. Basically, the project was only planned as a by-product of the ETCS (European train control system) conversion on these locomotives.
Otherwise, many railway undertakings (RU's) are surprised that we are still investing so much in these old-build assets, the trend is actually strong towards parting with the old locomotives.

Contribution to/ compliance with:

- relevant regulatory requirements
- sustainable development – environmental effects. In case of risk of negative effects, mitigation measures introduced
- horizontal principles such as equal opportunities and non-descrimination

The homologation of the national railway authorities is driven of a growing number of safety regulations, which degrease the competitiveness of the rail system against road transport. The certifying of actions like the TMC/ZMS upgrade for class 139 will take over 4 years.
Under "return on investment conditions" this period is to long for a successful follow up of this process.

References to relevant deliverables (e.g. pilot action report, studies), investment factsheet and web-links
If applicable, additional documentation, pictures or images to be provided as annex

D.T 3.2.11 - PA for ECO-innovations on energy efficiency deployment: tests on transport operations
D.T 3.2.13 – Testing of training pathways for energy efficiency deployment in the rail sector - Lokomotion