MIDNORDIC GREEN TRANSPORT CORRIDOR
Development project North East Cargo Link II

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Final report activity 5.5

for

NECL II

<WP 5: Logistic ICT solution for operative transport matching>

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Introduction

A logistic ICT solution (a *portal*) for matching of intermodal transports was pointed out in the former North east Cargo Link (NECL) project (2003-2006) as one of the most important issues for further development in the transport sector of the Mid Nordic Corridor. Since the end of the NECL project a prototype of such portal was developed and managed by the North East Cargo Link Association (NECLA), consisting of 63 organisations both public and private in the mid Nordic area, and the Mid Sweden University (MIUN). Further development of this portal started in this project in January 2011 as work package 5 and the activity 5.5 has ended during May 2013 according to the plan. This activity's focus was on testing the portal with real world through at least one case study. We have therefore tested with data about pellets transports provided by our associated partner Delta Terminal AB that operates two sea ports in the Sundsvall/Härnösand area and from 2014 a new built intermodal terminal for goods handling.

Purpose

The overall purpose was to further develop the ICT system through case studies with cargo owners and shippers in the mid Nordic corridor. The purpose with activity 5.5 is to verify the functionality through test in the real world.

Goal

The goal with the activity 5.5 was to verify through real world data that the portal is fully operational.

Deliverables

In the project plan the following activities was stated to be performed during activity 5.5.

- Tests and demos performed in cooperation with end users on regular basis
- Test case(s) to evaluate activity 1-4. Generality of system
- System requirements is demonstrated for other interested actors in the area and also in Russia
- Documentation and reporting of this activity

The above described activities have been delivered in time and this activity is fully explained in a scientific paper currently under review for publication in the international journal of shipping and transport logistics [1]. The system has also been demonstrated in Finland during a joint meeting with activity 4.5 in February 2013.

Result

Case study

Today pellets is transported from the port of Söråker near Sundsvall in Sweden (Figure 1) to places in the northern regions of Sweden (Figure 2).

In the example in Figure 3 the supplier want a transport from Trondheim to Tammerfors and the shipper has two transports available Trondheim- Sundsvall, three transports Sundsvall-Stockholm and two transports Stockholm-Tammerfors. All existing restrictions, for instance regarding time, can be added to the model and as indicated terminal operations can also be a part of the network. The optimization then automatic match all these things and in our case minimize cost, emissions and time aspects jointly. This is applied in our case on the network described in Figure 2.

Applying the optimization methods developed in activity 5.2 and 5.3 to this network model that today is published in [2], [3] and [4], and summarized in the final report for these activities available at the www.midnordictc.net, we receive accurate results in some seconds when rerunning the optimization nine times to generate results from the multi criteria optimization where our criteria are cost, emissions and time. This is a challenging problem since these criteria usually are in conflict to each other. This fact is depicted in Figure 4 showing that, for instance, train transports has low emissions, are slow and cost efficiency depends on the distance, truck transports are fast, comes with high emissions and cost is also here distance dependent etc.

In the prototype of the system today the weighting procedure developed in activity 5.3 and described in [1], [2] and [3] and that final report has not yet been fully implemented but it has been tested and evaluated in the optimization module (calculation core). This part is further described in the system documentation [5] that is also available at the homepage.

Pellets arrive with both trucks and trains to this port (Figure 1) but in this case we have only considered the distribution of Pellets out from this port to 8 customers with one hub on the way (Figure 2). The structure of the network is shown in Figure 3. Clearly even with a small amount of destinations there are many links between the nodes since there are many distinct transports between the nodes. Hence, in our test data we have 56 distinct possible links.

Figure 1: The port of Söråker with all four transport modes in near distance to the port

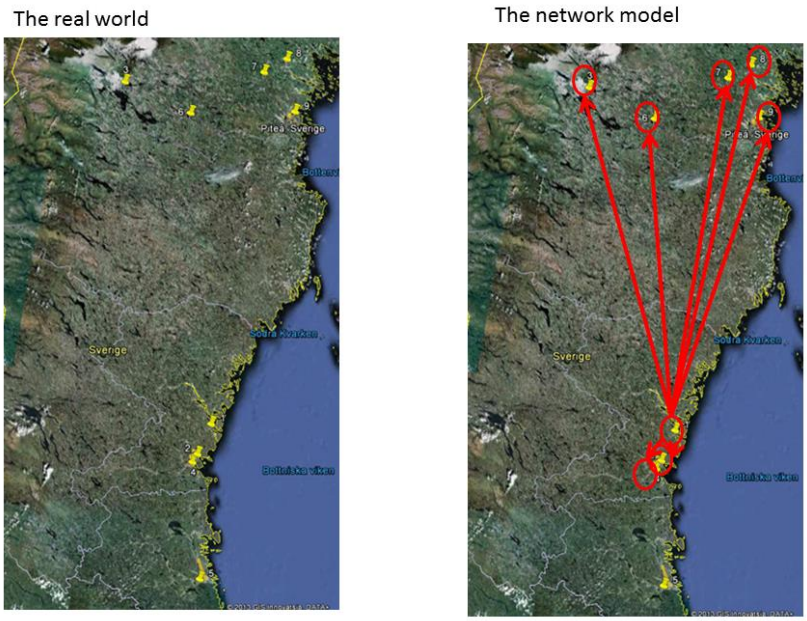

Figure 2: The real world map with some placeholders to the left indicating the nodes used in the case study. To the right the network is defined in this map

However, Pareto optimal solutions is as described in [1] swiftly received for this case. It can, furthermore, be, noted that with similar time and cost, the solutions will have low emissions. If one focuses on the minimal time, the solution will often have high cost and a high emission. In other words, cost, time, and emissions are not independent. There are various relationships between them. The positive relationship between cost and emission indicates that reduction of cost is accompanied also reduction of emissions. There are trade-offs relationships between cost and time and between time and emission, where improvements in the cost or the emission dimensions cannot occur without deterioration of the time dimension. This is due to the fact depicted in Figure 4.

The compromise between cost, time and emission should in this case be considered and saved to best meet the needs of various interests.

With respect to reaching low carbon transports in intermodal logistics, it is of concern for shippers and suppliers to be able to view emission related information and relate this to cost and time aspects when suggesting transport alternatives. The possibility to use a system like the portal in order to match shipping agents empty volume to available cargo using an automatized optimization routine enable for larger utilization of carriers and thus a more effective value chain, and using the approach with multi-criteria optimization enable for weighing emissions against other criteria. In this manner, when focusing on carbon emissions, low carbon transports that meet other requirements of a supplier can be identified. Of course, other emissions, such as nitrogen and sulphur, can be included in the model.

From the result in the real life and our analysis is it obvious that solutions that have been lost when focusing on only one single objective at a time has been found and these solutions lie on the Pareto frontier. However, since the three objectives are dependent it is very important to use multi-criteria optimization since an ordinary single objective approach will have severe issues with coping with interdependencies and the conflicts depicted in Figure 4 in a consistent manner.

A distinctive feature of the suggested approach is that the reduction of emissions can be achieved in two ways: First, by stipulating a restriction on the emission level in the optimization model and second, by selecting a desirable value on the emission in the method of ordering of solutions. This will satisfy both the shipping agent and the supplier and contribute to sustainable transport systems in the future.

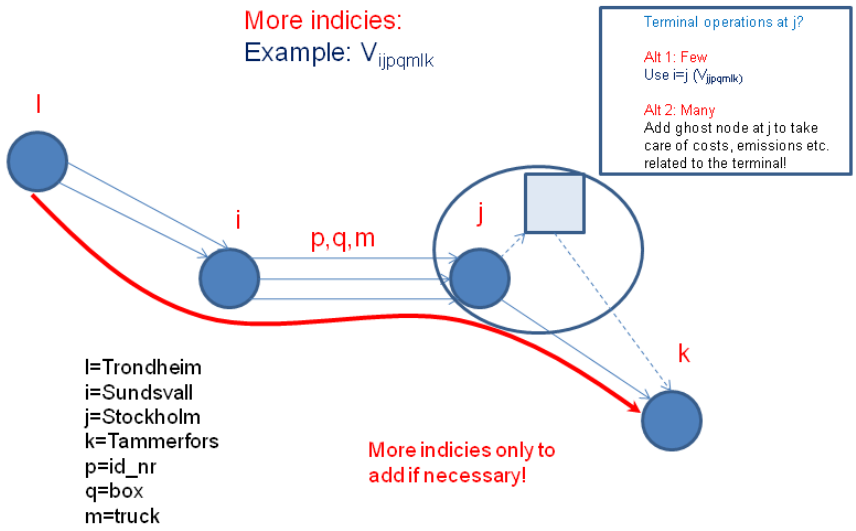

Figure 3: Visualization of the network formulation for the actual optimization problem.

Cost	High	Low, Medium	Low	Low, Medium
Time	Fast	Medium	Slow	Slow
Emission	High	High	Medium	Low

Figure 4: Different transport modes are good and bad at different criteria. Some criteria are for some transport modes distance dependent. For instance, the cost of truck transports is low on short distances but medium on medium distances and trains are the opposite. Then we can also have airplanes and vessels having their good and bad criteria in an intermodal transport system.

Documentation and reporting

Documentation has been performed

- On regular monthly basis in status reports to the project manager
- As short summary in this report.
- The case study and the multi criteria optimizations tests and evaluation are in detailed described in the scientific journal paper [1].

Discussion

According to the project plan and the purpose and goal for the activity 5.5 we feel that all parts, has been accomplished well in time. Activity 5.5 has therefore fulfilled the purpose to make the portal usable in the real world Furthermore the test indicates that the early developed model is very general and can be extended in many directions. Further improvements are currently ongoing as a part of a Master of Science student project.

During this activity no real problems have occurred.

References

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[3] Kalinina.M, Larsson. A and Olsson. L. 2013. " Easy-Interactive Ordering of the Pareto Optimal Set with Imprecise Weights," *World Academy of Science, Engineering and Technology: An International Journal of Science, Engineering and Technology(ISSN 2010-376X)*

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