

# **STEMM**

## **STRATEGIC EUROPEAN MULTI-MODAL MODELLING**

### **WORK PACKAGE 9A**

#### **CASE STUDY**

## **SCAN-LINK CORRIDOR**

## STEMM

Work package 9A of Project STEMM contributed to achieving its objectives. These were:

- \* to identify and quantify the factors affecting mode and route choice for passengers and freight;
- \* to develop method methodology for modelling intermodal chains for passenger and freight transport;
- \* to apply the developed methodologies to models representing mode and route choice for European networks and particularly case studies;
- \* to utilize these models to examine and test policy instruments for increasing the use of intermodal methods of transport;
- \* to examine barriers to intermodality arising from institutional and regulatory measures

by

- \* providing data for passenger transport modelling in WP1 and WP4A;
- \* utilize the passenger transport model developed in WP1 and WP4A to examine and test policy instruments for increasing the use of intermodal methods of passenger transport in the Scan-Link Corridor;
- \* applying theoretical and methodological principles for freight transport modelling developed in WP2;
- \* **developing a European freight transport model using the STAN package as a basic tool in co-operation with WP9B;**
- \* **utilizing the freight transport model developed to examine and test policy instruments for increasing the use of intermodal methods of freight transport in the Scan-Link Corridor;**
- \* providing impact analysis results for STEMM policy option assessment in WP7.

## STEMM PARTNERS

- \* Technical research Centre of Finland (VTT), work package leader
- \* Matrex Ltd, Finland subcontractor
- \* Temaplan Ltd, Sweden, associate partner
- \* SINTEF, Norway, partner
- \* Marintek, Norway, subcontractor
- \* Institute of transport Economics, associate partner

## STANBANK IN STEMM

* No. of centroids	158
* No. of regular nodes	4422
* No. of links	13127

\* **nine (9) modes:**

- road
- rail
- truck-ferry (Ro-Ro)
- rail-ferry (Ro-Ro)
- Lo-Lo
- bulk (sea)
- inland waterway
- car & truck ferry
- speed rail (corridor)

\* **twelve (12) products:**

- Food and Live Animals
- Beverages and Tobacco
- Crude Materials, Inedible, except Flues
- Mineral Flues, Inedible, except Fuels
- Animal and Vegetable Oils, Fats and Waxes
- Chemicals and Related Products
- Paper, Paperboard and Articles of Paper Pulp
- Metal Products
- Manufactured Goods
- Machinery
- Miscellaneous Manufactured Articles
- Valuable Machinery and Manufactured Articles

**\* seven (7) different 'cost areas':**

(possibility to use different cost functions)

Finland  
Sweden  
Norway  
Denmark  
Germany  
Rest of Europe  
Russia

## COST FUNCTIONS IN STEMM

Mode and route choice depend, besides transport and handling costs, also on the level of service and interest charges on floating assets. In STEMM six factors reflected these cost:

- A. Risk of damage
- B. Reliability
- C. Price (inventory)
- D. Operating cost
- E. Lead time
- F. Frequency (only in sea transportation)

The cost factors made it possible to analyse different kinds of improvements in transportation system.

**Risk of damage** includes costs that were related to losses or damage to goods during transportation. Some modes are considered to be more risky than others. Risk in temperature controlled transportation also varies a lot according to mode. Transfers are typical places for damage to occur. In this model risk of damage was included only as a cost for transfers.

**Reliability** measures how exactly door-to-door deliveries meet planned time schedules. Long distance and many transfers are the main reasons for unreliability. For some products reliability is more important than short lead time. Reliability is measured both for links and transfers.

**Price** determines the costs for “inventory on wheels”. The interest charge concerning these floating assets is depended on the commodity group and the total transportation time for links and transfers. This cost is essential for expensive commodities.

**Operating costs** include both transport and handling costs for links and transfers.

A short **lead time** is important for certain products and it is calculated on the basis of the total transportation time for links and transfers.

High **frequencies** mean shorter lead times and usually also more reliable deliveries. In STEMM, frequency is included only for sea connections where it is very important. Several ferry and lo-lo lines have a quite low frequency.

## **COST FUNCTIONS IN STEMM**

- \* **nine (9) modes**
- \* **twelve (12) products**
- \* **seven (7) different 'cost areas'**

Maximum number of cost functions would have been **756**.  
And besides this we had **six different cost factors**.

**Lack of capacity ???**  
**Or too large project ???**

## COST FUNCTIONS IN STEMM

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**Operating cost;** FIM/tonkm or FIM/ton

**Other cost factors;** a function of the time (delay)

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9 \* 7 (=63) cost functions; one for each mode and for each 'cost area'

one cost value for an average product (metal products)

Each product (12) had a weight for each cost factor (A,B,C,D,E,F). The weight described how much it differs from the value of the average product

## COST FUNCTIONS IN STEMM

In STAN we have three function classes (the three components of the function sets). Where to put the six cost factors?

**Function class 1:** Factor D (Operating cost)

**Function class 2:** Factors A+ B + C + D (logistic performance)

**Function class 3:** Factors F + C (cost for frequency and price)

Finally, in the STAN model there were three cost functions for each mode (and for each 'cost area'), which were:

- \* operating cost function
- \* cost function for
  - risk of damage
  - reliability
  - price (inventory)
  - lead time
- \* cost function for frequency and price (only in sea transportation)

## COST FUNCTIONS IN STEMM

One cost value for an average product (metal products)

The weights for each product ?

- How to get the weights
- Where to put the weights

- The **product user data** in STAN

- User data 1 (**up1**);  $A + B$
- User data 2 (**up2**);  $C + D$
- User data 3 (**up3**);  $E + F$

- One user data consists of six digits ( XXXYYY ).

-- **Product user data 1:**

First three digits for the weight of **A** (risk of damage),  
and last three digits for the weight of **B** (reliability).

-- **Product user data 2:**

First three digits for the weight of **C** (price), and  
last three digits for the weight of **D** (operating cost).

-- **Product user data 3:**

First three digits for the weight of **E** (lead time),  
and last three digits for the weight of **F** (frequency).

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## Examples of the cost functions in STEMM

### LINKS

1) Operating cost function (factor D):

$$fl1 = \text{unit cost} * \text{length} * (\text{up2} / 1000 - \text{int}(\text{up2} / 1000)) * 100$$

unit cost = operating cost (FIM/tkm)  
up2 = weight by product

For Finnish harbour links:

$$fl8 = \text{unit cost} * \text{length} * (\text{up2} / 1000 - \text{int}(\text{up2} / 1000)) * 100 * (2 + \sqrt{4^2 * (1 - \text{voltot} / \text{cap})^2 + ((2 * 4 - 1) / (2 * 4 - 2))^2} - 4 * (1 - \text{voltot} / \text{cap}) - ((2 * 4 - 1) / (2 * 4 - 2)))$$

2) Logistic performance (factor B+C+E):

$$fl101 = \text{time value} * (\text{length} / \text{average mode speed}) * ((\text{up1} / 1000 - \text{int}(\text{up1} / 1000)) * 100 + (\text{int}(\text{up2} / 1000)) / 10 + (\text{int}(\text{up3} / 1000)) / 10)$$

time value = average time value (FIM/hour/tn)

3) Cost for frequency and price (C + F):

$$fl231 = \text{time value} * (.5 * 24 * (7 / ul1) + (ul1 .ge. 1 .and. ul1 .lt. 5) * 50 + (ul1 .lt. 1) * 100) * ((\text{int}(\text{up2} / 1000)) / 10 + (\text{up3} / 1000 - \text{int}(\text{up3} / 1000)) * 100)$$

ul1 = frequency (departures/week)

## Examples of the cost functions in STEMM

### TRANSFERS

1) Operating cost function (factor D):

$$ft11 = \text{unit cost} * (\text{up2} / 1000 - \text{int}(\text{up2} / 1000)) * 100$$

$$\text{unit cost} = \text{operaiting cost (FIM/t)}$$

2) Logistic performance (factor A+B+C+E):

$$ft111 = \text{time} * \text{time value} * ((\text{int}(\text{up1} / 1000)) / 10 + (\text{up1} / 1000 - \text{int}(\text{up1} / 1000)) * 100 + (\text{int}(\text{up2} / 1000)) / 10 + (\text{int}(\text{up3} / 1000)) / 10)) * 100 + (\text{int}(\text{up2} / 1000)) / 10 + (\text{int}(\text{up3} / 1000)) / 10$$

time = 'handling time' at transfers and at borders

time value = average time value (FIM/hour/tn)

3) Cost for frequency and price (C + F):

only for mode *bulk (sea)*

$$ft216 = \text{time value} * (100 + .5 * 24 * (7 / .5)) * ((\text{int}(\text{up2} / 1000)) / 10 + (\text{up3} / 1000 - \text{int}(\text{up3} / 1000)) * 100)$$