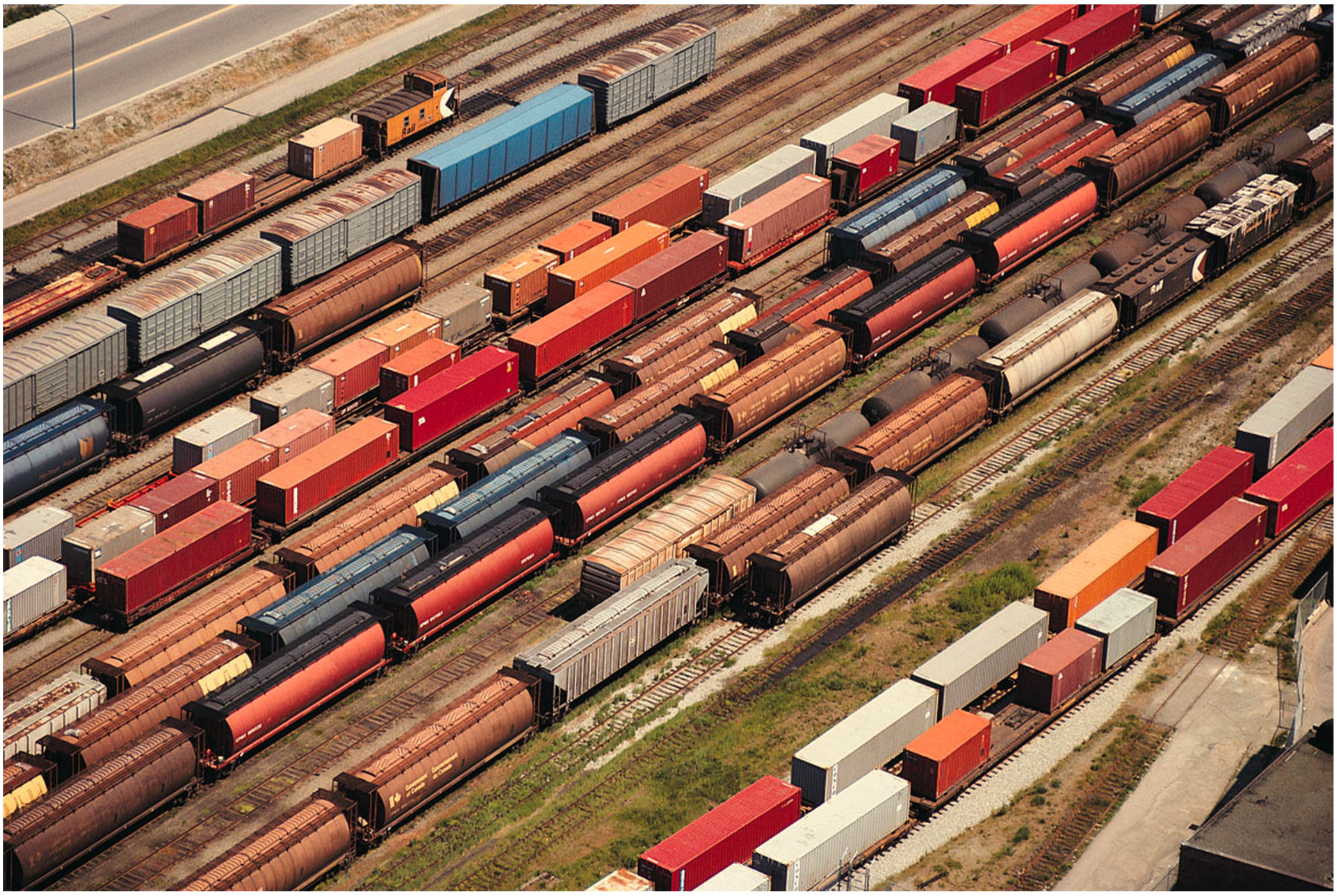

Living Lab 5: Adria Kombi - rail, truck and terminal collaboration

1 Background and introduction

1.1 Background

Europe is considered as one of the global leaders in the logistics sector. Eight EU Member States are ranked among the top 10 countries in terms of logistics performance for the year 2018[i], while the market size of the logistics sector in Europe was estimated as being equal to €878bn in 2012[ii].

However, in various sectors, logistics costs remain a significant part of total supply chain costs. These logistics costs represent 12% of total cost in the manufacturing sector and more than 20% in the retail sector[iii]. Moreover, logistics efficiency could be improved. Statistics have shown that 24% of all vehicle movements per kilometre in the EU are not carrying goods, while the average load factor for vehicles is estimated as being 57%[iv].

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To enhance efficiency in the EU logistics sector, increased collaboration could improve the current situation. More efficient synchronized networks and a decrease in operational costs are the main benefits for the companies involved in cooperation schemes[v], as it has been estimated that cost savings and efficiency gains of 6-10%, according to Transport Intelligence[vi], or a reduction of 9-30% in distribution costs, could be expected[vii].

1.2 SELIS (Shared European Logistics Intelligent Information Space)

However, a key barrier to collaboration is doubts around secure data exchange, and this is the barrier that SELIS aims to remove. The Shared European Logistics Intelligent Information Space (SELIS) project is a €17 million European Union Horizon 2020 Research and Innovation Programme, running from September 2016 to August 2019. The project has built a scalable and replicable platform for pan-European logistics applications, at every level allowing a standardized exchange of core data between any number of registered users.

The SELIS project combined strategies for innovative, efficient and green logistics with leading edge open source information technology techniques that support collaborative logistics, through building applications and testing them in real world use cases.

1.3 Living labs

Living Labs have been used by SELIS as the testing and proving environment by using current commercial and operational scenarios to test and refine the SELIS developed technical solutions. Some solutions incorporated opensource systems integrated into the overall platform.

The SELIS Living Lab activities have included the stress-testing of the solutions developed for building the basis for a safe, secure, reliable and robust data-sharing platform.

- Each living lab involved business partners willing to support the development and piloting of these applications.
- Each of these living labs tested one or more applications, with each pilot containing one or more trials, or use cases, which allowed the testing of developed solutions in a number of different scenarios, with different groups of collaboration partners, each effectively conducting a stand-alone experiment which generated a set of real-world results which can then be compared with the expected and anticipated benefits.
- Each real-world pilot and use case trial created insight on implementation, and the enablers and barriers to success.

1.4 The Concept of SELIS Community Nodes

SELIS has developed the concept of a network of logistic communities, each created as localized shared intelligent logistics information spaces, each adaptive, configurable and providing the privacy that collaboration requires. These communities are termed as SELIS Community Nodes (SCNs). The aim is to stimulate the growth of a network of these SCN, that will create a distributed common communication and navigation platform for transport and logistics, a platform that through multiplication can be extended and expanded to support Pan-European logistics applications, adaption and collaboration.

Each SCN is a secure domain where supply chain partners share data (e.g. raw data, analytics predictions, inventory, routing decisions etc.) in a secure and governed manner that, in turn, enables the implementation of a specific collaborative logistics model.

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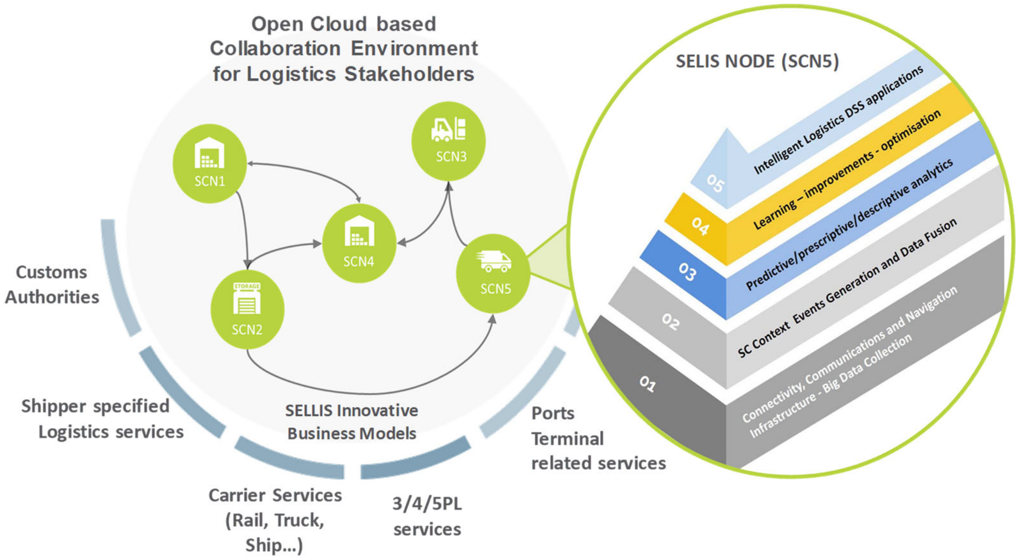

Figure 1: SELIS SCN concept

An SCN includes the necessary architecture to allows users (data publishers and/or subscribers) to:

1 - connect to multiple data sources;
2 - transform, reformat and normalize data;
3 - share data securely by means of user-defined access rights, thereby enabling collaboration;
4 - make use of machine learning that allows for self-learning and improving capabilities, such as continuous improvement in forecasting based on the ongoing and real-time use of accumulated data.
5 - adapt and deliver the capability as required by a specific industry or sector.

If appropriate, an SCN could communicate with other SCNs through an open and cloud-based architecture to create a network of SCNs; this would allow any operator to connect with another, such as a single port SCN, which could share appropriate data with an inland 3PL (Third party Logistics provider) or rail SCN.

2 Living lab 5 - Adria Kombi - rail, truck and terminal collaboration

2.1 The Adria Kombi problem and opportunity

Living Lab 5, led by Adria Kombi, addresses visibility and scheduling issues within the rail, terminal and ports community. The barriers to collaboration include a lack of reliable communication between parties and gaps in the information shared. Operational gaps included unreliable information on estimated time of arrival of train wagon sets, poor wagon set capacity utilization and a lack of environmental impact estimates on rail freight journeys which, if available, would help facilitate end to end supply chain calculations of environmental impact.

Recording and communicating the status of containers moving through the rail freight system and terminal relied on manual processes that were both consuming and prone to error. In addition, any mitigation against delays in rail transport, which involves deciding an alternative best use of the available wagon set, was constrained by inability to predict delays in rail transport and the impact of delays on rail wagon-set planning.

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2.2 SELIS solution

SELIS aimed to provide supply chain visibility to help track the performance of rail freight on time arrival, and through tracking events throughout the chain better predict late arrival of trains at terminals. This visibility and the ability to notify relevant stakeholders of delays was addressed through the SELIS solutions for tracking the flow of containers and wagons through logistics gateways, the visualized real time mapping of these recorded events, and the notification functionality that automates the push of updates to all interested parties. The model built upon a number of previous studies on rail scheduling problems and identified good practice[viii][ix][x].

The trial also involved developing a search mechanism for container owners, to allow them to find and track the progress of their cargo, along with measures for rail refight system users that would measure the visibility of rail freight for any given rail operator. The tracking and reporting functionality proposed included consolidating the status information of each container within the system, including real time updates of location and estimated time of arrival at the final destination. The consolidation of container status information required the automated gathering and matching of data from multiple sources. The communication of the data would be through a publishing mechanism so the data is searchable by owners and logistics planners, and the publication of data achieved either through 'publish/subscribe' solutions or through a simple online interface where the user would enter the unique container identification number.

With better tracking and forecasting of the late arrival of rail freight, the opportunity arises for better corrective action, and so a rescheduling tool was proposed to allow for a new optimal configuration of the available wagon set and available containers. This tool would allow users to put together the best utilization of the wagon set based on the containers expected to have arrived in time for loading.

2.3 Results of the Living Lab

A container visibility portal was built, based around a dashboard that summarises and visualises data on each container, including current location, estimated time of arrival at next freight cross docking location, and the estimated contribution to CO_2 emissions. Status and impact data are calculated using data gathered from a range of sources, incorporating data from multiple transport legs to create a cumulative impact assessment of container due date.

The SELIS functionality was linked to the Adria Kombi legacy systems using API (Application Programming Interface) connectors, and a standardised messaging structure for this information using XML (XML stands for eXtensible Markup Language).

The SELIS solution delivered the container search functionality, which is illustrated by the screen shot shown below.

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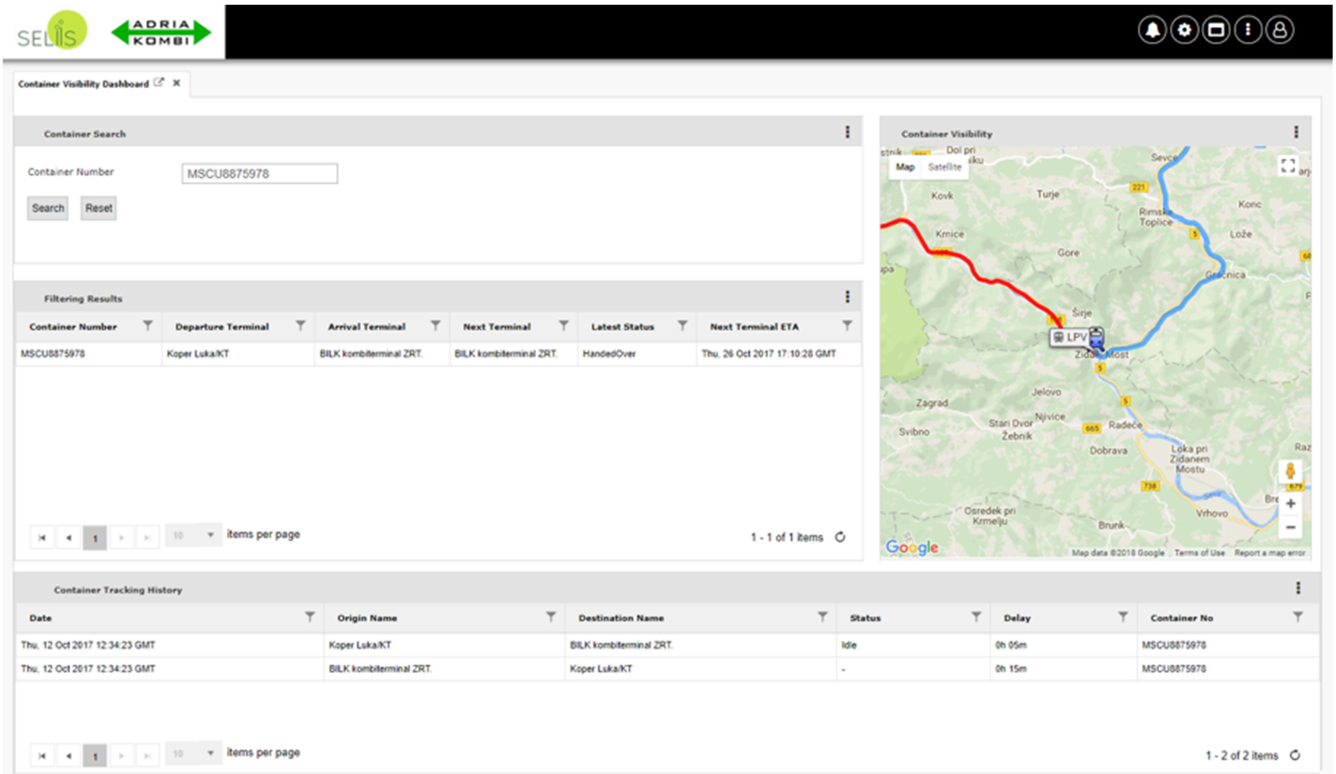

Figure 2: Container Search Functionality

The notification service was developed and implemented to provide exception reporting, making relevant parties aware of delays or unexpected rerouting of containers within the rail system. The push notification is shown in the screen shot below.

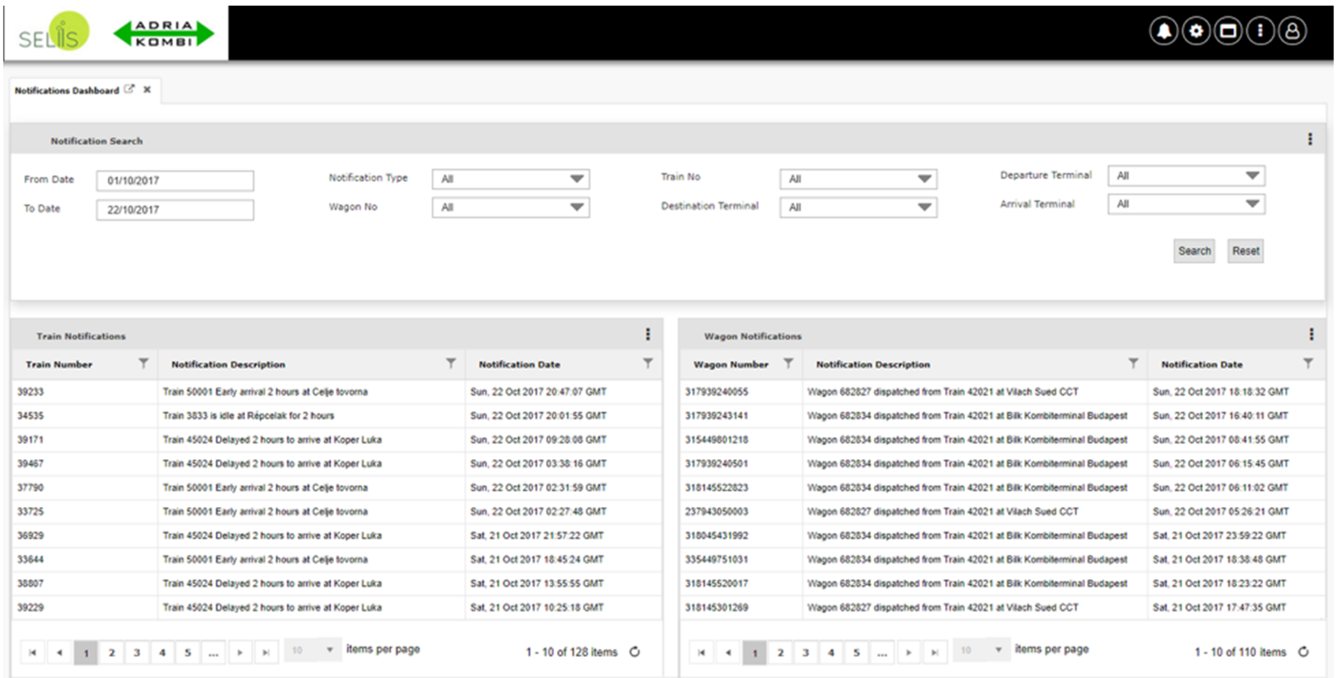

Figure 3: Notification Functionality

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The wagon set and container rescheduling tool was implemented, and the identification of expected delay is illustrated in the screen shot below which provided the ability to predict delays allows for rescheduling of subsequent movements.

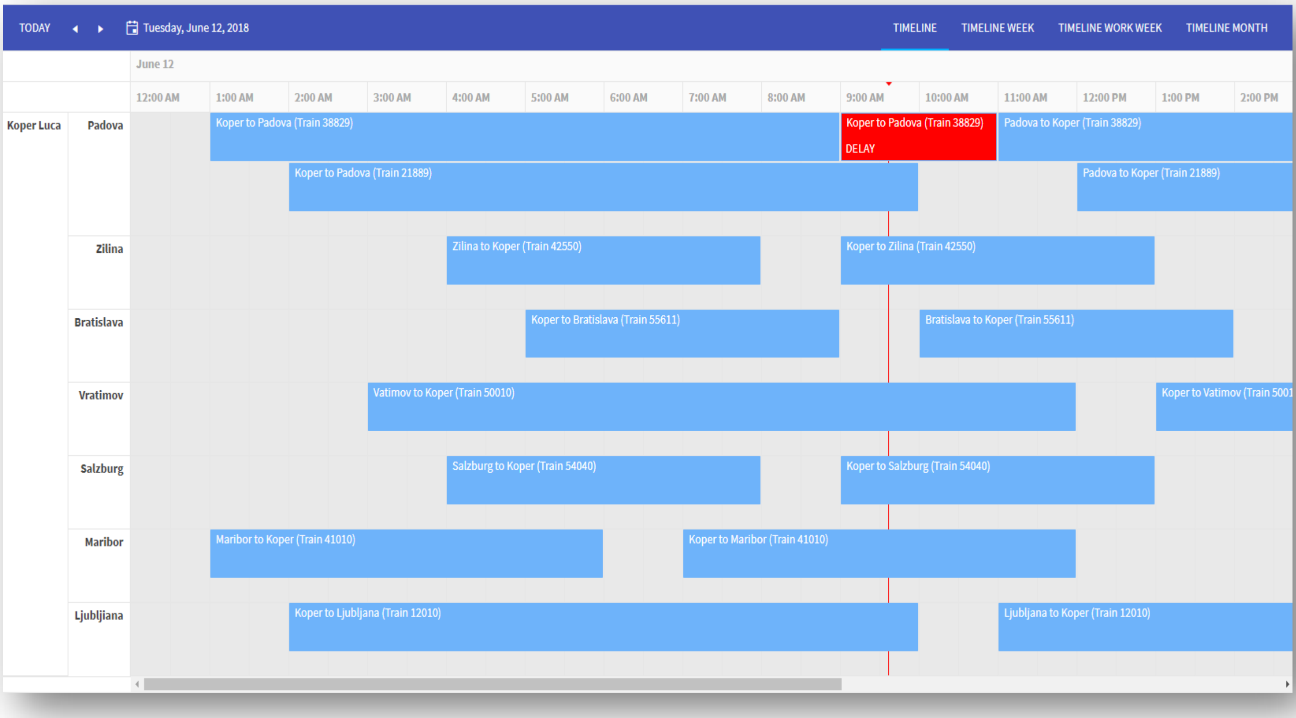
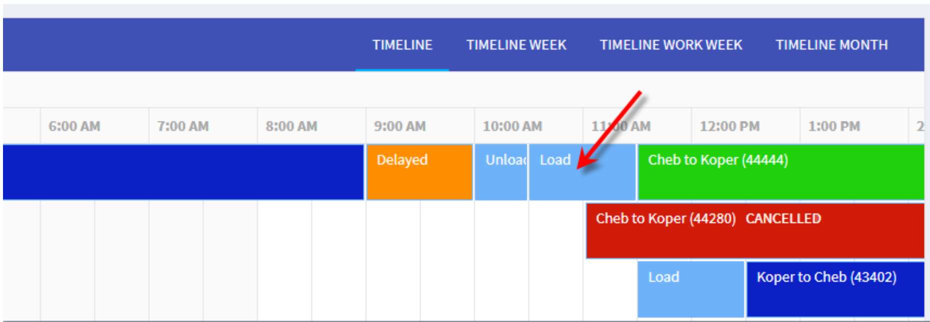


Figure 4: Tracking and Predictive Identification of late arrivals

A screen shot of the wagon and container rescheduling tool is shown in the screen shot below, that illustrates the ability to put together a new optimized load in response to delayed and cancelled trains.



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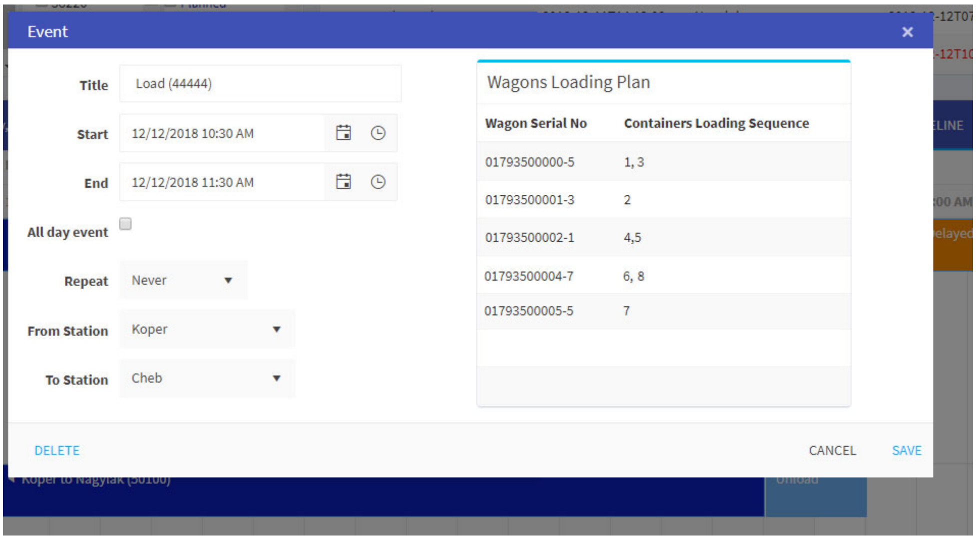

Figure 5: wagon loading optimiser

2.4 Business Impact

The solutions delivered transformed the visibility of containers within the rail freight system, keeping interested parties updated and dramatically reducing the need for ad hoc and manual communication.

The rescheduling tool improved the effectiveness and efficiency of the mitigating action taken in response to delays, reducing the time and resource expended on re-planning by at least 10%.

Improved visibility and response capability improved the utilisation of capacity and resources, improving the utilisation of available wagon sets by 15%.

The improved communication and faster re-planning reduced the time lost to delays at terminals by 10%.

Perhaps most significantly, the improved service improved the use of rail, generating more revenue for the rail system. The new ETA prediction capability that allowed for correct prediction of delays and trigger automatic rescheduling utilised what would have been idle wagon-sets, increasing the rail capacity and loss of traffic to road. Therefore, the subsequent modal shift from road to rail was estimated to reduce CO_2 emissions per container by 10 to 20%.

3 Conclusions

3.1 Lessons learnt for future development and implementation

The SELIS solutions went through extensive and iterative process of testing and revision, and the Adria Kombi recognized the business potential and value added by the new tools. The new functionality improved business processes within their control, and enhanced the service offered to customers, and as a result, they have attracted custom away from road and onto rail.

However, despite the high quality of the estimated arrival times generated by the application of machine learning, several sources of uncertainty were identified that remain barriers to accuracy. Adria Kombi plans to re-evaluate the impacts of these uncertainties to better account for these variables in the algorithms used, as part of the process of continually improving both the estimated arrival times and the machine learning that delivers it.

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3.2 Any further next steps and recommendations

The tools developed have huge potential for use across the rail freight sector. Big data analytics and knowledge graphs, both developed within the SELIS platform, proved critical in the design of the rescheduling tool, a functionality that if widely adopted could save time and resource across all rail freight networks.

The rapid and process orientated rescheduling solution allows users to model a range of anticipated scenarios, and so the application of the tool could be extended to more tactical and strategic planning.

Another selling point for wider adoption is the significant savings in CO_2 emissions per container delivered through better wagon and train utilization, and the modal shift from road to rail.

Following completion of the SELIS project, Adria Kombi plan to continue testing and improving the both the Estimated Time of Arrival (ETA) prediction algorithms, improving the recommendation produced in the wagon-rescheduling tool. Adria Kombi is confident that the time and resource lost to re-planning can be halved through further development and deployment of the rescheduling tool, even with growth in rail traffic as they attract more customers to their improved service.

4 Further questions

If you wish to ask further questions of the teams involved in this project, please contact Stephen Rinsler (steverinsler@elupeg.com), or Beatriz Royo (broyo@zlc.edu.es).

The SELIS website is https://www.selisproject.eu/

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