MIDNORDIC GREEN TRANSPORT CORRIDOR
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Final report activity 5.3

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 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 5.3 has ended during September 2012 according to the plan. This activity's focus on further development of the optimization modules selection between, sometimes conflicting criteria's, will be presented here. The considered criteria's that has been weighted are for the transports cost, emissions and time.

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 5.3 is to further develop the model developed in 5.2 to handle conflicts between the criteria's cost, emission and time in an intermodal supply chain.

Goal

The goal with the activity 5.3 was a fully operational multi criteria model that automatic and swiftly gives good transport alternatives with respect a relevant weighting between emissions, costs and time.

Deliverables

In the project plan the following activities was stated to be performed during activity 5.3.

- Conflicts between aspects such as time, emissions and cost can be handled in calculations
- Solutions can be further analyzed with respect to conflicts and scenarios and with respect to uncertainty in delivery time.
- Documentation through at least one scientific paper.

The above described activities have been delivered in time and has been documented in a conference paper accepted for publication at the *the IEEE International Conference on Industrial Engineering and Engineering management (IEEM2012), in* Hong Kong at 10-12 December 2012[1].This article will be published, as well as, the paper describing activity 5.2 [2] at the time of the conference.

Result

Handling of conflicts between multiple criteria's

The network optimization model depicted in Fig. 1 already used in the prototype developed in 2007 was further developed and thoroughly tested using an old data set in activity 5.2 (Fig.2).

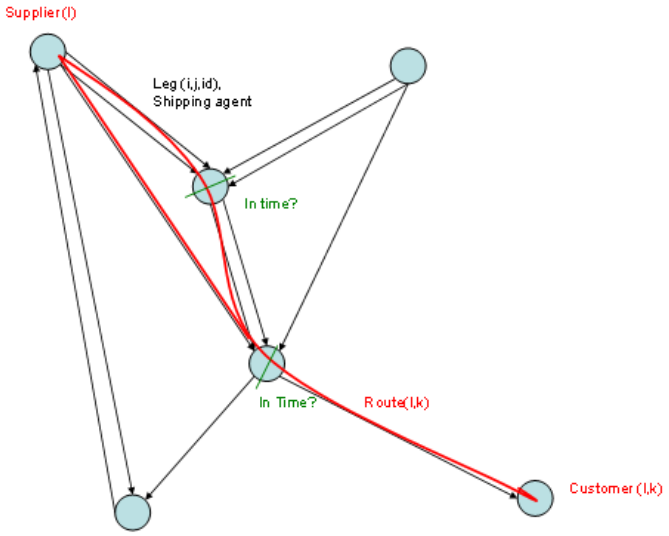

Fig. 1.The matching problem depicted as a network model.

As with activity 5.2 we used the same test data (Fig. 2) and more information about this can be found in [2] and [3]. However, the contribution of activity 5.3 was the extension to be able to, in the optimization module, automatic weight between emissions, times and costs. We also updated the optimization software and discovered that this new release of the software has features allowing for all calculation to be performed within the optimization module. Hence, the intention to have one special multi criteria module is no longer needed and this part has instead been included as an extension of the optimization model.

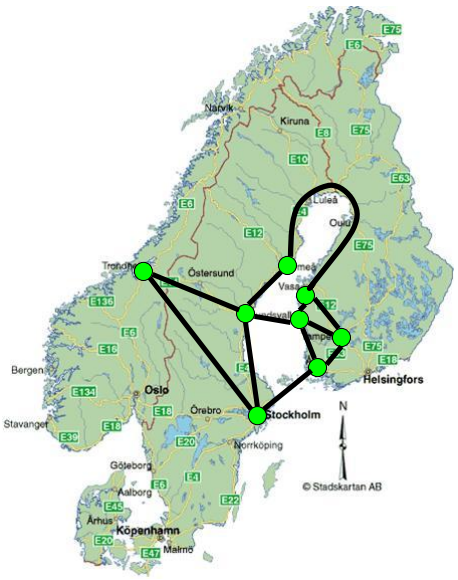

Fig. 2: Leg and nodes from the old data where legs are defined in both directions.

The results from the test are presented in Table 1. The current model uses advanced methods from the area of multi criteria decision analysis combined with optimization [4] to receive good suggestion of transports for the supplier. The technical and mathematical details are, for the interested reader, presented in [1].

In the Table 1, if we searching for three possible suggestion for transports by the supplier, the model will select solution 1, 10 and 14 in the automatic case. Of course weights will also be able to set by the supplier if he only is interested in solutions when cost is most important etc.

In this case is predefined that the most important criteria's are cost and emissions and that delivery time is only constrained to be feasible for the supplier. The first solution is therefore best with respect to cost and 14th solution with respect to emissions. A third suggestion is given by the 10th solution that is "balanced" between all three criteria's.

Table 1: Result from multi criteria optimization using test data letting the model choose the weights between the criteria's cost, time and emission.

nr	Cost	Time	Emission
1	10917	181	5200
2	11067	178	5000
3	11132	158	5200
4	11147	170,5	4000
5	11147	161	5000
6	11243	163	4800
7	11338	218,5	2800
8	11378	166,5	3800
9	11718	164,5	3800
10	12498	200,5	3600
11	12592	158,5	4000
12	12738	212,5	2600
13	12778	160,5	3600
14	12822	284,5	1600
15	12872	158	4400
16	12878	146,5	4600
17	13958	131,5	4800

Clearly these three suggestions cover the needs by the supplier that wan 't to have a first view what the differences is between the *"best for the wallet transport", "the best for the environment transport"* and a solution that seems "*okay in all these aspects".*

Documentation and reporting

Documentation has been performed

- On regular monthly basis in status reports to the project manager
- As short summary in this report.
- At the scientific conferenceIEEM2012, both the article [1] and as PowerPoint presentation.

Handle risk and uncertainty

This part has been discussed a lot during this activity with different stakeholders and is now included as a part of the model. This part has however not been tested on this example since no data were available. However, it will be tested on the real world case data in the ongoing activity 5.5.

Discussion

According to the project plan and the purpose and goal for the activity 5.3 we feel that all parts, has been accomplished well in time. Activity 5.3 has therefore fulfilled the purpose to make the model complete. Furthermore the test indicates that the model is very general and can be extended in many directions. Further model improvements will be a part of the activity 5.5 in a real world setting.

During this activity no real problems have occurred.

References

[1] Kalinina.M., A.Larsson. and L.Olsson."Generating of Ordering of Transport Alternatives in Intermodal Logistics in the Presence of Cost, time and Emission Conflicts*" in the IEEE International Conference on Industrial Engineering and Engineering management,* Hong Kong 2012.

[2] Olsson.L, Larsson.A., Matching of Intermodal Freight Transports using optimization in a decision support system, *in the IEEE International Conference on Industrial Engineering and Engineering management,* Hong Kong 2012.

[3] Olsson.L, Final report activity 5.2, published at *www.midnordictc.net*

[4] Winston.W.L *Operations Research – Applications and Algorithms, 3rd Edn*. Duxbury Press, Belmont, California, USA. 1994.

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