MIDNORDIC GREEN TRANSPORT CORRIDOR
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Final report activity 5.2

for

NECL II

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

Author
Leif Olsson

Date	Contact
2012-06-11	Leif Olsson Ph.D in logistics Wp 5 manager, Necl II Department of Information Technology and Media Mid Sweden University SE 85170 Sundsvall, Sweden Phone: +46(60) 148886 Celluar. +46(70) 2600327 Email: Leif.Olsson@miun.se

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Introduction

A logistic ICT solution (a *portal*) for matching of intermodal transports was pointed out in the former NECL I 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 I project a prototype of such portal was developed and managed by NECLA 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 5.2 has ended in June 2012 according to the plan. This activity focused on further development of the optimization module in the portal will be presented here.

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 5.2 is that the calculations in the optimization module of the portal will perform calculations, accurate, swift and reliable.

Goal

The goal with the activity 5.2 was to further develop the optimization model in the prototype and to tailor it to a new 64-bit version of the optimization solver and test it on a sample data.

Deliverables

In the project plan the following activities was stated to be performed during activity 5.2.

1). Further tailor the existing optimization module from the prototype

2) Documentation and reporting of this activity

3). Further develop the optimization model so that it also can handle risk and uncertainty

The first two of these points has been delivered in time. The last point has been moved to activity 5.3 because it is better to develop this part after the model has been extended to cope with the conflicting objectives emissions, time and costs in activity 5.3. The two first deliverables will be described in this report and the last one will be described in the final report of activity 5.3.

Result

Further tailor the existing optimization module

The network optimization model depicted in Fig. 1 already used in the prototype developed in 2007 has been further developed and thoroughly tested using an old data set that has been extended (Fig.2).

The model consists of legs of possible transports from the shipping agents and routes that are defined by the supplier's need of transports to their customers. In this way it is possible to add all types of restrictions and costs to the model. For instance, on the legs the capacity of a transport could be added. As seen in Fig.1 there can be several legs with defined start and stop times between different nodes. The nodes define goods terminals or other places where goods is handled in some way. The details of the optimization model and all parts of this activity can be found in [1].

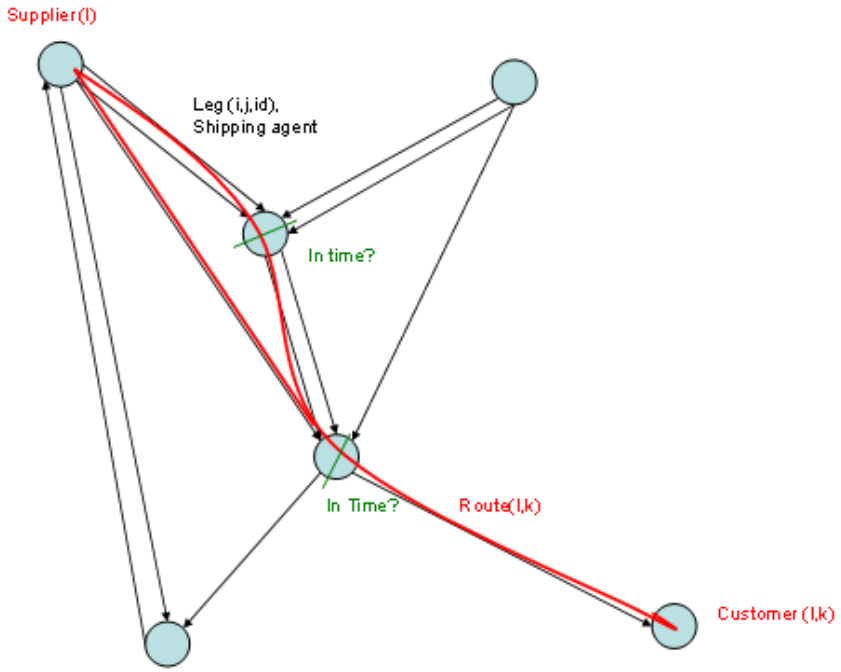

Fig. 1.The matching problem depicted as a network model.

However, this only a model and we have no idea how it works if not tested. Therefore, we developed a test case from old data (Fig. 2).

The old data is an extension of the data used when we developed the prototype first time. Back then we only considered one single transport from the supplier. However, in this new case we consider seven transports demanded by the suppliers to different customers. The number of possible transports e.g. legs has also been extended from 23 to 55. This is a more relevant test situation then the former one especially since the aim of the portal is fill up the load carriers as much as possible.

The results from the test are presented in Table 1. and this table indicates that solutions usually are achieved within some seconds on a standard PC, using standard software jointly considering cost, time and emissions. This is promising since it is very important that calculations can be done swiftly from a user point of perspective when using a decision aid of this kind. As indicated with the shortage cost the calculation also indicates if not all goods can be transported and where the problem occur as depicted in the "actual shortage" column in Table 1.

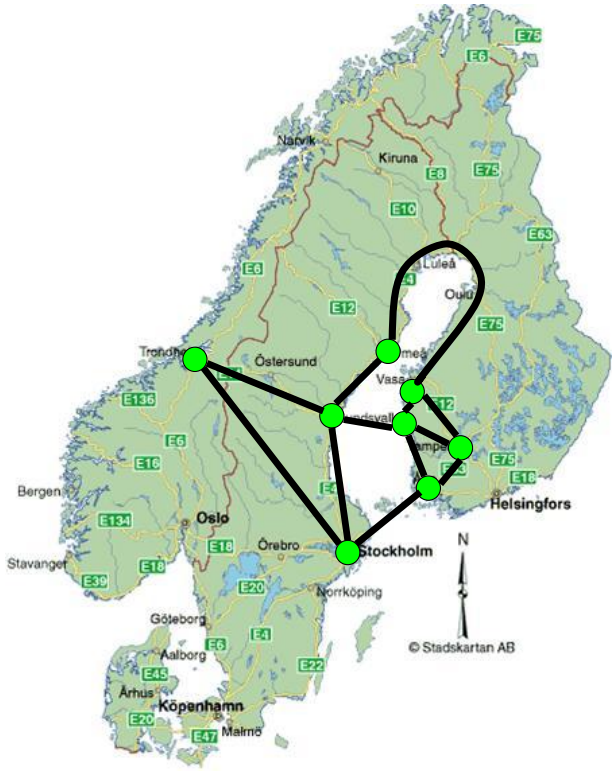

Fig. 2: Leg and nodes from the old data where legs are defined in both directions.

Table 1: Result from optimization using test data.

Total cost (SEK)	**Total time (hrs)**	**Total emissions (kg CO_2)**	**Shortage Cost (SEK)**	**Solution time example (H:M:S)**	**Actual shortage**
10 917	181	5 200	0	00:00:01	None
11 067	178	5 000	0	00:00:04	None
11 147	170,5	4 000	0	00:00:07	None
11 378	166,5	3 800	0	00:00:03	None
12 778	160,5	3 600	0	00:00:23	None
10 397	151,5	2 800	570962	00:00:40	Turku-Trondheim route not possible
11 877	128,5	2 600	570962	00:00:30	Turku-Trondheim route not possible
9 005	117	2 400	1712886	00:02:14	Turku-Trondheim and Stockholm. Sundsvall routes not possible

However, in this test case we only minimized the costs and used time and emissions as constraints. This is currently extended in activity 5.3 so that all these aspects are considered jointly using a multi-criteria optimization framework.

Documentation and reporting

Documentation has been performed for this and other activities within WP 5 on regular monthly basis in status reports to the project manager and the results are summarized in this report. The work described has also been submitted for publication and presentation at a scientific conference [1]. The

interested reader finds all the details of this activity as well as details about the optimization model in that paper.

Handle risk and uncertainty

Although this part has been discussed a lot during this activity with different stakeholders, the extension of the model to handle uncertainty has been moved in to activity 5.3 since it is better done after the development of the multi-criteria handling of costs, time and emissions.

Discussion

According to the project plan and the purpose and goal for the activity 5.2 we feel that all parts, expected for the one moved to activity 5.3, has been accomplished in time. Activity 5.2 has therefore fulfilled the purpose, to transform the old portal optimization model to a model that can be used for several transports optimized jointly. Furthermore the test indicates that the model is very general and can be extended in many directions.

During this activity no real problems has occurred and the transition of the model to activity 5.3 has also been very smooth.

References

[1] Olsson.L, Larsson.A., Matching of Intermodal Freight Transports using optimization in a decision support system, submitted to the supply chain management session at the IEEM2012, Hong Kong 10-13/12-2012, www.ieem.org, notice of acceptance 1/8-2012.

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Leif Olsson Wp 5 manager