Report on the pilot implementations

Grant Agreement N°:	SCP2-GA-2012-314255
Project acronym:	**ViWaS**
Project title:	**Vi**able **Wa**gonload Production **S**chemes
Funding scheme:	Collaborative project
Project start:	1 September 2012
Project duration:	3 Years
Work package N°:	10
Deliverable N°:	10.1
Status/ date of Document:	FINAL, 27/11/2015
Due date of document:	31/08/2015 (internal shift to 30/11/2015)
Lead contractor for this document:	SBB Cargo Switzerland
Project Website:	http://www.viwas.eu/

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
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CO	Confidential, only for members of the consortium (including the Commission Services)	

Involved partners

Following project partners have been involved in the elaboration of this document:

Partner N°	Organisation short name	Involved experts
1	HaCon	Niklas Galonske, Sebastian Weismantel (as technical coordination leader)
2	Bentheimer Eisenbahn	Marko Beckmann, Arno Boll
4	Eureka	Victor Behrends
5	Fret SNCF	Denis Levy, Luc Débant
7	NEWOPERA	Armand Toubol (as technical coordination contributor)
8	SBB Cargo	Thomas Fuchs, Patrik Dober, Katharina Wachs
10	Wascosa AG	Irmhild Saabel, Torben Kempf

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BE	Bentheimer Eisenbahn
FLP	Forstlogistik Partner (Swiss Company; Partner in demo operations)
GLZ	Grafschafter Logistik Zentrum
GUI	Graphical User Interface
IBC	Intermediate bulk container
ICT	Information and Communication Technologies
kN	kilo Newton
RLC	Rail Logistic Centre
SWL	Single wagonload
TCCU	Telematics Communication Control Unit
RRT	Rail road tractor
KPI	Key Performance Indicator
RFF	Réseau de Fer France (now SNCF Réseau)
IM	Infrastructure Manager

1 Introduction

The ViWaS project

Single wagonload (SWL) transport is still a major component in numerous European states transport systems and in the logistics of different economic sectors such as steel, chemical industry and automotive. However, changing framework conditions and increasingly demanding market requirements have led to dramatic market losses and even to complete shutdown of SWL business in some countries. As this business segment has been evaluated as important for specific transports in a European co-modal transport system also for the future, significant improvements are needed.

The ViWaS partners believe that for the success of SWL the following two issues might be crucial:

(1) A viable SWL system is highly dependent on the critical mass. Thereby all options have to be considered to secure a high utilisation of the trains operated on the trunk lines, including a combined production with intermodal loads.

(2) Only comprehensive and complementary measures are able to sustainably improve and preserve the European SWL systems in accordance with increasingly demanding market requirements.

The ViWaS project will follow such a comprehensive approach; therefore aiming at the development of

- Market driven business models and production systems to secure the critical mass needed for SWL operations,
- New ways for "Last mile" infrastructure design and organisation to raise cost efficiency,
- Adapted SWL technologies to improve flexibility and equipment utilisation,
- Advanced SWL management procedures & ICT to raise quality, reliability and cost efficiency

The applicability of these solutions and their effects will be proved on the basis of pilot business cases (by demonstrations). Thereby important findings will be gained for a European wide implementation of developed solutions.

ViWaS stands for Viable Wagonload Production Schemes.

The ViWaS consortium includes railway operators (SBB Cargo, Fret SNCF, and Bentheimer Eisenbahn), infrastructure providers (Interporto Bologna / IB Innovation) technology partners (Eureka, Wascosa) and consulting/ scientific partners (ETH Zürich, TU Berlin, HaCon, and NEWOPERA).

Work Package 10 is focusing on pilot implementations, tests and assessments of suitable solutions or components to secure viability of SWL transport in the future. This will be done on the basis of previously agreed pilot business cases, to prove the applicability of developed solutions under real operation conditions, considering one complete operation period.

This deliverable provides a documentation of the conducted field tests and further demonstration activities.

The pilot implementations within each business case are described as follows. The first subchapter provides an updated documentation of the respective business case. The subsequent subchapters describe the different tests or demonstration activities focussing on the following aspects, if applicable:

- Documentation of conducted field tests
- Operational experiences and proposed/conducted adjustments
- Results documentation of selected KPIs
- Conclusions/Outlook

For the definition of demonstrations and related training activities the following business cases and test installations have been considered:

(1) **Swiss-Split 2** deals with the improvement of the current SWL distribution system to private sidings in Switzerland by renewing rolling stock and shunting locomotives, introducing a new loading platform to improve loading and unloading operations in sidings and therefore reducing costs and optimising time and effort.

Responsible ViWaS partners: SBB Cargo in collaboration with Wascosa and supported by ETH Zürich IVT;

(2) **Regional network of rail logistics centres** aims to improve "last mile" services and to establish transshipment and rail logistics nodes for customers without own rail access points in a border region between Germany and the Netherlands. The business case is also used to evaluate the deployment of hybrid locomotives.

Responsible ViWaS partners: Bentheimer Eisenbahn supported by HaCon;

(3) **Innovative Telematics and ICT services** seek to improve operation performance and on-time delivery by introducing telematics devices together with a telematics data distribution service. These telematics devices are managed and controlled remotely by the TCCU and inform the different partners involved in real time about position, speed, impacts, loading status etc., as well as wear related data like wheelset mileage. A further newly introduced aspect deals with sensors for wagon load measurements.

Responsible ViWaS partner: Eureka

(4) **Modular wagon components based on the Flex Freight System** deals with the improvement capacity utilisation and flexibility of rail wagons by new and modular wagon components: One component is the Flex Freight Car, a light container wagon with a driveable grid floor that is also able to carry 45' containers. The wagon is also part of the business case Swiss Split 2. The second component developed within ViWaS is the Timber Cassette 2.0. This advanced cassette is stackable for empty runs in order to provide more loading capacity for container transport on the standard rail container wagons and reduction of empty wagon transports by the enhanced flexibility (combination of containers and timber loads on one wagon).

Responsible ViWaS partner: Wascosa

(5) **Last mile service on French secondary lines** works on a new concept for the streamlining of "last-mile" and shunting operations based on active collaboration between RU and shippers. The RU distribution train stops in front of each siding and helps a bimodal vehicle driver in the shunting operations, (coupling, decoupling, switch...) which are performer by the shipper with its own traction unit. The neighbouring shippers organise themselves with a shared bimodal road-rail vehicle which replaces every shunting vehicles of each partner.

Responsible ViWaS partners: Fret SNCF supported by NEWOPERA;

According to the second amendment request – dated 16/04/2015 - The documentation of tests and demonstration activities for this business case are included in deliverable D6.2. Here, again the main aspects are described, following the structure as agreed for this report.

2 Demonstration of pilot business cases

2.1 Business case "Swiss Split 2"

2.1.1 Business case at a glance

The traditional scope of SWL transports can be broadened by integrating intermodal solutions. The business case "Swiss Split 2" focusses on delivering maritime containers to sidings by using the encompassing Swiss SWL transport network. Thus the critical mass for a viable SWL system and its efficiency can and will be improved.

One part of the effort to attract more traffic to the Swiss Split operating system is improving the track layout, capacity and production systems used in terminals. Therefore – as outlined in the ViWaS proposal – improvements were being planned with the construction of the Basel Nord and Limmattal gateway terminals. In the meantime both projects have been the centre of a broad public discussion in Switzerland. As a result market experts and authorities agreed on improvements within the Swiss terminal landscape in general. The tri-modal terminal Basel Nord enjoys a broad support in the market; the work on the terminal will be progressed. The planning works for Limmattal gateway have been stopped. This change in the Swiss terminal strategy has no impact on the ViWaS project.

Instead the project's development work within the tackled business case focusses on other aspects. To realize cost efficient transport solutions specific rolling stock has to be developed to increase the quality of transports and meet the customer needs. The business case will result in forward looking, cost efficient solutions that will replace end of cycle wagons with high maintenance costs currently used by SBB Cargo.

Two innovative rolling stock solutions have been developed by the partners ETH Zurich, Wascosa and SBB Cargo:

- As a first solution a new type of container wagon was engineered and tested in customers' sidings. This so called "flex freight wagon" is based on a classical, but lighter container wagon. Its passable iron-grid floor allows for loading and unloading containers in sidings by driving with forklifts on the wagon.
- The second solution is based on three flexible 20ft platforms, which will simplify loading and unloading operations of containers in sidings. The so called container loading adapters guarantee a totally flat, passable surface on the wagon and it is mountable on standard Sgns-container wagons.

2.1.2 Flex Freight Car

Documentation of conducted field tests

For container transports to customers' sidings SBB Cargo has been looking for a new cargo wagon. The Ks-wagon, a two axle wooden floor wagon currently in use, was originally determined to transport bulky goods, such as vehicles, spare parts for bigger machines or other goods that are less sensitive to environmental influences. Today SBB Cargo also uses these types of wagons to deliver sea containers from gateway terminals in Switzerland to customers' sidings. Although the wagons' dimensions suit the sidings perfectly, there is a number of disadvantages. Due to the fact that the Ks wagon is not equipped with receptive points for containers, they have to be secured manually by nailing wooden blocks into the floor on each side of the container. Over the years the floors got weakened, thus maintenance costs are high.

Together with Wascosa and ETH Zurich, a solution for a new type of wagon that meets the requirements for loading and unloading containers in sidings was developed. The wagon, called "flex freight" wagon, is based on a classic container wagon (code Sgnss). Compared to standard KS wagons the wagons' floor is filled in with iron grids.

The grid is modular, meaning, that it is possible to remove the different parts of the grid as they are not permanently connected to the chassis. This results in a higher flexibility in wagon usability: The wagon can be used as a classic container wagon for terminal-terminal transports, where no floor is needed or – after a few modifications – it can be used to distribute sea containers into sidings.

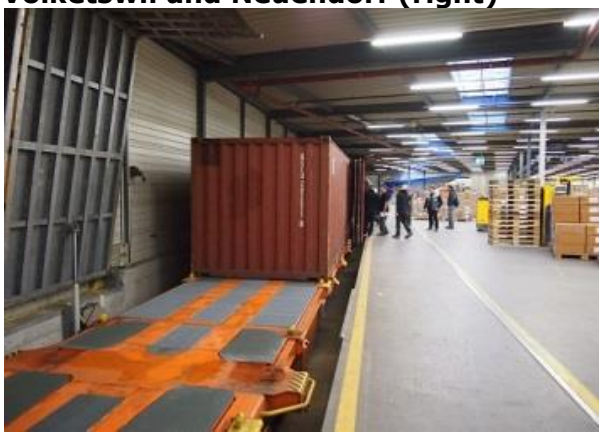
To test the wagon under realistic conditions SBB Cargo deployed the wagon in defined sidings. Therefore the wagon has been integrated into the SBB Cargo wagon pool.

The test involved the production of one test wagon and its disposition to sidings. First of all appropriate sidings had to be defined to analyse the wagons abilities in different environments. The test scenarios have been selected only in sidings, where loading and unloading is done by forklifts or other floor conveyor vehicles.

First tests took place at the following venues:

- Migros distribution centre in Neuendorf
- Migros distribution centre in Suhr
- Migros distribution centre in Volketswil
- IKEA distribution centre in Laufen

Figure 1: Test setting for 'Flex Freight Car' at Migros distribution centre in Volketswil and Neuendorf (right)



Source: SBB Cargo

During the test-preparations, all involved employees had to be trained in the new grid-covered wagons' handling. In addition involved customers had to be informed about the changed loading- and unloading processes during the tests. Information letters were sent, workshops held.

Table 1: 'Flex Freight Car' - Main milestones of training

Date	Venue	Training contents	Number of participants
02/2014	Basel	Test planning: Coordination of test processes and test reporting after finishing test processes	5
02/2014	Basel	Selection of suitable customers	3
03/2014	Basel	Information workshop (e.g. Dispo SBB Cargo)	8
03/2014	Basel	Workshop on terminals and wagon management	20
03/2014	Basel	Customer Information (telephone)	3
04/2014	Customers	Customers' training in wagon handling	4

Operational experiences and proposed/conducted adjustments

After having tested the flex freight wagon in several sidings, some problems concerning the height of the wagon occurred. If the wagons were loaded by heavy containers, the level of the wagons' surface was too low. As highlighted on the following picture, the low height lead to the problem, that sometimes the container doors couldn't be opened completely.

Figure 2: Problems with reduced wagon height of 'Flex Freight Car' at Migros distribution centre in Suhr

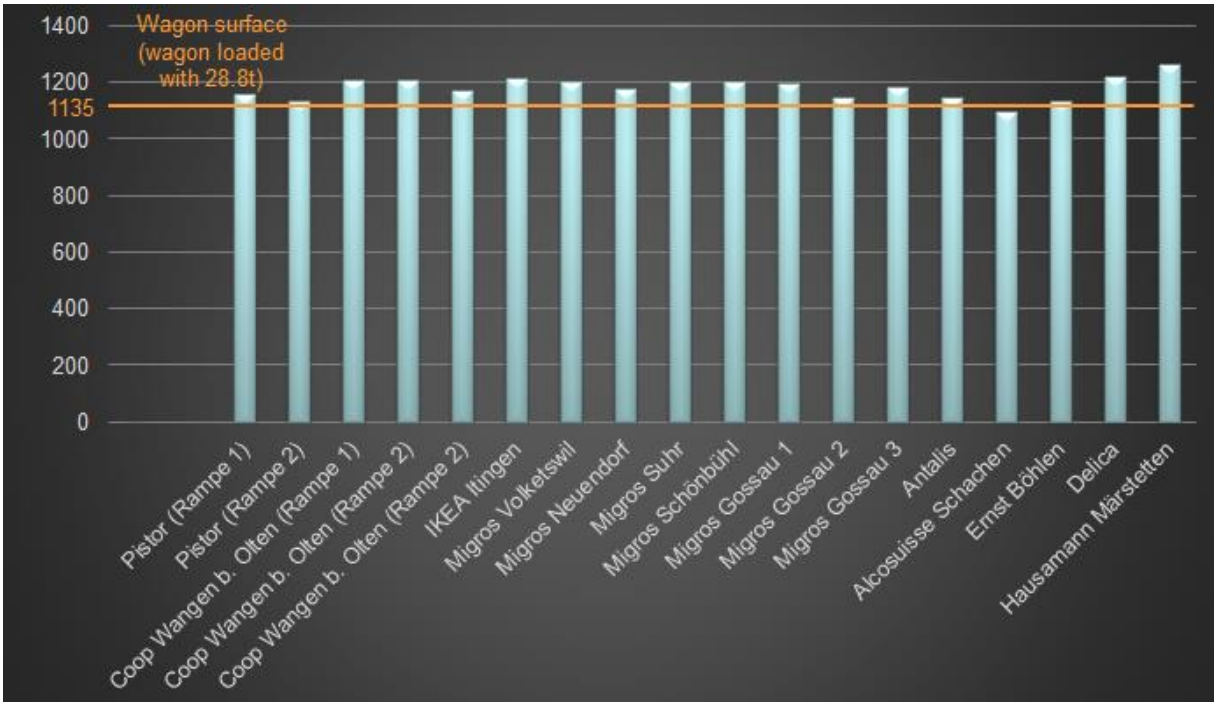
Source: SBB Cargo

Another difficulty was discovered at the IKEA distribution centre in Laufen. Due to the fact, that the sidings' dimensions can vary from customer to customer, some sidings are constructed in a way that the gap between the wagons' surface and the loading dock is

too wide. Sgns wagons are only as wide as sea containers which means, that the gap to the loading dock gets even wider.

After the first testing phase Wascosa decided to measure all the sidings in Switzerland, which receive containers by Swiss Split. The results show, that the Wascosa wagon is too low for about 20% of the relevant sidings.

Figure 3: Analysed ramp heights of selected railway sidings in Switzerland



Source: Wascosa

Conclusions/Outlook

For SBB Cargo customers the Wascosa flex freight wagon can work as a replacement for the old wooden floor wagons. But it doesn't' work in every siding and this can be a bigger problem when it comes to the dispatching of the wagons. SBB Cargo prefers to have one wagon, that fits in every siding and this is why SBB Cargo decided to develop an alternative with the container loading adapter (see section 2.1.3)

2.1.3 Container Loading Adapter

Documentation of conducted field tests

As an alternative to the flex freight wagon with grid inlays (= Flex Freight Car), SBB Cargo developed a solution with three 20' platforms – called 'Container Loading Adapter' – which can be put on every standard Sgns or Sgnss container wagon. The adapters guarantee also a stable surface to load and unload the containers by forklifts.

In contrast to the Wascosa test wagon the design of platform offers some advantages in terms of width and height. With the platform the wagon is about 7cm higher than the test wagon and there is the possibility to build the platform wider than the wagons' width to reduce the gap between the loading dock and the wagon. The platform is heavier than

the grid inlays, but it doesn't compromise the wagons' payload capacity. Normally payload in the Swiss Split never reaches its limits due to the fact that of 60 feet only 45 can be used for loading. The platform is now in production and first tests are planned to take place in January 2015. Therefore different kinds of training are needed. The preparations for the training sessions is planned to take place by the end of November, after the first platform is produced. Until then, the wagon with the adapters will circulate in the everyday traffic and will be used as conventional container wagon.

Table 2: 'Container Loading Adapter' - Main milestones of training and tests

Date	Venue	Training contents	Number of participants
04/2015	Rothenburg	Delivery of the first two adapters and first tries to lift them up to the wagon	3
04/2015	Gossau	Training to handle the adapters in the terminal of Gossau	4
06/2015	Olten	Information workshop: How to set up the tests with the six adapters (two wagons)	12
09/2015	Basel	delivery of four other adapters (six in total)	2
10/2015	Olten	Presentation of the new Swiss Split container adapters (internal meeting)	7
11/2015	SBB	Wagon circulating in everyday traffic	n.a.

Operational experiences and proposed/conducted adjustments

As explained, the development of the "Container Loading Adapter" is resulting from the operational experiences of the flex freight car and the analysis of ramp dimensions of Swiss railway sidings. Regular circulation in daily operations only started in November 2015. So far, no problems have been reported. A more detailed evaluation will be possible after a longer operation period that will be the basis for a purchase decision by SBB Cargo for further units.

Figure 4: Training session in Gossau

Source: SBB Cargo

Results documentation of selected KPIs

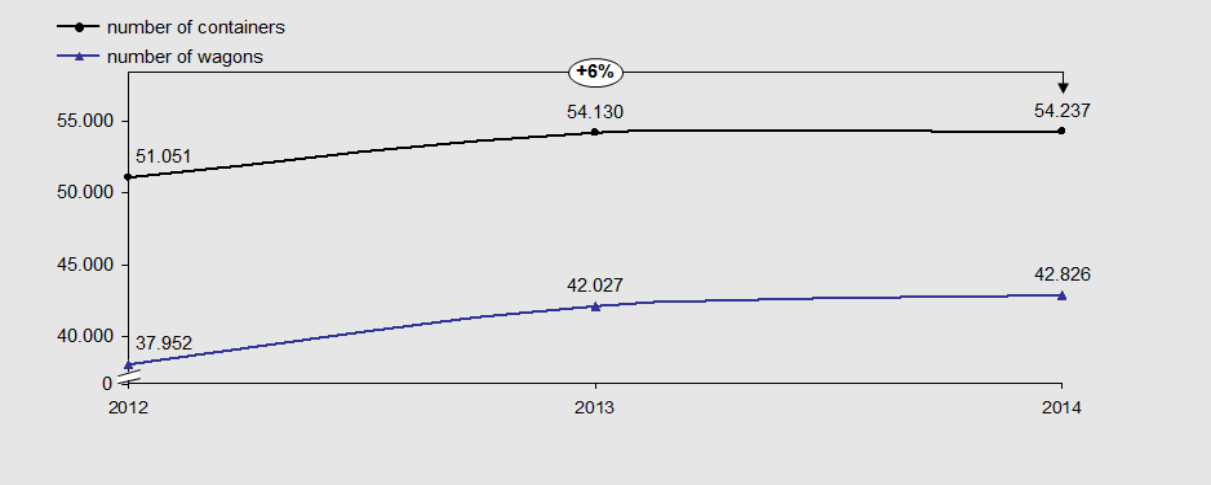
During the project, SBB Cargo scaled up its efforts to increase transport volumes in single wagonload traffic.

On the one hand, the handling capacity in the existing terminals has been expanded, laying the foundations for further growth. Moreover, SBB Cargo is also prepared for the future challenges of increasing Swiss Split traffic. The creation of the bimodal gateway terminal Basel Nord, as starting point for a new tri-modal terminal, will enhance the efficiency of transportation processes and lead to an increased volume of sea containers shifted to rail.

On the other hand, activities were directed to develop and implement possible solutions concerning wagon equipment for Swiss Split 2 to further enhance the shift from road to rail. Within the project the necessary wagon equipment has been developed, constructed and tested during the project phase.

Thanks to the project activities, the transport development until today meets the KPI values for SWL as shown below. In comparison to the growth in total SWL in Switzerland (+2%) between 2012 and 2014, Swiss Split grew more than 6% (see Figure 5).

Figure 5: Swiss Split transport volume 2012 – 2014 [containers or wagons]



Source: SBB Cargo

Conclusions/Outlook

In contrast to the flex freight wagon with grid inlays the design of the container loading adapter offers some advantages in terms of width and height. With the platform the wagon is about 7cm higher than the test wagon and there is the possibility to build the platform wider than the wagons' width to reduce the gap between the loading dock and the wagon. The platform is heavier than the grid inlays, but it doesn't compromise the wagons' payload capacity. Normally payload in the Swiss Split never reaches its limits due to the fact that of 60 feet only 45 can be used for loading.

The results show that the implemented solutions may be applied differently. While the grid inlay solution for the Swiss Split wagon can be implemented for 80% of customers, the container loading adapter solution can be used in 100% of cases.

2.2 Business case "Regional network of rail logistics centres"

2.2.1 Business case at a glance

In the Rail Logistics Centre "Grafschafter Logistikzentrum (GLZ)" of Bentheimer Eisenbahn in Nordhorn, about 70 single wagons per month are loaded/unloaded, serving multiple customers. Last-mile services to these customers are carried out by truck. In correspondence to specific requirements of customers' logistics, freight is partly stored in the Rail Logistics Centre (RLC). The logistics chain is separated into several working steps starting with the preparation of transhipment up to the invoicing.

The business case "Regional network of rail logistics centres" of Bentheimer Eisenbahn (BE) deals with a better integration of truck distribution and long-distance transport by SWL rail transport. The goal is the optimisation of the transshipment between truck and train in order to shift additional transport volumes to SWL.

For this purpose Bentheimer Eisenbahn developed a methodology to analyse and optimise related transhipment processes and technologies. This methodology has been applied for specific SWL transports of Bentheimer Eisenbahn to identify the most efficient equipment (forklifts) and internal transport and handling processes with respect to these transports and the specific spatial conditions within the Rail Logistics Centre. For the optimisation of transhipment processes the following goods have been analysed: (1) steel panels, (2) intermediate bulk containers (IBC) and (3) big bags with salt products. The methodology and results of the developments are described in Deliverable 6.1, part 2 "Report on transhipment improved technologies for cost-optimised cargo collection / delivery".

Based on the results of the analyses, it was decided to buy a new, more powerful forklift Kalmar GCE70, that is deployed to optimise the internal transport and handling operations and thereby improve the cost-efficiency of the considered SWL traffic. The work processes resulting from the higher performance of the Kalmar forklift were structured and documented for the demonstration phase. For employees directly involved in handling and storage operations, the demonstration phase began after the training was executed in May 2014. The demonstration includes the following three elements.

- Use of Forklift with increased capacity
- Optimised internal transport and handling processes.
- Flexible usage of staff.

Unlike in other reports, these elements will not be analysed separately, due to the fact that there was no separation between them in the regular operation.

2.2.2 Pilot implementation of improved equipment and processes

Documentation of conducted field tests - overview

The practical elements of the business case "Regional network of rail logistics centres" aim at the further improvement of the efficiency and thus competitiveness of single wagonload in decentralised regions. Therefore, the processes during the cargo handling were improved by the help of new equipment, the reorganisation of the transport and handling processes as well as the flexible usage of staff.

The regular operation, which now lasts since more than one year (10/2014 – 11/2015 and ongoing) proves the effectiveness of all three measures in combination. The starting point of the regular operation was October 2014. Before, intensive considerations and trainings took place for the preparation of the new forklift usage.

Table 3: 'Forklift & improved handling' - Main milestones of the demonstration

Date/Period	Event
02/2014	Information meeting with forklift-dealer about technical preferences
05/2014	Meetings with Still, Kalmar, Toyota and Jungheinrich Delivery of Kalmar forklift for testing
05/2014	Theoretical and practical training on the Kalmar forklift
06-07/2014	Internal test rides by instructed personnel
08/2014	Purchase of Kalmar forklift
09/2014	Trial operation
10/2014	Start of regular operation

Documentation of conducted field tests – forklift & improved handling

The forklift operations were mainly carried out by a team of five employees of Bentheimer Eisenbahn. The pilot operations were prepared by the initial theoretical and practical training on the forklift Kalmar DCE 70 in May 2014. A special focus was given to the issues:

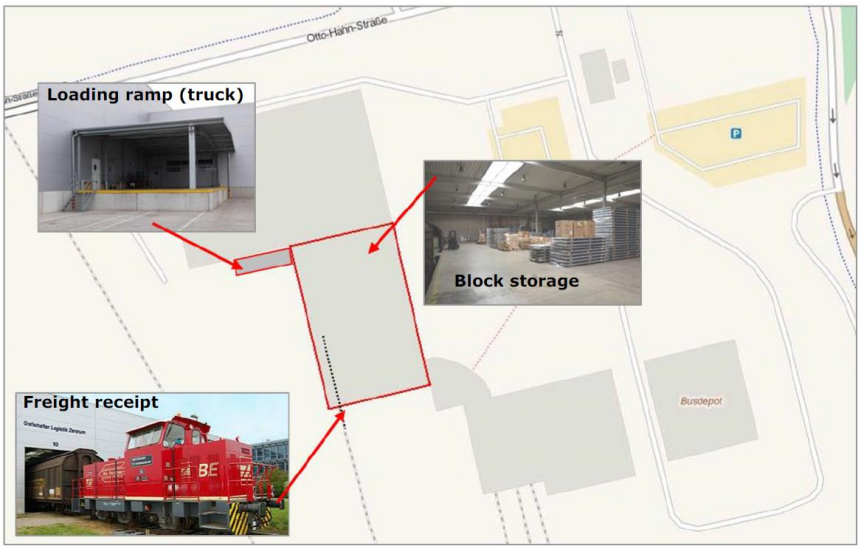
- Weight distribution and reliable loads (important because the new forklift has an increased capacity of 2,500 kg compared to the old forklift)
- Familiarisation with the forklift functions
- Driving and forklift utilisation (larger dimensions than before, e.g. turning circle)
- Safe stop off of the vehicle
- Energy efficient handling of the machine.

In addition to the forklift handling all involved staff members were instructed on the new processes which are now in regular operation at the following facilities:

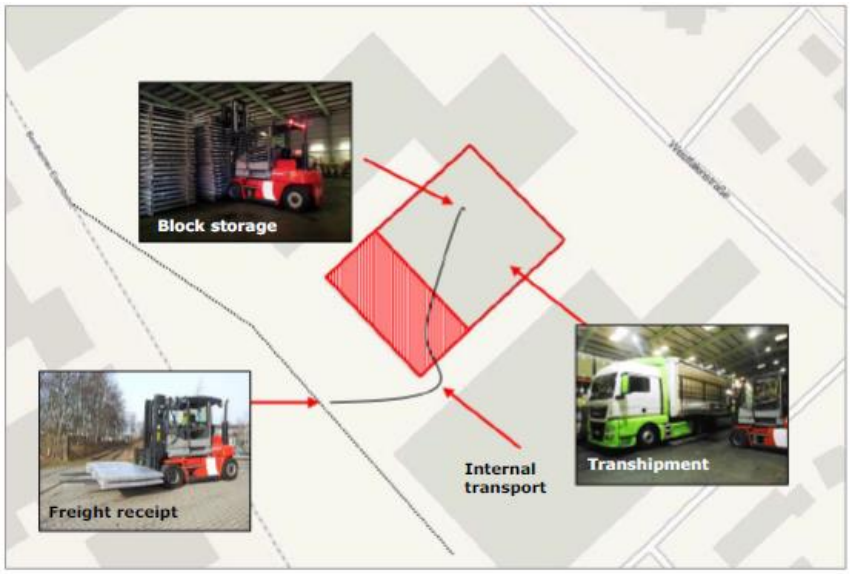
- **Rail Logistics Centre Nordhorn** for general cargo handling with 2,355 sqm storing area and 48 meters rail tracks for loading / unloading of wagons "under roof". Loading of trucks taking place in the hall (Figure 6, top picture)
- **Warehouse "Westfalenstraße**" for bulky and "slow moving" goods with 2,500 sqm storing area (unloading of wagons has to be made outside the hall, loading of truck is done in the hall (Figure 6 bottom picture).

After trial operations in September 2014, regular operations according to the improved processes started already in October 2014. A documentation of the demonstrated transshipment processes with steel plates is provided by Table 4 (RLC Nordhorn – steel plates) and Table 5 (Warehouse Westfalenstraße).

Figure 6: Implementation areas for optimised handling and transport processes



RLC Nordhorn



Warehouse Westfalenstraße

Source: Bentheimer Eisenbahn

Table 4: Demonstration of the transhipment of steel plate bundles at the RLC Nordhorn

Transhipment chain Steel plate bundles		Processes demonstrated and/or topics considered

Transhipment (unloading of wagon)		• opening of rail wagon
		• control of steel plates bundles
		  ○ number
		  ○ damages
		  ○ condition (e.g. corrosion)
		  ○ load securing
		• max. no. of bundles per lift

Place into stock		• loading capacity hall • optimised ways for forklift • storage location • data transfer to storage IT-system
Removal from stock		• client's order • consignment by for forklift • detection of loading weight (items and total consignment) • data transfer to storage IT-system • preparation of loading plan of for the delivery truck (weight/tour plan)
Internal transport		• size of consignment • optimized way of forklift to loading ramp
Transhipment (loading of truck)		• loading of truck (loading plan of the truck regarding weight a. tour plan) • loading security • final check (damages and corrosion) • overhanding of loading papers

Source: Bentheimer Eisenbahn

Table 5: Demonstration of the transhipment of steel plate bundles at the warehouse "Westfalenstraße"

Transhipment chain Steel plate bundles		Processes demonstrated and/or topics considered

Transhipment (unloading of wagon)		• weather conditions (rain, snow)
		• opening of rail wagon
		• control of steel plates bundles
		  ○ number
		  ○ damages
		  ○ condition (e.g. corrosion)
		  ○ load securing
		• max. no. of bundles per lift

Place into stock		• loading capacity hall (increased compared to RDC!) • optimised way for forklift • storage location • data transfer to storage IT-system
Removal from stock		• client's order • consignment by for forklift • detection of loading weight (items and total consignment) • data transfer to storage IT-system • preparation of loading plan of for the delivery truck (weight/tour plan)
Internal transport		• size of consignment • weather conditions (rain, snow) • optimized way of forklift to loading ramp
Transhipment (loading of truck)		• loading of truck (loading plan of for the truck regarding weight and tour plan • loading security • final check (damages and corrosion) • overhanding of loading papers

Source: Bentheimer Eisenbahn

Figure 7 shows the forklift with increased handling capacity (Kalmar DCE 70) in daily operation.

Figure 7: Forklift in daily operation

Source: Bentheimer Eisenbahn

Documentation of conducted field tests – flexible usage of staff

Another improvement aspect considers the flexible usage of staff. The concept has been already described within Deliverable D9.1:

At the RLC Nordhorn, the available 48m long loading / unloading track can accommodate simultaneously maximum three four-axle wagons for loading or unloading. Assuming that a smooth transport flow is guaranteed, loading in the outgoing transport volumes would require about 1.5 hour (including the necessary load securing processes). After completion of transhipment procedures, the loaded rail wagons must be replaced by empty ones.

Since the staff in charge of the shunting procedures very frequently has to provide wagons for other customers outside the logistics centre in the station yard of "Nordhorn South", a seamless wagon change is rarely directly possible. As a consequence, resulting unproductive and costly idle times have negative effects on the economic efficiency of the single wagon load shipments caused by freight flow congestions; in addition pallets have to be buffered because an empty wagon is not available.

At the workshop within the rail logistics centre, a shunting machine is almost always available, but the staff there is primarily assigned to repair and maintenance services and is therefore rarely available for shunting in relation to wagon movements from/to the

warehouse. In order to increase the flexibility and efficiency of the single wagon load handling, Bentheimer Eisenbahn developed a concept that enables personnel for the cargo handling and additional staff for the conduction of shunting operations (they deal with shunting machines and wagons inspections).

Table 6 provides an overview on the main milestones related to the demonstration activities on 'Flexible usage of staff'.

Table 6: 'Flexible staff usage'- Main milestones of the demonstration

Date/Period	Event
02-03/2014	Theoretical training of 2 staff members
04-06/2014	Practical training (train driving, shunting processes,…)
06/2014	Start of extended task allocation to trained staff members

In total two staff members have been trained as a train driver and shunting agents for these internal shunting operations. The theoretical training took place in February/March 2015. Practical training took place in the period April-June 2014. Further shunting trainings are done on demand, so that it can be ensured that at least one person capable of the shunting operation is always available. The new qualifications of the staff include issues like train formation, train driving, brake testing and wagon checks.

From June 2014 the new concept was implemented in daily operations. From that time the involved colleagues were carrying out the following tasks on demand. Waiting times of the warehouse staff are reduced and the frequency of handling is increased.

Operational experiences and proposed/conducted adjustments

As mentioned before, no essential negative consequences arise from the deployment of the ViWaS measures. Thanks to daily practice, the handling speed with the new forklift increased to the end of the ViWaS project compared to the training phase and the first months of regular operation (but already at this time, the effectivity was better than with the old forklift due to its lower capacity). At the beginning the new and bigger dimensions of the forklift required some familiarisation. Especially the bigger turning radius has to be considered by the drivers. While the former Toyota forklift had a turning radius of 2.75 metres, the Kalmar forklift needs 3.30 metres (+0.55 metres). During peak phases when the warehouses are full with cargo, also on normally free areas, the handling of the forklift is more challenging. For the internal organisation, it has to be considered that dedicated shunting areas have to be foreseen for the forklift.

The drivers like the new forklift due to its increased comfort. The drivers' cabin is an advantage for operations that have to be performed outside the warehouses. Although the dimensions are new, the handling of the forklift is easy (also thanks to the training). Compared to the former forklift, the new one causes less noise and although it has a higher capacity and more engine power, the energy consumption is equal or even less than before. Under consideration of the reduced operating time (cp. subchapter below) it can be stated, that the energy consumption and the corresponding CO2 emissions could be reduced.

The optimisation of internal transport and handling processes as well as the flexible usage of staff was well accepted. Since the employees recognise the positive development that was started by the ViWaS measures, they are more motivated than

before. Moreover, the varying work tasks promote continuous concentration and thus reduce the error susceptibility and increase safety.

Results documentation of selected KPIs

The results documentation of selected KPIs for this business case is difficult. Main purpose is the increase of efficiency and thus the reduction of costs. At the same time the implemented measures aim at the smoothening of handling operations and also make them more predictable and reliable. Since the measures were deployed in combination and the transports/volumes changed during the demonstration period, a clear allocation is not possible under realistic conditions.

For the deployment of the new forklift, a dedicated allocation is possible on the basis of the KPIs "handling duration" and accordingly "cost savings". The handling duration (time in minutes) was documented broadly, because it was considered as not useful to control it via stopwatch. This shows that the originally estimated durations (cp. deliverable 6.1) meet the experiences of the last year of operation. This is also due to that fact, that there are only very few variables (simple case, it is obvious that a forklift carrying twice the load only requires about half the time for its tasks). The summary for the calculation based on the receipt of one wagon with steel panels, intermediate bulk containers (IBC) and big bags, including monetary values can be found in Table 7 - Table 10 on the following pages.

Table 7: Steel panel forklift movement costs (one wagon, 50 t steel panels)

Working area – goods receipt	**time in min.**	**hourly rate**	**total**
Toyota-forklift	60	30.00 €	30.00 €
Kalmar-forklift	60	30.00 €	30.00 €
time/cost savings	***0***		***0 €***
Working area – LIFO storage			
Toyota-forklift	60	30.00 €	30.00 €
Kalmar-forklift	30	30.00 €	15.00 €
time/cost savings	***30***		***15.00 €***
Working area – LIFO removal			
Toyota-forklift	45	30.00 €	22.50 €
Kalmar-forklift	30	30.00 €	15.00 €
time/cost savings	***15***		***7.50 €***
Working area – internal run to transhipment place			
Toyota-forklift	45	30.00 €	22.50 €
Kalmar-forklift	30	30.00 €	15.00 €
time/cost savings	***15***		***7.50 €***
Working area – loading of goods (2 trucks with each 25 tonnes)			
Toyota-forklift	120	30.00 €	60.00 €
Kalmar-forklift	60	30.00 €	30.00 €
time/cost savings	***60***		***30.00 €***
Result 1 wagon	**time in min.**	**hourly rate**	**total**
Toyota-forklift	330	30.00 €	165.00 €
Kalmar-forklift	210	30.00 €	105.00 €
time/cost savings	***120***		***60.00 €***

Source: Bentheimer Eisenbahn

Table 8: IBC forklift movement costs (one wagon with IBCs)

Working area - unloading	time in min.	hourly rate	total
Toyota-forklift	30	30.00 €	15.00 €
Kalmar-forklift	15	30.00 €	7.50 €
time/cost savings	***10***		***7.50 €***
Working area - storage			
Toyota-forklift	30	30.00 €	15.00 €
Kalmar-forklift	20	30.00 €	10.00 €
time/cost savings	***10***		***5.00 €***
Working area - removal			
Toyota-forklift	30	30.00 €	15.00 €
Kalmar-forklift	20	30.00 €	10.00 €
time/cost savings	***10***		***5.00 €***
Working area - internal run to transhipment place			
Toyota-forklift	30	30.00 €	15.00 €
Kalmar-forklift	15	30.00 €	7.50 €
time/cost savings	***15***		***7.50 €***
Result 1 wagon	**time in min.**	**hourly rate**	**total**
Toyota-forklift	120	30.00 €	60.00 €
Kalmar-forklift	70	30.00 €	35.00 €
time/cost savings	***50***		***25.00 €***

Source: Bentheimer Eisenbahn

Table 9: Big bag forklift movements costs (one wagon with salt products)

Working area - storage			
Toyota-forklift	35	30.00 €	17.50 €
Kalmar-forklift	20	30.00 €	10.00 €
time/cost savings	***15***		***7.50 €***
Working area - removal			
Toyota-forklift	35	30.00 €	15.00 €
Kalmar-forklift	20	30.00 €	10.00 €
time/cost savings	***15***		***5.00 €***
Working area - internal run to transhipment place			
Toyota-forklift	30	30.00 €	15.00 €
Kalmar-forklift	15	30.00 €	7.50 €
time/cost savings	***15***		***7.50 €***
Working area - transhipment			
Toyota-forklift	75	30.00 €	37.50 €
Kalmar-forklift	50	30.00 €	25.00 €
time/cost savings	***25***		***12.50 €***
Result: 1 wagon	time in min.	hourly rate	total
Toyota-forklift	175	30.00 €	87.50 €
Kalmar-forklift	105	30.00 €	52.50 €
time/cost savings	***70***		***35.00 €***

Source: Bentheimer Eisenbahn

The cost savings achieved in the handling of the different types of cargo sum up to a total of 1,720 € per month in an average month at Bentheimer Eisenbahn (Table 10). The single figures may vary with the season and the respective order situation.

Table 10: Summary of the monthly cost savings related to the new forklift

Summary of the monthly cost savings (movement costs)			
	ø Cost saving per wagon	**ø Wagons per month**	**ø Cost savings per month**
Salt products	35 €	12	420 €
Steel panels	60 €	16	960 €
IBCs	25 €	20	500 €
ø Total savings without considering fixed costs			1,880 €
Additional fixed costs compared to the former forklift			160 €
ø Monthly savings			**1,720 €**

Source: Bentheimer Eisenbahn

The flexible usage of staff made operations more predictable, because the handling is now decoupled from the main train drivers' availability. Now, 9 wagons can be handled in a normal 8 hour shift with two persons for unloading and loading. A further increase is possible with the deployment of more employees.

Conclusions/Outlook

All of the measures (new forklift, optimised internal transport and handling processes and flexible usage of staff) have been approved in daily operation. The new equipment and processes have completely replaced the former structures without leading to bigger negative consequences.

The operational staff members – trained on the ViWaS developments - continued their former shift schedule with the implemented novelties. An exchange of experiences took place among the employees was well as with the ViWaS representatives.

Due to the fact, that all combined (and for itself comparatively simple) measures worked out very well, already at the beginning of the regular operation, a more detailed documentation of the demonstration was not considered as necessary.

Thanks to the ViWaS project new and beneficial measures for the increase of SWL efficiency at Bentheimer Eisenbahn have been introduced. By their help, it was possible to achieve and maintain complete cost-coverage (contribution margin IV, all costs excluding overhead), which transferred SWL services of the BE in a viable position for today and in the years to come.

For the future, the concept of flexible usage of staff will also be introduced to other business fields if it is recommendable.

All implemented actions and their respective preparation can serve as a basis for a catalogue for the improvement of Rail Logistic Centres / Railports in order to support single wagonload in decentralised regions.

2.3 Pilot implementations of "Intelligent wagon telematics and TCCU"

The target of the test-installation was to demonstrate the following:

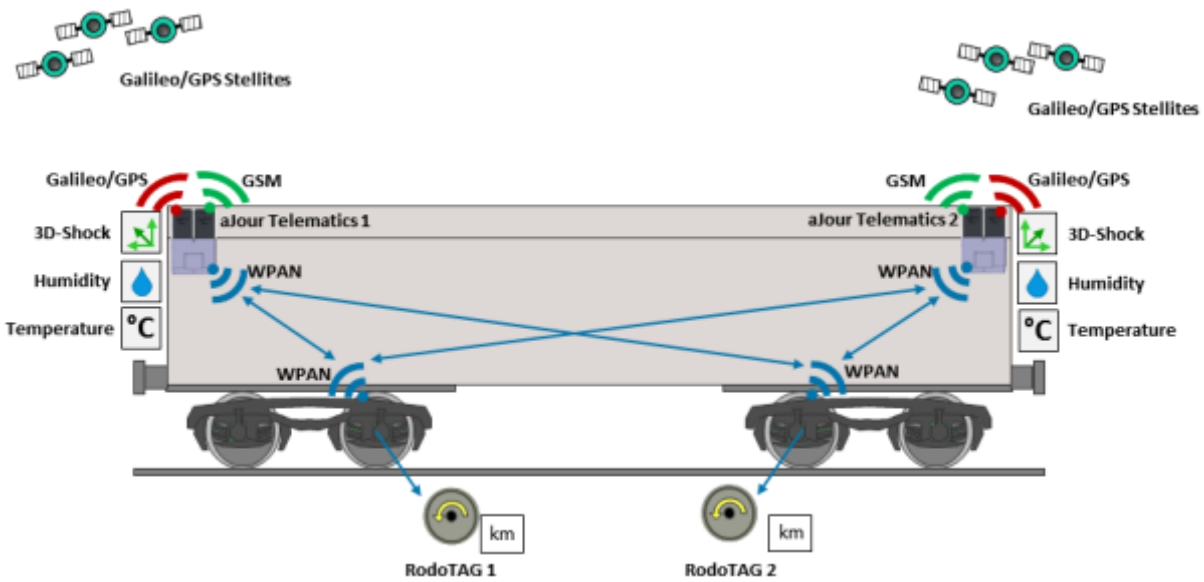
- Demonstrating the easy mounting of aJour Telematics units to different wagon types.
- Demonstrating the save and persistent mounting of aJour Telematics units, for example with a bracket, at a service workshop and during an 'in the field installation'.
- Proofing the operability of aJour Telematics by functionality tests of the telematics with different settings.
- Proofing the reliability of the GPS positioning and the GSM data transmission by reliability tests.

Additionally to the two installations in the context of ViWaS, i.e. the Wascosa "Flex Freight Wagon" and the SBB Cargo "Swiss Split Platform 2", the completion of the ViWaS targets and KPIs were also evaluated in other projects additionally.

2.3.1 Easy mounting of aJour Telematics units

During the test-installation-phase several mounting positions on a wide range of wagon types were tested. Figure 8 shows a schematically view of a coil-transport wagon equipped with two aJour Telematics units and two RodoTAG mileage tracking systems and there possible ways of communication with each other.

Figure 8: Schematically view of a multi-equipped 'Shimmns' wagon.



Source: Eureka

The high variability of possible mounting positions ensures also a high accessibility of the aJour Telematics units after mounting, which eases maintaining them and guarantees to find a mounting position where the GPS antenna has a free viewing angle to send and receive data.

Figure 9: Different mounting positions on different wagon types.

Source: Eureka

2.3.2 Save and persistent mounting of aJour Telematics units

Before mounting an aJour Telematics unit to a wagon it is necessary to decide which mounting type, of three available, is expected:

- mounting with bracket
- mounting with pair holder
- mounting line holder

Mounting with bracket holder

The advantage of mounting with the bracket is that the bracket, which is carrying the mounting plate with the aJour Telematics unit, is simply hooked into the signal bracket at the end of a wagon. The bracket itself provides an additional signal bracket of course, so that the End-of-Train signal can still be attached, as can be seen in Figure 10. After hooking the bracket in, it is locked with a combination lock, which is then also locked by using a protection screw, to protect it against thievery.

Figure 10: Back and front side of the bracket on the left side, and after it was mounted to a wagon on the right side.

Source: Eureka

Mounting with pair holder or line holder

When mounting an aJour Telematics unit with the pair or line holder it is necessary to either screw or weld the adapter plate to the wagon surface first. After cleaning the surface, where it is expected to attach the aJour Telematics unit, the colour is erased and then the colour free surface is protected with a protection coat. Afterwards the adapter plate is weld or screwed to the surface and then the mounting plate is screwed to the adapter plate. In both cases a locking plate is screwed to the mounting plate using a protection screw, o protect it against thievery (refer to Figure 10 and Figure 11).

Figure 11: Back and front side of the line holder as well as Mounting-Adapter.

Source: Eureka

2.3.3 Proofing the operability of aJour Telematics

The following settings were tested during the functionality tests of the aJour Telematics units:

- The GPS-Positioning, Speed and GPS-Heading.
- The distance and the direction of the current position to the next UIC station.
- Tracking of motion and duration and vice versa standstill and duration.
- Recording start and stop time.
- The measurement of temperature and humidity.
- Measuring 3D shocks in directions X, Y and Z, separately for each axis.
- Digital input, for example switch (maximum 4).
- Analogue input 0 to 32 VDC (maximum 2).
- Analogue output (maximum 2).
- Checking of the current load status (loaded or unloaded).
- Measuring the load weight in kilogrammes.
- Tracking of the GSM cell ID and the GSM country.
- Measuring the total kilometres of wagons and wheel sets.
- Measuring the daily kilometres of wagons and wheel sets.

Table 11: Table of the KPI requirements - Information Flow

KPI	Definition	Measure (compared to initial situation) Reference: CREAM Telematics	Target
Information flow	Information quantity in terms of information frequency and number of different information types.	Number of different types of information (e.g. movement/standstill status, shock in X, Y and Z, mileage, ...).	Increase number of types of information.

2.3.4 Proofing the reliability of GPS and GSM positioning

The evaluation of the reliability of GPS and GSM positioning was done with the ViWaS wagon '33 85 4552 144-9', where device 'CS02112' is mounted. The evaluation was done via a time period of three months, from 2nd of August 2015 to 2nd of November 2015.

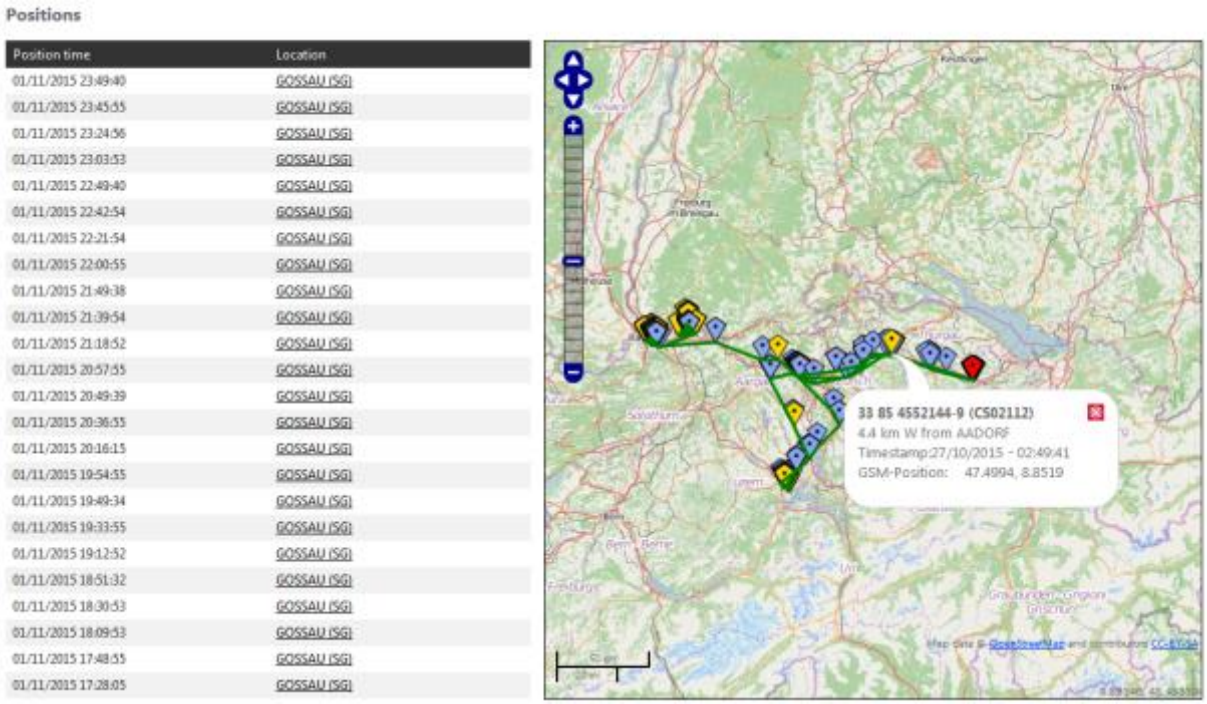
The wagon starts a positioning every 20 minutes, which are for 92 days an expected amount of 6624 GPS positions. The GPS positioning failed in 186 cases; therefore the GPS-availability equals 97.2%.

The GSM positioning succeeded in 99%.

The map below (Figure 12) shows GPS positions as blue kite shape and GSM positions as yellow kite shape. The current position appears as red kite shape. When clicking one of the positioning icons a bubble pops up showing more detailed information about the

location such as Wagon ID and Device ID, the distance and the direction to the next location in kilometres, the measurement timestamp and the co-ordinates.

Figure 12: Position availability of three months wagon operation.



Positions

Position time	Location
01/11/2015 23:49:40	GOSSAU (SG)
01/11/2015 23:45:55	GOSSAU (SG)
01/11/2015 23:24:56	GOSSAU (SG)
01/11/2015 23:03:53	GOSSAU (SG)
01/11/2015 22:49:40	GOSSAU (SG)
01/11/2015 22:42:54	GOSSAU (SG)
01/11/2015 22:21:54	GOSSAU (SG)
01/11/2015 22:00:55	GOSSAU (SG)
01/11/2015 21:49:38	GOSSAU (SG)
01/11/2015 21:39:54	GOSSAU (SG)
01/11/2015 21:18:52	GOSSAU (SG)
01/11/2015 20:57:55	GOSSAU (SG)
01/11/2015 20:49:39	GOSSAU (SG)
01/11/2015 20:36:55	GOSSAU (SG)
01/11/2015 20:16:15	GOSSAU (SG)
01/11/2015 19:54:55	GOSSAU (SG)
01/11/2015 19:49:34	GOSSAU (SG)
01/11/2015 19:33:55	GOSSAU (SG)
01/11/2015 19:12:52	GOSSAU (SG)
01/11/2015 18:51:32	GOSSAU (SG)
01/11/2015 18:30:53	GOSSAU (SG)
01/11/2015 18:09:53	GOSSAU (SG)
01/11/2015 17:48:55	GOSSAU (SG)
01/11/2015 17:28:05	GOSSAU (SG)

GPS positions appear as blue kite shapes, GSM positions as yellow kite shapes. The current position appears as red kite shape.

Source: Eureka

2.3.5 Load sensor

The ConnTAG load sensor was developed with focus to the following functionalities:

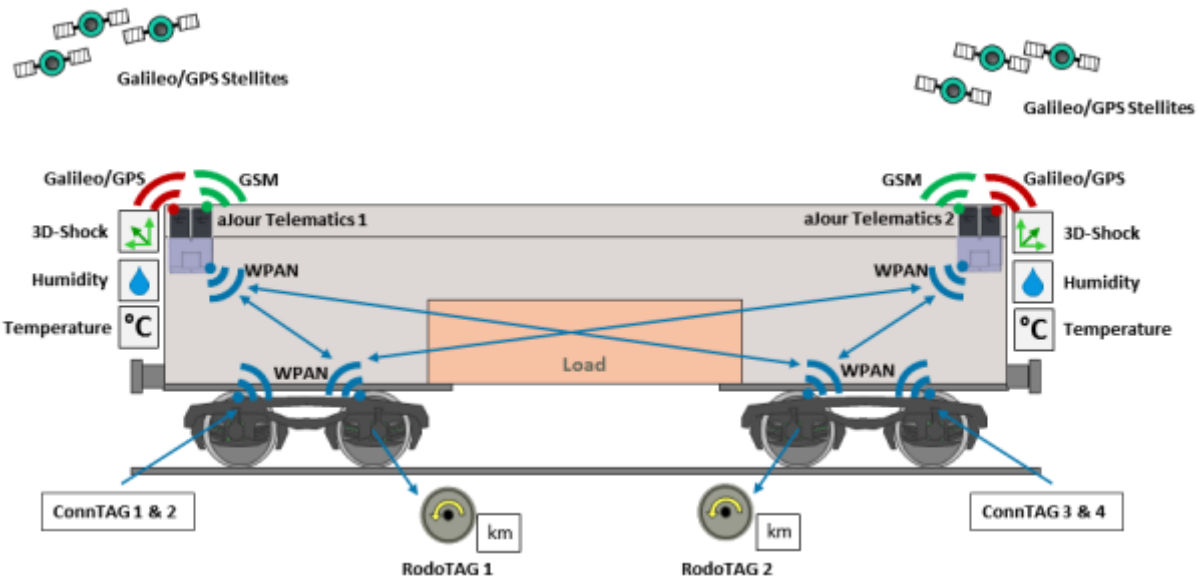
- Automatic detection if a wagon is loaded or empty.
- Manual or automatic over weight detection.
- Measuring weight during the loading process.
- Loading assistant on smartphones or tablets.

It serves the following features additionally:

- Measurements with internal and external sensors, various sensors are possible.
- Event triggered messages or cyclic messages.
- Identification and data transmission using WPAN in a range of 50 to 200 meters to aJour Telematics (or HotSpot).

Figure 13 below shows a multi equipped wagon, including four ConnTAG sensors for the weight measurement. A load control can be executed by using just one ConnTAG sensor. An exact weight measurement requires four ConnTAG sensors, two for each wheelset.

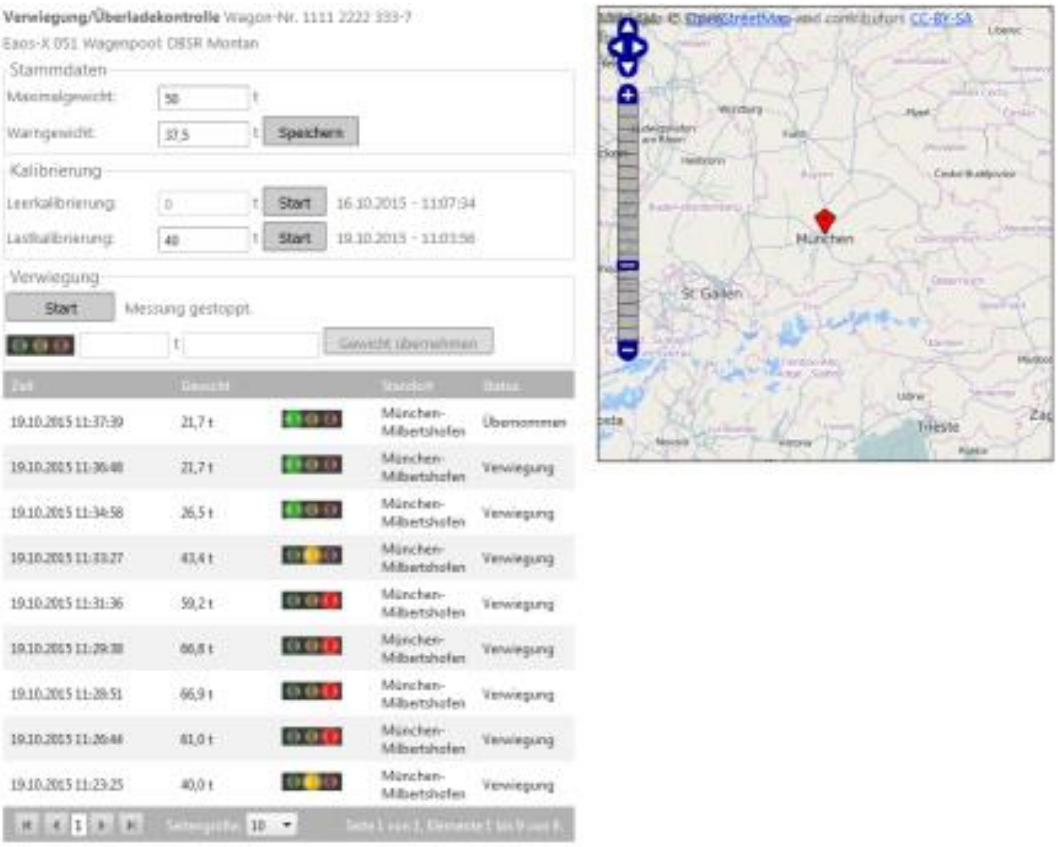
Figure 13: Wagon, multi equipped, with four ConnTAG sensors for the weight measurement.



Source: Eureka

The weight and load measurement is handled using the corresponding GUI in aJour Online (TCCU portal), Figure 14 shows the GUI for executing an exact weight measurement. The corresponding aJour Online GUI is also executable on mobile devices.

Figure 14: The GUI to execute an exact weight measurement in aJour Online.



Source: Eureka

Table 12: Table of KPI requirements of the Load Sensor

KPI	Definition	Measure (compared to initial situation) Reference: CREAM Telematics	Target
Load Sensor	Quantity of sensors required for sensors required for a) Weighing b) loaded/empty detection	Number of Load sensors to be required for an Y25 four axle wagon.	Weighing: max. 4 Load detection: max. 2
	Information Quality, measure weight accuracy of the load sensor.	Measure sensor results with different calibration weights. Calculate typical and max. weight deviation of sensor.	Max. +/- 3.5% for wagon overweight detection. Max. +/- 1% for weighing with official verification.

The field tests lead to the result that only four weight sensors are necessary to execute an exact weighing, with a residual of +/- 1%.

The load detection can be executed with reliable results when using just one weight sensor.

The image series below (see Figure 15) shows images taken during the testing of the weight sensor and measurement.

Figure 15: Images taken during the tests of the weight sensor.

Source: Eureka

2.4 Pilot implementations of modular wagon technologies based on the Flex Freight System

2.4.1 Business case(s) at a glance

Efficiency of single wagon load freight traffic is directly connected to the mileage with payload: High mileage with payload equals low costs per tonne-km. To reduce the amount of empty wagon transport the single wagon has to become more flexible. The wagon has to able to carry different types of cargo. The Flex Freight System of Wascosa has been further developed within the ViWaS project. The newly developed components (Flex Freight Car, Flex Freight Car 45', Timber Cassette 2.0) have been designed for specific use cases and partially tested in real life situations. The following sections provide an overview on the relevant use cases.

'Flex Freight Car'

The use of the Flex Freight Car for the loading and unloading of maritime containers in railway sidings has been tested extensively within the ViWaS business case "Swiss Split 2" (see chapter 2, section 2.1).

Another use case deals with the transport of 45' cooled containers from Antwerp and Bremerhaven to Switzerland (see also Deliverable D11.1). In fact this transport will be also organised within the Swiss Split system. For the loading and unloading operations of the container in the railway siding it is necessary to provide a certain forklift operation area on the wagon. This would be not possible if the 45' container would be positioned in the middle of the wagon as it is the normal case for the transport of 45' containers with 60' wagons. Consequently, a second prototype of the Flex Freight Car has been developed that enables the transport of 45' containers at the wagon end. The 45' Flex Freight Car will be delivered in December 2015. Therefore test operations are scheduled after the end of ViWaS period.

'Timber cassette 2.0' - functionalities and usage instructions

In 2010, Wascosa has presented the first flex freight unit for timber transports that is a major market for SWL. Within ViWaS, the so-called timber cassette has been further developed according following design goals. It should be

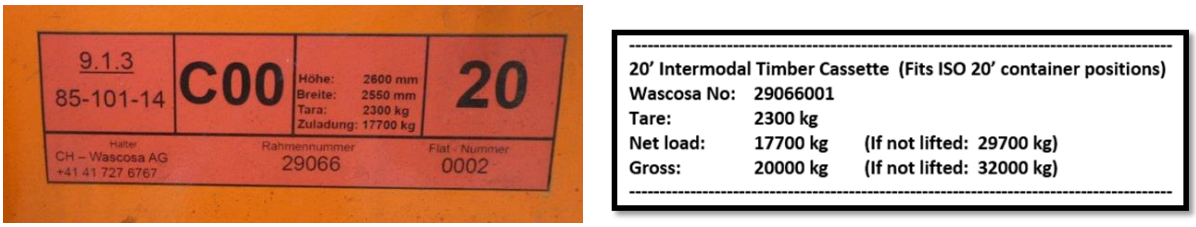
- compatible for intermodal handling equipment
- foldable and stackable on standardised twist lock positions

Three units of the prototype 'timber cassette 2.0' were delivered in August 2014. The main characteristics of the delivered cassettes are as follows:

- Base of the module is a 20' frame to be placed on a standard 20' position with container spigots.
- The module can be handled by both fork lift and reach stacker.
- The empty modules can be stapled on each other.

Core data e.g. regarding technical details and owner are displayed by the inscriptions on the cassette (cp. Figure 16).

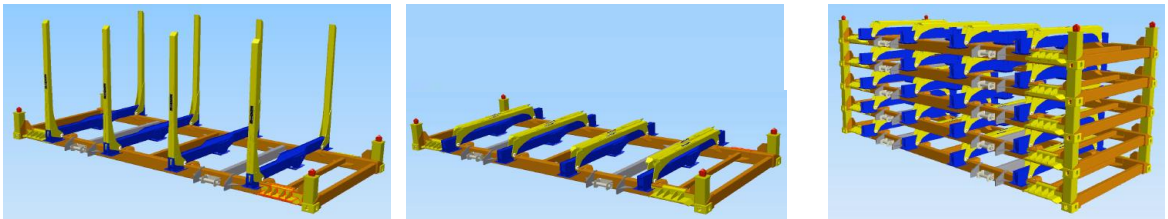
Figure 16: 'Timber Cassette 2.0' - inscriptions



Source: Wascosa

Generally, up to six cassettes are stackable. The transport of empty cassettes could be done either by train or truck. This will give room for container transport on the way back. The number of stackable cassettes in rail transport is limited by the loading gauge of the track. The wagon combination Sgnss wagon + timber cassette allows the stacking of up to 4 empty cassettes with loading gauge G1 and up to 5 cassettes with loading gauge G2.

Figure 17: Timber cassette 2.0 – general design



Timber cassette 2.0 with stanchions in upright position ready for transport of timber (left), with folded down stanchions ready for empty transports (middle) and group of stacked cassettes (right; up to 5 cassettes possible in rail transports).

Source: ExTe / MHS

Each cassette is equipped with four foldable stanchions on each side with a maximal height of 2,386 mm. If the cassette is empty the stanchions have to be folded down so that damage of the equipment, e.g. bolts is avoided (see Figure 18).

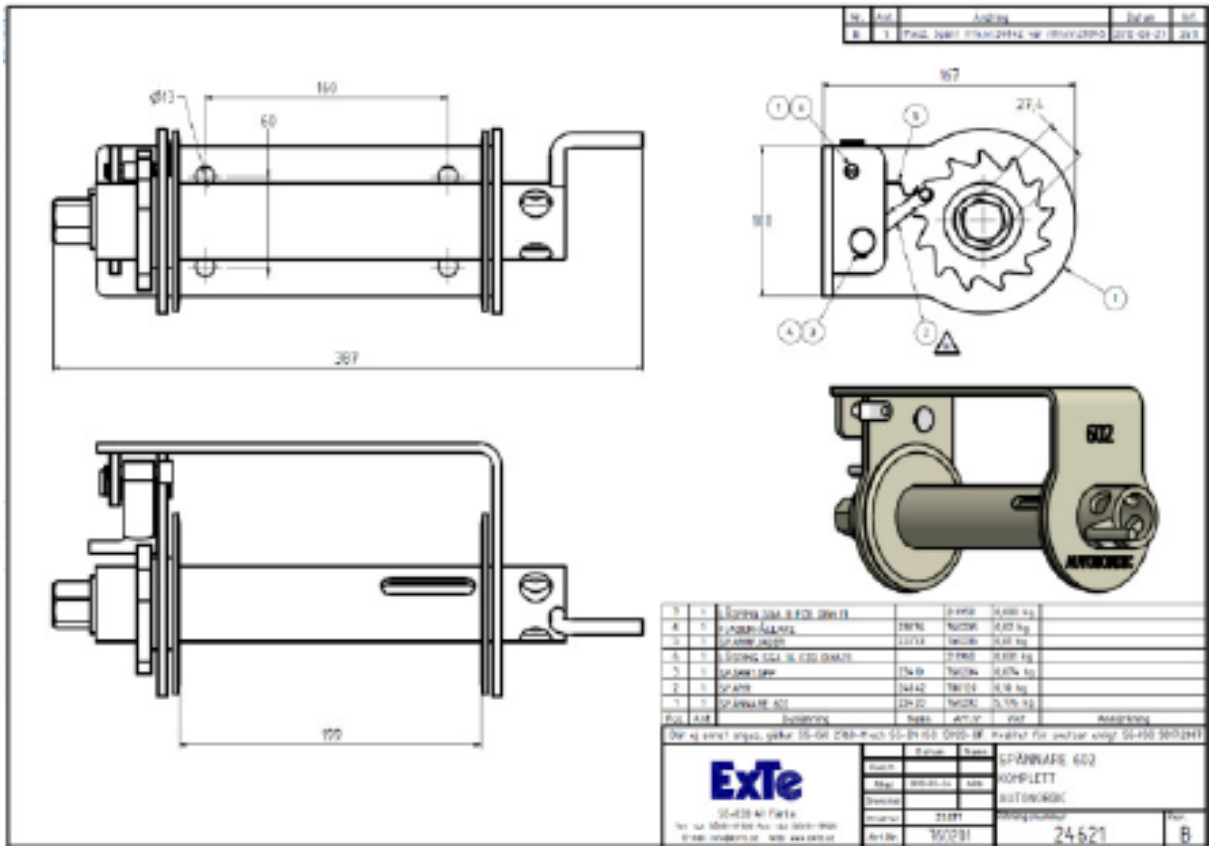
In order to enable loading of timber according to actual cargo securing standards each side of the cassette is equipped with four winch systems (see Figure 19). The tied up belt do have a length of 10 meters and strength of 60 kN. Depending on the type of timber several belts have to be used for securing.

When working with the cassettes necessary safety equipment like helmets, gloves, safety shoes always have to be used. Also slippery ground has to be taken care of.

Figure 18: Sgnss wagon + empty timber cassette 2.0 with lowered stanchions

Source: Forstlogistik Partner

Figure 19: Timber cassette 2.0 – winch system



Source: ExTe

'Timber cassette 2.0'- bi-directional timber/container traffic

When using standard timber rail wagons (Snps, Roos, etc.) the train runs empty on the way back which leads to unnecessary costs. Due to current tariff systems of former state railways (e.g. SBB Cargo), further additional costs have to be paid when transporting empty private wagons. During ViWaS, the combination flex freight car / timber cassettes have been used as private wagons. Even though there is a certain reduction in the transport tariff for loaded private wagons, the overall transport costs are higher due to the charges for empty runs.

To prevent empty runs, which is a goal also without such unfavourable tariff conditions, it is important to use train capacities in both directions. With a block train the empty cassettes can be folded and stacked on each other so that the empty places on the wagons can be used for containers or swap bodies. This transport back can e.g. be for final products (wood chips, wood panels,…) in containers/swap bodies to the customer to close the logistic chain.

Example: 24 wagons carry 72 timber cassettes 2.0 loaded to the factory. On the way back 6 wagons carry the empty cassettes, the remaining wagons can carry up to 54 20' containers. Even if the way back would be longer, this transport would be efficient.

Wagons that carry the stacked empty timber cassettes 2.0 do have a gross load of 44.5 t and a maximum height of 3095 mm above rail.

'Timber cassette 2.0'- intermodal usage

One advantage of the timber cassette 2.0 is that it can be positioned by truck directly into the forest to be loaded with timber (Figure 20 provides an impression on the physical conditions in the forest for loading/unloading of timber). When being loaded the cassettes are transported by truck to the railway station where the loaded cassette are transhipped onto the rail wagon. Another potential function the cassettes could be used for is the storage of timber. This would be an advantage, especially when the size of the timber storage area at the station is limited.

Figure 20: Timber in the forest ready for loading

Source: Wascosa

2.4.2 Flex freight timber cassette

Documentation of conducted field tests + Operational experiences and proposed/conducted adjustments

On 22/07/2014 the flex freight wagon 338545521399 arrived in Swiebodzien to pick up three timber cassettes 2.0 from the manufacturer's production site. Consequently, a first loading of the wagon took place on 28/07/2014 at the manufacturer in Swiebodzien (MHS). The first test loading was also used for a training on technologies and safety procedures. The loaded wagon reached Menznau in Switzerland on 05/08/2014. A training for the end customer Kronospan in Menznau was done on the same day again concerning wagon technologies and safety procedures. Another training was performed for the timber supplier (FLP) and SBB Cargo regarding wagon technologies and cargo securing rules. Basis for all trainings is a manual by ExTe, covering all points to be considered for a proper and safe usage of the new equipment. In detail this concerns the following topics:

- Idea of loaded and empty/stacked transport of timber cassette;
- Change of wagon payload when using timber cassettes;
- Dimensions of timber cassette (inscription on cassette);
- Payload of timber cassette when lifted empty (inscription on cassette);
- Payload of timber cassette when lifted loaded (inscription on cassette);
- Lifting of cassette with fork lift;
- Lifting of cassette with reach stacker
- Handling of foldable stanchions;
- Securing of cargo with adjustable straps;
- Stacking of empty cassettes.

Table 13 contains an overview on the milestones of the conducted demonstration and preparatory training activities

Table 13: 'Timber cassette 2.0' - Main milestones of the demonstration

Date/Period	Venue	Event
28/07/2014	Swiebodzin	Test loading; training
June/July 2014	Swiebodzin - Menznau	Transfer of new timber cassettes to Switzerland; arrival in Menznau on 05/08/2014
05/08/2014	Menznau	Technique timber cassette
03/12/2014	Moudon	Start of test operations FLP
14/04/2015	Rothenburg	Training with FLP and SBB Cargo
05/10/2015	Saignelegier	Last loading within test operations FLP
From 12/2015 (planned)	Bad Bentheim	Tests of timber cassettes at Bentheimer Eisenbahn

In December 2014 test operations of the 'Timber Cassette 2.0' started with the timber supplier and forestry logistics specialist Forstlogistik Partner. The test runs do not include a bi-directional loading or intermodal usage. Instead, the tests were intended to make general experiences on the daily use of the equipment to draw conclusions on its applicability. The test runs were concluded in October 2015. Further tests – involving the extended functionalities of the cassette – will be carried out outside the ViWaS life time.

The Sgnss wagon with three units of the 'Timber Cassette 2.0' was used for totally 32 transports (see Table 14). During these test transports, the largest measured load per wagon was 57.714 tonnes. The least measured load was 31.893 tonnes; on average 43.133 tonnes. In comparison to the possible load capacity of the wagon – which is 66.200 tonnes – the average capacity exploitation of the wagon is only 65% which is by far not sufficient.

Table 14: 'Timber cassette 2.0' – Overview on conducted test runs of FLP

Waggon-Nr.	Verl.Dat.	Bahnhof	Abnehmer Holz	gemessen To
2139-9	03.12.2014	Moudon	Kronospan AG	46.394
2139-9	12.12.2014	Colombier	Kronospan AG	54.737
2139-9	22.12.2014	Les Verrières	Kronospan AG	51.634
2139-9	08.01.2015	Les Verrières	Kronospan AG	46.259
2139-9	15.01.2015	Les Verrières	Kronospan AG	36.157
2139-9	27.01.2015	Biel-Mett	Kronospan AG	48.644
2139-9	04.02.2015	Cossonay	Kronospan AG	57.714
2139-9	11.02.2015	Cossonay	Kronospan AG	52.606
2139-9	18.02.2015	Moudon	Kronospan AG	35.999
2139-9	26.02.2015	Nyon	Kronospan AG	43.402
2139-9	09.03.2015	Vallorbe	Kronospan AG	52.952
2139-9	16.03.2015	Moudon	Kronospan AG	32.357
2139-9	24.03.2015	Moudon	Kronospan AG	33.883
2139-9	09.04.2015	Oensingen	Rothenburg, Film abgesagt	54.945
2139-9	27.04.2015	Delémont	Rothenburg, Film Viwas	56.160
2139-9	02.05.2015	Gossau (Messe München)	Wascosa AG	20.000
2139-9	05.06.2015	Bière	Kronospan AG	44.333
2139-9	12.06.2015	Bière	Kronospan AG	44.150
2139-9	22.06.2015	Cossonay	Kronospan AG	32.792
2139-9	25.06.2015	Les Verrières	Kronospan AG	37.044
2139-9	03.07.2015	Les Verrières	Kronospan AG	34.890
2139-9	15.07.2015	Les Verrières	Kronospan AG	44.352
2139-9	24.07.2015	Colombier	Kronospan AG	34.600
2139-9	10.08.2015	Cossonay	Kronospan AG	32.288
2139-9	14.08.2015	Moudon	Kronospan AG	31.893
2139-9	20.08.2015	Moudon	Kronospan AG	33.187
2139-9	27.08.2015	Moudon	Kronospan AG	39.388
2139-9	04.09.2015	Moudon	Kronospan AG	31.794
2139-9	14.09.2015	Nyon	Kronospan AG	47.511
2139-9	23.09.2015	Le Locle-Col-des-Roches	Kronospan AG	52.478
2139-9	29.09.2015	Le Locle-Col-des-Roches	Kronospan AG	50.518
2139-9	05.10.2015	Saignelegier	Kronospan AG	39.244
				1380.270

Source: Forstlogistik Partner

Impressions from the operations during training and demonstration activities are provided in Figure 21.

Figure 21: Impressions from training and demonstration

Empty cassette prepared for stacking (left), loaded cassettes (middle), securing of cargo (right).

Source: Wascosa / Forstlogistik Partner

Conclusions/Outlook

If the timber cassette 2.0 is only used for rail transport it does not generate any advantage compared to standard rail wagons for timber. However, under certain framework conditions there is a considerable potential for improvements identified. This concerns especially the loaded operations in both directions to prevent empty train runs which are not possible with standard timber wagons. Further improvement aspects concern intermodal usage or possibilities to use the cassettes for storage purposes. A more detailed analysis on the potential and further exploitation possibilities is included in deliverable D11.1.

2.5 Business case "Last-mile service on French secondary lines"

A documentation of the demonstration activities of Business case "Last-mile service on French secondary lines" is already included in Deliverable D6.2, submitted to the Commission by end of August 2015. For reasons of better readability the main contents is transferred and partly extended in correspondence to the presentation structure as agreed within the WP10 work group.

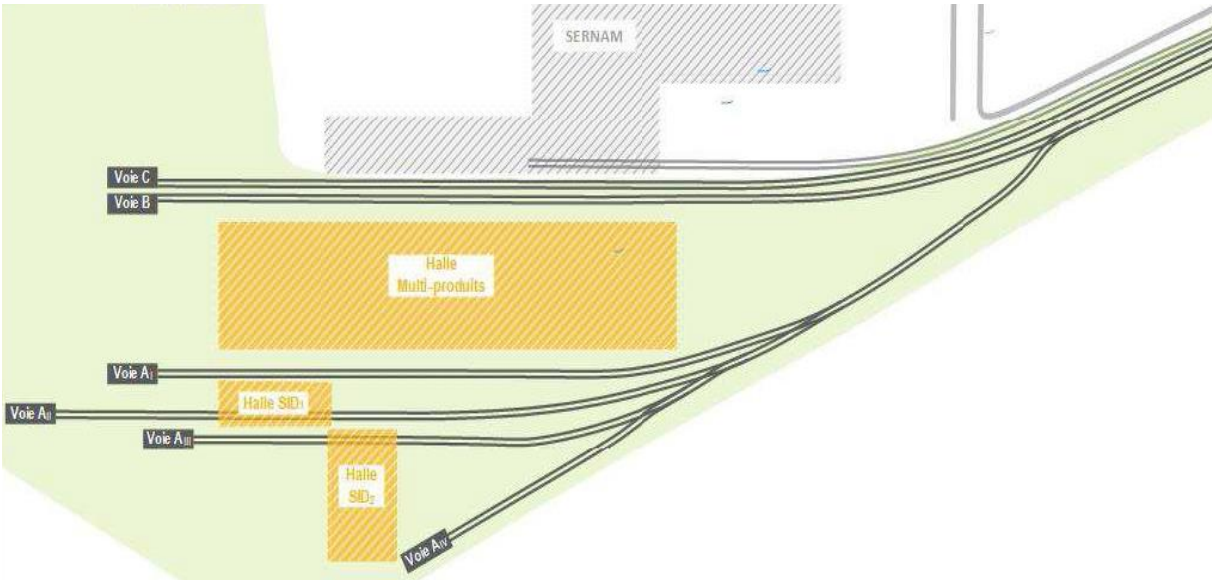
Documentation of conducted field tests

For the intended test operations of the new "last-mile" operation method – developed by Fret SNCF – specific safety/operating procedures had to be set up and approved by the French Infrastructure Manager (IM).

Initially, it was planned to apply the new method on a feeder line linking the public rail network and private sidings. Even for the relatively short movement on public tracks, the IM is demanding a specific agreement for the bi-modal vehicle. Numerous meetings have been conducted with the IM to get an exceptional permission for the tests. Unfortunately, no agreement could be reached. The application process for the demanded specific agreement on changed operation rules would have taken significant additional time efforts.

To avoid further delays and to assure proof of the concept within the project lifetime, SNCF Fret decided to shift the tests to an area that does not require the usage of public tracks but is at the same time identical in the operating conditions compared to the initially selected test case. This specific configuration could only be found in a private siding which is operated under the responsibility of SNCF Fret at the Lyon St. Priest Terminal ("fallback solution").

Figure 22: Logistics site of St. Priest – operating configuration



Source: HaCon based on SNCF

Presently SNCF runs the distribution train to the inside of the private siding by long backing movements. Then the movement of the wagons between the various tracks is performed by a light rail Diesel Motor tractor Y8000.

The search of an adequate Road/Rail tractor led to the rental of a MOL 2444 which power is largely sufficient to ensure a full reliability of the operations (see Figure 23).

Figure 23: Road/rail tractor MOL RR 2444 during test operations

Source: NEWOPERA, SNCF

The demonstration lasted 3 months after training the staff to the new vehicle. The precise operations were:

- To place the half train of CO_2 on the unloading track and exchange it with other half when the operation was over and to bring them globally back to the entrance of the private siding where SNCF took them in charge with their diesel locomotive.
- To serve the two sheds where the steel coils were to be handled by several sets of few wagons placed under the Gantry crane of the shed.

Table 15 provides an overview on all project phases and milestones in relation to the test and demonstration activities for the new last-mile operation method.

Table 15: 'Last Mile method' - Main milestones of the demonstration activities

Date/Period	Event
2012/2013	General design of last-mile operation method; initial ideas regarding potential field test locations
Until 10/2013	Location search for potential field tests – first phase
02-08/2014	Location search for potential field tests – second phase
Continuously	Negotiations with IM (RFF) to run bi-modal vehicle on public tracks
08/2014	Selection of test location (St Priest)
10/2014	Economic analysis → decision to run field tests
12/2014	Selection of bimodal road-rail tractor
02/2014	Delivery of road/rail tractor to test site
02/2015	Training
03-07/2015	Field tests (Demonstration)

Operational experiences and proposed/conducted adjustments

Compared to the Y8000 service the complexity of the operation has been largely reduced as the Road/Rail Tractor could leave the embedded track anywhere. Moreover the Road/Rail tractor is equipped with a remote control which could enable any operation to be made by a single operator. Even backing movements could be made by a single operator as soon as the radio remote command could be used with one hand only.

The demonstration has shown significant gain of time for the steel operations (30%) and a marginal gain for the CO_2 operation.

The demonstration has shown that the ability to drive and operate the Road/Rail tractor is obtained in one day, that the safety is at a high level with convenient footboard, with a vigilance system in case of a fall down of the operator, with a slewing seat enabling to have the best driving position, with a very precise positioning when touching the buffers of the wagons and with many other devices like cameras. The time to get the right pressure in the brake pipe of the wagons to move them is 20% shorter than with the Y8000 enhancing the efficiency. The team operating was very favourably impressed.

For that reason SNCF Fret is presently tendering a 5 years contract to get such a RR tractor similar or slightly less powerful to operate inside and outside the private siding.

Some other private siding owners are interested in implementing the technology. For that reason we have studied the questions raised by the Infrastructure Manager as regards the safety devices that could be touched by the tyre of the engine. This might happen if the grove which is created in the middle of the tyre becomes too deep after a certain period of operation. A quick analysis of the problem shows that a light maintenance procedure can avoid this risk: the depth of the grove must be checked regularly and as the movement of the RR tractor on rail is not at high speed (above 60km/h) there is a very simple solution by vulcanisation of a slice of rubber in the grove to remain in the acceptable depth.

If this proposal is accepted there should not be any difficulty to get larger derogations until this type of RR Tractor is homologated in an acceptable way.

Results documentation of selected KPIs

The following detailed process times for the Road/Rail tractor have been measured during the field tests:

- **Time to set on rail:**
  2 to 3 minutes
- **Time to exit from rail to road:**
  less than 30 seconds
- **Time for coupling:**
  identical with shunting locomotive
- **Time to put the brake pipe at the right pressure:**
  20% compared to the diesel locomotive

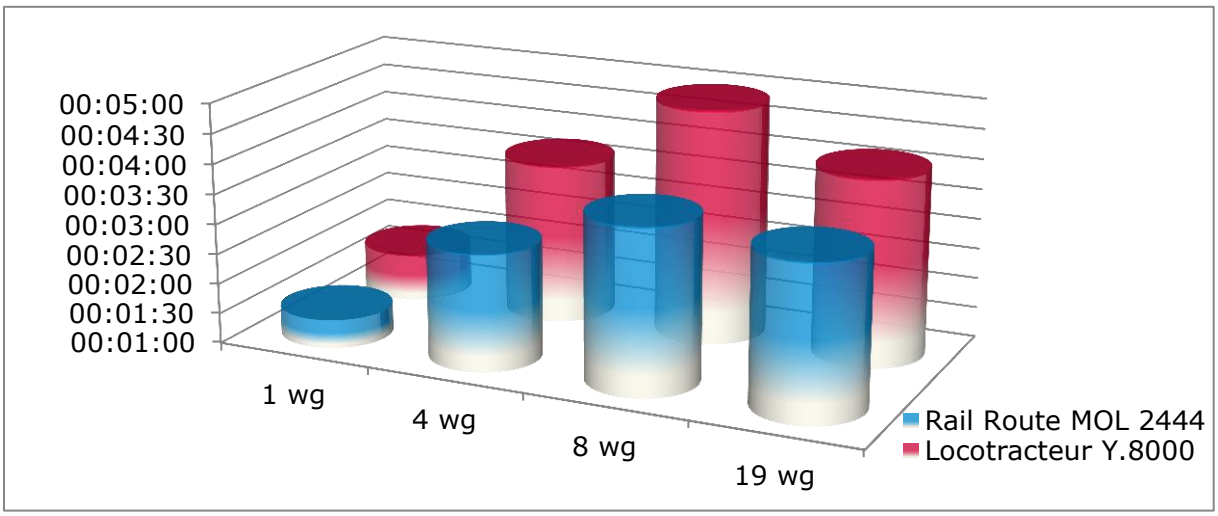
40 separate measurements have been performed with up to 19 wagons. The comparison between Y8000 and MOL RR 2444 shows significant time savings for the RR tractor. (cp. Figure 24 and Figure 25).

Figure 24: Comparison of manoeuvre times between Y8000 and MOL RR 2444 (table)

Mesures		Locotracteur Y.8000			Rail Route MOL 2444			Analyse Comparée	
Format (en n.wagons)	N.mesures	Temps Mini (Y.8000)	Temps Maxi (Y.8000)	Moyenne (Y.8000)	Temps Mini (MOL.2444)	Temps Maxi (MOL.2444)	Moyenne (MOL.2444)	Gain du MOL.2444	Performance du MOL.2444
1 wg	5	00:01:37	00:01:57	00:01:47	00:01:18	00:01:39	00:01:29	00:00:18	17,3%
4 wg	5	00:03:11	00:04:10	00:03:41	00:02:46	00:03:07	00:02:57	00:00:44	20,0%
8 wg	5	00:04:52	00:04:57	00:04:55	00:03:30	00:03:58	00:03:44	00:01:11	23,9%
19 wg	5	00:03:51	00:04:22	00:04:06	00:02:57	00:04:09	00:03:33	00:00:33	13,6%

Source: NEWOPERA

Figure 25: Comparison of manoeuvre times between Y8000 and MOL RR 2444 (diagram)



Source: NEWOPERA

Conclusions/Outlook

In general, the conclusions of the tests performed with the RR MOL2444 are positive despite the fact that they have not been able to experiment all the functionalities. Compared to the Y8000 light rail motor tractor the functionalities are improved as well as the conditions of use by the agents in terms of comfort and safety.

It is to be noted that it has not been possible to fully explore all the options and functionalities during the 3 months test period. However, the flexibility of use and the possibility to operate with a single agent are not only a simple improvement of the manoeuvres or the capacities to cope with high or low level of activity. It also opens up the opportunity to reorganize completely the logistics operations and thereby generating significant efficiencies.

Besides that, the more the penetration distance on the national railway network will increase the more possible changes in the system will appear. Today, the fact that the RR tractor is not yet authorised on the French national railway network yet is still a weak point.

The demonstration in St Priest was therefore studied by the management of SNCF Fret at local and national level. The main question was the capacity to be able to get permission for the road/rail tractor to get on the National Railway network for a short distance. The discussions were progressing but no definite agreement could be reached. However it appeared that RFF (to SNCF Réseau) had already in the recent past granted derogations to allow such engine to access to the National Railway Network for a short distance. The purpose was not of the same operational nature but no major differences could be raised for a refusal.

The economic analysis documented within Deliverable 6.2 shows very clearly the interest of developing the solution. The implementation will become very easy when the present evolutions on the secondary network in France will be achieved with an extended possibility for "short liners" to operate on the secondary network with alleviated rules. In other European countries it is already possible to use the remote control on the National Network like in Switzerland. The daily application appears possible in certain sites and a methodology to select them is proposed within Deliverable 6.2.

2.6 Summary and conclusions

An important aspect of ViWaS was to develop and implement short to medium term improvement based on real use cases (also business cases). This concerns especially technical innovations (modular wagon components, telematics) but also improved processes. The tests clearly showed the applicability of the developed solutions and the resulting benefits. At the same time the tests also revealed weak points that would need further evaluations and development work

Due to the relatively quick implementation the experiences could be used to specify subsequent developments (e.g. Swiss Split 2: Flex freight Car > Container Loading adapter) or implement further improved processes already during the project lifetime.

In some cases the demonstration activities reveal unfavourable framework conditions (e.g. required permission to run bimodal road/rail tractors on public network; fair tariff conditions for private wagons supporting innovations) and support discussions to solve these challenges.

Generally, all experiences and measured KPIs are being used as input for final evaluation of ViWaS developments and potential implementation strategies, documented in deliverable D11.1.