ACTIVITY 3.2 Pilot actions implementation

D.T 3.2.4 – PA for multimodal nodes/terminal efficiency and optimization: ICT/ITS tools for rail operation.

PILOT ACTION FINAL REPORT
Port of Rijeka Authority

Final Version
05/2020

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1. BACKGROUND

Introduction

Technical Work Package 3 includes pilot actions and trainings for cooperation in multimodal transport chains and business activation. Within this WP, activity 3.2 involves the implementation of the pilot actions.

Each partner shall carry out its pilot (as it is specified in the application form) and prepare its pilot report. In all cases other partners are involved, too (assessment, capitalization etc).

Purpose of this document

In order to have a same quality level of pilot report, PP8 Freeport of Budapest as WP leader provides a series of reporting templates, including:

- the pilot action inception report,
- the pilot action mid-term report,
- and the pilot action final report.

This document – the template of the pilot action final report - is the third and last element of this series. The aim of this document is to provide methodological support to be used to summarise the implementation of each pilot action.

Which project partners are involved?

Each project partner who has a pilot is involved. The following table summarises the pilot actions and the responsible PPs.

Topic	Pilot action - Deliverable	Partner responsible
Last mile connections of multimodal nodes	D 3.2.1. PA for last mile connectivity of multimodal nodes: Feasibility Study for a new rail terminal	PP4 - ZAILOG
Multimodal terminals efficiency and optimisation	D 3.2.2. PA for multimodal nodes/terminals efficiency and optimization: innovative control shunting system	LP - NASPA

Topic	Pilot action - Deliverable	Partner responsible
Multimodal terminals efficiency and optimisation	D 3.2.3. PA for multimodal nodes/terminals efficiency and optimization: ICT/ITS tools for rail traffic	LP - NASPA
Multimodal terminals efficiency and optimisation	D 3.2.4. PA for multimodal nodes/terminals efficiency and optimization: ICT/ITS tools for rail traffic	PP6 – Port of Rijeka
Multimodal terminals efficiency and optimisation	D 3.2.5. PA for multimodal nodes/terminals efficiency and optimization: new WMS (warehouse management system) model	PP16 - CODOGNOTTO POLAND
Assessment of market opportunities to reinforce or activate new multimodal services	D 3.2.6. PA for activation/optimization of multimodal services: new services port gateway/freight village	PP4 – ZAILOG AND LP - NASPA
Assessment of market opportunities to reinforce or activate new multimodal services	D 3.2.7. PA for activation/optimization of multimodal services: modal shift form road to rail	PP16 - CODOGNOTTO POLAND AND LP - NASPA
Alternative fuels deployment	D 3.2.8. PA for ECO-innovations on alternative fuels deployment: development of new e-mobility	PP8 – FREEPORT OF BUDAPEST (WITH PP9 – PUBLIC PORTS JSC INVOLVEMENT)
Alternative fuels deployment	D 3.2.9. PA for ECO-innovations on LNG deployment as alternative fuels: logistic model for LNG	PP16- CODOGNOTTO POLAND
Energy efficiency solutions	D 3.2.10.	PP5 – LUKA KOPER

Topic	Pilot action - Deliverable	Partner responsible
	PA for ECO-innovations on energy efficiency deployment: test of energy efficiency in cargo handling	
Energy efficiency solutions	D 3.2.11. PA for ECO-innovations on energy efficiency deployment: tests on transport operations	PP14- LOKOMOTION (assessment by PP7 – RCH)
Trainings	D 3.2.12. Testing of training pathways for energy efficiency deployment in the rail sector – RCH (report is not needed)	PP7 – RAIL CARGO HUNGARY
Trainings	D 3.2.13. Testing of training pathways for energy efficiency deployment in the rail sector – Lokomotion (report is not needed)	PP14- LOKOMOTION

2. PILOT ACTION IMPLEMENTATION

PROJECT PARTNER	Port of Rijeka Authority (PP6), Riva 1, 51000 Rijeka, Croatia
PILOT PROJECT NAME:	TalkNET Thematic work package 3 – Optimization of cargo container loading on railway wagons
PILOT PROJECT ID:	O.T3.4 PA for multimodal nodes/terminal efficiency and optimization: ICT/ITS tools for rail operation.

3. DESCRIPTION OF THE PILOT ACTION

NEEDS AND CHALLENGES ADDRESSED BY THE PILOT ACTION (max. 2000 characters)

Executed pilot was a logical consequence on initial investigations on local needs in line with project goals and identification of last mile process bottlenecks, in this case, aimed towards onshore container terminals. When loading cargo on wagons, it is extremely important to optimize loading in relation to the wagon capacity. The current mode is that operators, according to experience and using simple Excel table, create wagon utilization calculation and loading plan.

Such primitive work cannot ensure the ideal utilization of wagon capacity. The result is a loss of space and capacity on the wagon, inefficient work and transport by rail and increased GHG emissions.

One possible way to tackle this issue is to create tailor-made software that will independently calculate the cargo loading plan based on individual cargo characteristics and technical wagon data. This will result in speeding up the loading process and increased productivity of rail transport. Ultimately, it also contributes to increasing the competitiveness of the transport route.

After the stakeholder meeting, a comprehensive analysis was undertaken, that involved the following:

1. Identification of stakeholders and railway operators,
2. Identification of technical data on utilized wagons,
3. Identification of technical data on used containers,
4. Business process analysis of wagon cargo loading,
5. Translation of business case to application requirements,
6. Identification of application configuration and use-cases.

After thorough analysis, a suitable partner was identified for the key pilot action – Transagent LLc, Rijeka, Croatia, who has provided guidance and who is also a leading rail service provider in the region. The partner proved to be trustworthy, and enabled business process modelling, explanation of applicable rules and subject regulation, that was translated into functions of the application. The stakeholder also beta tested the application, and provided input for the RFEs (Requests For Enhancements) that might be used during future development of the application, or its alignment with the needs of the other targeted stakeholders.

BEST PRACTICES AND ACTION PLANS SUPPORTING THE PILOT ACTION (max. 2000 characters)

Best practices supporting the pilot action were prerequisites identified during business process modelling and preliminary phases of the project.

The stakeholders agreed early in the project on the absolute necessity of introducing the Port Community System that started with development in Rijeka early in 2018, and will be completed by end of 2020. They emphasized its importance in achieving a competitive position of the traffic direction in relation to other northern Adriatic ports and optimizing the employability of all stakeholders. The introduction of PCS will be a great advancement in the business process of all stakeholders, however, scope of the PCS does not anticipate a separate module for railway cargo loading, and this is the root cause of need for the railway cargo wagon loading functionality executed as a part of a separate project, hoping to be one day integrated with the PCS or local TOS, resource permitting. The stakeholders especially emphasized the importance of introducing software that would optimize the stacking of containers on railway wagons. They thought it will certainly contribute to the optimization of rail transport, the utilization of wagons, the utilization of workforce and mechanization at the terminal and contribute to the modal shift.

After the pilot action project was set and agreed, other best practices were identified in cooperation with the main stakeholder who provided support in business process modelling. There were separate sets of rules to be observed:

1. Local and supranational (EU) legislation, regulating area of railway cargo transport
2. National railway infrastructure regulation
3. Technical limitations of leased or owned railway cars
4. RID goods
5. Optimization methods and linear programming logic
6. Input data structure and output data format

All those rules make up a set of best practices to be identified, and incorporated within scope of the pilot application.

PURPOSE OF THE PILOT ACTION (max. 1000 characters)

Port of Rijeka Authority has identified three different needs according to predefined project clusters, whose satisfying and fulfilling outlines the purpose of the project:

1. As a part of Cluster 1, the need is to introduce operative research methodology in container loading thus increasing last mile connectivity efficiency (considering location of the terminal in the city center), improve financial efficiency as a component of overall sustainability (by maximum loading used wagons), introduce additional efficient multimodal shuttle trains.
2. Requirement of the Cluster 2 is improvement of the terminal-rail connection and terminal management by increase of total throughput.
3. Final need within Cluster 3 was enhancement of the terminal-rail connection, introduction of innovative methods in container loading process, and establishment of a model for new services by including new wagon models.

Purpose of the successfully executed pilot was to create an online application, that might be accessible by all railway cargo operators conducting their business activities from Rijeka, and that could be used to optimize container loading on railway wagons in a way to utilize the least number of wagons and transport the largest amount (weight) of cargo, but simultaneously respecting business rules, rules of cargo loading and state of the railway.

CONTENT AND OUTPUT OF THE PILOT ACTION – DESCRIPTION OF THE DELIVERABLE (max. 15000 characters)

The main activities of the Port of Rijeka Authority in the project relate to the Study, Pilot Project design and implementation and visibility: organization of seminars, workshops, trainings:

- Making a research study and findings of the current status at the beginning/end of the logistic chain as well as measures for improvement (last mile connection)
- Making a research study and findings of the current status of NAPA territories with a particular focus on the Port of Rijeka and improvement measures

• Making a pilot project for IT Connection: applications for the preparation and schedule of loading cargo onto wagons; design and implementation of the pilot project.

When loading cargo on wagons, it is extremely important to optimize loading in relation to the wagon capacity. The current mode is that operators, according to previous experience and using simple Excel table, or even just by using mental effort and skipping formal optimization, create wagon utilization calculation and loading plan.
The task Android application needs to achieve is to load and distribute containers that need to constitute one shipment to available train wagon composition to be transported from point A to B and show them visually/graphically.

The chosen solution is to create tailor-made software that will independently calculate the loading plan based on cargo and wagon data. This will speed up the loading process and increase the productivity of rail transport. Ultimately, it also contributes to increasing the competitiveness of the transport route.
Container train is composed of a number of wagon cars:

Each wagon type possesses specific technical data, among which most important are:

- Number of axles
- Weight
- Maximum total weight
- Length

Wagons are loaded with containers, and each wagon depending on type, can carry one or more containers.
Containers are divided by their length and standardized:

- 20 ft.
- 30 ft.
- 35 ft.

- 40 ft.

Furthermore, containers can be Dry Van (DV/DB), High Cube (HQ/HC), Flat Rack (FR), Refrigerated-reefer (RF), and Open Top (OT), and these models in various configurations.

The task Android application needs to achieve is to load and distribute containers that need to constitute one shipment to available train wagon composition to be transported from point A to B and show them visually/graphically.

Pilot activity refers to the identification of bottlenecks and the development of solutions. The solution was found in consultations with key stakeholders who defined how cargo loading optimization software should look like. Pilot activity includes software development, testing, education, and everyday use.

The task the application achieves is to load and distribute containers that need to constitute one shipment to available train wagon composition to be transported from point A to B and show them visually/graphically.

Application configuration:

1. Ability to enter container models and data
2. Ability to enter and save train compositon (up to 20 wagons each)
3. Ability to exchange saved train composition data with other registered users
4. Administrative rights for selected users

Application functionalities:

1. Input number and type of containers to be transported
2. Load cargo list in predefined Excel form (sample provided)
3. Load and save train composition to be used
4. Automatically distribute containers to wagons according to business rules – optimization goal is full wagon utilization by weight
5. Possibility of „manual“ mode: redistribution of containers on wagons after computer-assisted optimization
6. Save loaded cargo train composition
7. Every user can access only own data related to train composition and end result, but can use predefined container types common for all users
8. Dangerous cargo is automatically placed at the end of train composition
9. Application respects maximum length of the train according to State of the railway network, maximum weight, maximum axle load and technical characteristics of the used wagons

Predefined and loaded dynamic loading schemas for the following vagons used with locomotives in the port of Rijeka:

- Sggrs(s) 80’
- Sggmrss 90’
- Laags 90’
- Rgs-Z 60’

- KGS-Z 40‘
- LGS-Z 40’

The application is given to use to all stakeholders organizing railway cargo transport who ask for user name and password. Main achieved quantitative (numerical) outcomes of the pilot project are:

1. 1 Key pilot action use-case partner
2. 1 Functional specification developed
3. 1 dedicated Web domain leased (http://www.prailway.host)
4. 1 hosting VPS server leased (dual core, Strasbourg data center http://www.ovh.com)
5. 1 Web/Android application developed, accessible at domain http://www.prailway.host
6. 1 UAT (User Acceptance Test) performed
7. 1 Technical documentation of application’s components utilization
8. 6 test users created
9. 1 set of source code delivered
10. 3 video presentations created:
    - Introduction
    - Business processes
    - Application features and use

Main achieved pilot action goals:

1. Introduction of operative research methodology in container loading thus increasing last mile connectivity efficiency (considering location of the terminal in the city center),

2. Improvement of financial efficiency as a component of overall sustainability (by maximum loading used wagons),
3. Introduction of additional efficient multimodal shuttle trains
4. Improvement of the terminal-rail connection and terminal management by increase of throughput
5. Enhancement of the terminal-rail connection
6. Introduction of innovative methods in container loading process, establishment of the model for new services by including new wagon models

Stakeholders workshop; consultations with stakeholders were held on 23rd July 2019. And 8th August 2019. There was a continuous communication with the identified key pilot action partner, where they provided information required to complete the business case and process modelling prior to coding and development.

The application was alpha tested internally using live data provided by the stakeholder. Beta testing and user acceptance testing was done by the key partner, and application functionality is confirmed in writing.

The partner provided several points for improvement and declared a few minor bugs. All identified bugs were fixed, part of the requirements were acknowledged, if they were within the scope of the TalkNET project. Others are noted to be used as request for enhancements in the following versions of the software.
Technical methods description:

1. Application frontend uses Bootstrap and Bootstrap, jQuery modules, rangeslider.js, NProgress, FileSaver and SheetJS.
2. Static webpage serving is achieved using Nginx, a for other, bidirectional communication, za Socket.IO is used.
3. Server user Linux operating system, Debian Stretch distribution.
4. Backend stability on the server is achieved using module Supervisor for Node.js (v10.16.3) run in the screen instance.

5. Used database is MariaDB (v10.1.38).

The project relied as much as possible on open source technologies, in order to enhance portability, make the system more easily upgradeable and avoid the possibility of vendor lock-in.

WERE THERE ANY DEVIATIONS IN TERMS OF THE CONTENT OR PURPOSE OR ANY PART OF THE PILOT ACTION – IF YES, PLEASE DESCRIBE THE REASONS (max. 2000 characters)

There were no significant deviations in terms of the content of purpose vs. Application Form. During project execution, certain aspects of the project were refined and focused after engaging stakeholders and other PPs. At the beginning of the project, there were many unknowns, for example, the railway cargo loading process was not modeled, its sequence of steps and involved actors were not known. Also, the technology to be used was not well known. Finally, before engaging the stakeholders, and the main stakeholder who provided insight into the process and guidance, it was not possible to understand the full extent of the pilot project or the application developed as a part of it.

However, we believe that the application has reached communicated goals. Also, as a part of project activities, RFEs (Requests for Enhancement) possibilities were studied along with the stakeholders, and included in the project documentation for post-project activities consideration. Some of such activities and future developments are:

1. Connection with ERP (Enterprise Resource Planning systems) of the cargo railway operator – at the moment, data exchange is achieved using structured Excel spreadsheets
2. Inclusion of fully dynamic, customizable wagon technical datasheet – at the moment, technical wagon schemas are hardcoded with a limited number of wagon models available
3. Inclusion of other limitations and business rules (for example, more granular recognition of dangerous goods according to RID classes, TDG (Transport of Dangerous Goods) regulations and placement/optimiziation of such containers loading on wagons, depending on the hazardous good type and security rule (for

example, placement at the end of the railway composition, inclusion of empty, “safety” wagons between those that are TDG and similar).

However, none of the above was planned to be implemented in the beginning, and depends on each stakeholder (cargo railway operator), and particular needs and requirements, so it does not present a deviation from the project plan, rather a list of possibilities for future developments.

4. STAKEHOLDER'S INVOLVEMENT

HOW THE STAKEHOLDERS WERE INVOLVED (max 2000 characters)

Stakeholders have been engaged by means of several meetings held in Rijeka from end of 2017. Until end of summer 2019. After definition of needs, stakeholders related to railway cargo operations have been singled out, and they were approached directly (as of August 2019. until end of the pilot action). Port of Rijeka Authority, and the subcontractor contracted to map business rules and develop the application, worked with the stakeholder Transagent Rail d.o.o. who was the most eager to help during the pilot. The main results of the involvement were:

1. Guiding Port of Rijeka Authority towards more details related to the pilot
2. Understanding business rules
3. Understanding technical limitations of the wagons and the railway route (state of the railway)
4. Basic understanding of the nature and format of used data
5. Beta testing of the developed and deployed cargo loading optimization application created as a part of the pilot project
6. Checking accompanying documentation created as a part of the project

Stakeholder and project meetings prior to the August 2019. when the pilot project outlines began emerging were held according to the following schedule:

PP6-Meetings and themes discussed

DATE AND VENUE	MEETING	CLUSTER	THEMES
03/11/2017 Rijeka	WORK MEETING	1-3	Railway connect, intermodality
08/06/2018 Rijeka	PCS MEETING	1-2-3-4-5	Intermodality, digital connectivity, sustainable and safe mobility, terminal management
28-30/09/2018 Rijeka	NAUTIC BOAT SHOW	1-2-3-4-5	Road-rail connections, terminal management, digital connectivity, alternative fuels use, environmental impact

In Rijeka (23/07/19)	STAKEHOLDER MEETING	1-3	Related to terminal-rail connection, relations to national railway infrastructure manager, environmental and financial sustainability components.
In Rijeka (08/08/19)	STAKEHOLDER MEETING	1-3	“stakeholder meeting” about railway container loading process, and intermodality.
In Rijeka (27/08/19	STAKEHOLDER MEETING	1-3	“stakeholder meeting” about road-rail connection, environmental and financial sustainability components and terminal management.

5. TRANSFERABILITY OF PILOT ACTION RESULTS

TRANSFERABILITY OF THE PILOT ACTION RESULTS (max. 2000 characters)

As already described, action pilot results could be transferred to other market players but that would significantly increase the project scope. Requirements for transfer are alignment of the application with the individual stakeholders' needs. Some of the requirements for transfer of the pilot action result by extension of the project scope are:

1. Connection with ERP of the cargo railway operator – at the moment, data exchange is achieved using structured Excel spreadsheets
2. Inclusion of fully dynamic, customizable wagon technical datasheet – at the moment, technical wagon schemas are hardcoded with a limited number of wagon models available
3. Inclusion of other limitations and business rules (for example, more granular recognition of RID goods when a part of TDG)
4. Addition of other optimization rules. At the moment, only one optimization criteria is included (most cargo weight loaded on least number of wagons). However, some other stakeholders might require also inclusion of other optimization criteria, for some internal reasons.
5. Possibility of dynamic addition of state of railway as a part of the application or module itself.
6. Incorporation of the module as a part of the local PCS (Port Community System) or TOS (Terminal Operator System), in order to streamline operations and fully endorse single window operations.

Transfer of the pilot project to interested direct or indirect stakeholders involves:

- Current state of technology
- Deployment of existing optimization technologies
- Analysis of used types of containers and their technical datasheet
- Analysis of local state of railways (max. speed per section, max. axle load, max. composition load, max height, max composition weight and similar)
- Analysis of type of transported cargo
- Matrix of applicable TDG rules

- Functional process analysis
- Data analysis (up to the level of data element)
- Process and resident system analysis (PCS, TOS, ERP)
- Risks and opportunities analysis
- Identification of the pilot deliverables (algorithm, UX, mock ups) to be connected/transferred to already present system
- Integration
- UAT (User Acceptance Testing)
- Production exploitation

Furthermore, the module for cargo loading optimization might also be transferred as a separate module, but within a suite of IBIS/ERP systems used by port terminals, or as a part of TOS (Terminal Operating System) or PCS (Port Community System), in cases where terminal operator accepts containers by railway.

Finally, within scope of the project, only standardized container loading optimization is implemented, but there are also goods that are not containerized, but transported by rail in bulk. One action as a part of transferability might also be inclusion of functionality to include bulk and non-containerized cargo in the optimization algorithm.