SAMFERDSELSDEPARTEMENTET

Norwegian Ministry of Transport and Communications

The basis for traffic evaluations and forecasts in the Barents region

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Summary

As part of the ongoing work of the Steering Committee in the Barents Euro Arctic Transport Area (BEATA), the Norwegian Ministry of Transport and Communications has studied the basis for traffic forecasting in the Barents region.

The intention has been to gain a better foundation for, and understanding of, the basis for a joint transport strategy for the Barents region.

Based on a review of the national transport models systems in Sweden, Finland and Norway, and a comparison of six selected reports on transportation in the Barents region, a tentative conclusion is that forecasts for transport demand in the region is not at yet a practical direction to work towards.

The following is proposed for the further work:

- Review the possibilities to carry out a market survey of main market players in the Barents region in order to map needs and obstacles in the transport system
- Map the technical quality/condition and capacity in the defined transport network compared to present transport flows
- Exchange and co-ordinate information about infrastructure projects and national priorities between sub-regions in the Barents region

The two former tasks should be considered followed up as part of an INTERREG-project and through further development of the BEATA GIS database.

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APPENDIX

1. INTRODUCTION

As part of the ongoing work of the Steering Committee in the Barents Euro Arctic Transport Area (BEATA), the Norwegian Ministry of Transport and Communications has studied the basis for traffic forecasting in the Barents region. The intention has been to gain a better foundation for, and understanding of, the basis for a joint transport strategy for the Barents region.

A transport plan in the traditional sense would in this case include an infrastructure investment plan for the Barents area, with forecasts for passenger and freight transport demand as a starting point. Such forecasts would form the basis for infrastructure projects, which in turn would be selected and ranked by profitability derived from cost-benefit analyses.

The critical question related to this issue is whether forecasts for transport demand is a necessary and sufficient condition for deciding infrastructure development measures in the BEATA area. What are forecasts able to – and unable to – provide of information? What are the benefits from forecasts compared to the resources needed to develop them, and at the operational level: Do we have a sufficient database for developing forecasts? Are there other, simpler methods that could provide just as good or even better background information for infrastructure decisions?

As a first approach this report compares studies describing present and expected future transport demand in the area. Regional authorities and interest groups (financed for instance through EU's Interreg and Tacis programmes) have initiated the included studies. In addition to giving an overview of approaches and recommendations regarding the transport system in the Barents region, the intention is to assess whether there are inconsistencies between the studies' estimations of future transport demand. This may prove useful in order to avoid making recommendations based on inconsistent studies and also serve as input for future studies.

Transport demand forecasts can roughly be sorted into two levels of analyses:

1) forecasted transport demand at the aggregated level, where development in key variables such as economic growth, population growth, changes in demographic structure, growth in important industries etc., result in forecasts for transport demand at a aggregated level (transport trends), and
2) forecasted transport demand based on the effects of a single measure, such as an infrastructure investment project in a local transport network and traffic analyses as part of a cost-benefit analysis, which results in forecasts at a limited, local level.

The national model system for the transport sector is a foundation for the individual countries' transport plan. The use of cost-benefit analysis at the national level is also of interest, as these analyses lie under priorities and ranking of infrastructure projects in the national infrastructure plans.

In the following, chapter 2 gives an overview of transport models and cost benefit analyses at the national level in the Nordic part of region (Norway, Sweden and Finland). In chapter 3 the selected studies of transport in the Barents region are presented and summarised. Chapter 4 points out challenges for further work in developing a transport plan for the Barents region and recommendations for further work, with focus on forecasting and alternative approaches.

1. NATIONAL TRANSPORT MODELS AND COST-BENEFIT ANALYSES

Making satisfactory transport demand forecasts in the Barents region can prove to be a major task. In order to indicate what could lie ahead if a forecasting model were to be developed, we can compare the three Nordic countries' transport plan systems at the national level. These countries (presumably) have closely related planning traditions. A comparison of transport plan systems can be of transport models or specific projects. While the former includes variables such as population, income and employment, the latter includes factors such as construction costs, time benefits and environmental effects for measuring socio-economic profitability of the project.

Forecasting transport demand in the Barents region requires an interregional transport model including all countries and modes. National transport models estimate future transport volumes and modal split at the national level, and to a certain extent at the regional level. Presently, the transport model systems in the Nordic countries vary in respect of their possibility to forecast future passenger and freight transport demand at the national and regional level.

In Sweden, the research institute SIKA has forecasted population, employment and income scenarios to 2010 and 2020, at a detailed level (app. 6 000 areas) which constitute common plan assumptions. The scenarios are consistent for the whole nation.

As part of the preparatory work of the Swedish national transport plan for the next 10 year period, a new national model for passenger travels has been developed (SAMPERS). The model is based on data from the national travel behaviour survey and includes regional, long and foreign journeys. SAMPERS is a system of models, including a model for foreign journeys, long journeys and six regional models. A specific model treats car ownership and car use.

The regional so-called PALT-model can also manage internal trips in municipalities. Trips are defined as working, business, shopping and leisure trips. The forecasting models are more uncertain at the regional level (in general they are more uncertain the smaller the analysed area). Cross-border trips are in general not included in the models.

SIKA has developed a model for freight flows between municipalities in Sweden. A model is developed which can treat foreign trade between Swedish municipalities and "the world". Foreign trade is split into a large number of product groups. In general, the forecasts for freight transportation are more uncertain than for passenger transport.

In Finland, Tilastokesus (Statistics Finland) has developed forecasts for population and employment in each of the Finnish municipalities. The forecasts go to 2030.

The transport administration agencies in Finland have together worked out a national transport model for passenger journeys. The journeys include travels made between the 450 municipalities in Finland and are based on the national travel behaviour survey from 1992. Trips are split into work, business, education, shopping and leisure. Included transport modes are car (driver/passenger), bus, train, aeroplane, walking and bicycle. In addition, local models exist for regions within the nation. There are no national models for freight transportation in Finland.

In Norway, the national passenger transport model gives detailed information of long journeys, preferred choice of transport mode, how much people travel, etc. The model is considerably less comprehensive and detailed with regard to short trips than the Swedish model, SAMPERS, while the models are relatively similar in the treatment of long journeys. The Norwegian model is unsuitable for analyses of short trips, which are requested at the local and regional level.

The national model for freight transportation is established on a data basis from 1993-95. The model is spilt into 4 groups of commodities, which for the most purposes is a too rough classification. The Norwegian model for freight transportation lacks a model for forecasting growth in the individual commodity groups.

In addition, the Norwegian transport agencies use several types of local models. The main part of the models is aimed towards certain projects and specific approaches. This causes problems comparing results and effects of measures between the transport modes. The Norwegian model system is being developed as part of the preparatory work for the national transport plan for the period 2006-2015.

Forecasts can be used as a basis for deciding new projects. Specific projects may however also be decided without prior forecasts. Infrastructure projects are often politically initiated without prior forecasting or project proposals from transport agencies. Local transport demand models are normally incorporated as part of the project assessment. There is in other words no consequent top-down thinking from aggregated forecast demand models to specific projects.

When infrastructure projects are proposed, cost-benefit analyses are undertaken as part of the decision-making process. Socio-economic net benefits are estimated in order to assess the project's isolated profitability and profitability compared to

competing projects. Cost-benefit analyses of a project show effects on factors such as environment, travel times and safety.

It is important that methods for assessing a project's profitability are comparable across transport modes. That does not imply that the applied tools have to be identical for all modes, but they must be consistent. The request for consistency between modes may among others imply use of common assumptions, a common method that secures that analyses are the same regardless of mode, and that dependencies between projects are taken into account. Cost-benefit analyses are in general not able to estimate the effects of measures in one transport sector on other transport sectors. This is especially a problem when transport modes compete for the same future passengers/freight flows.

In addition, transport administration agencies that analyse economic profitability of infrastructure investment projects may well operate with different approaches to traffic forecasts for individual (local) projects. This may also make if difficult to compare projects with regard to profitability.

The table below (Table 1) shows factors and calculation values that are used in Finnish, Swedish and Norwegian railway and road infrastructure projects. The list is not exhaustive and values are from different years, still it provides a reasonably good picture of the complexity of cost-benefit analyses. It should be noted that differences in values to some extent might reflect actual differences between countries (for instance in income), and therefor are unproblematic. Nevertheless, the table indicates significant differences in factors that are used to calculate a project's profitability as well as the values of common factors.

Differences in calculation values imply different requirements for a project's profitability. Shorter wear life length and a higher discount rate in Finland than in Sweden implies for instance that the requirement for profitability of an infrastructure project in Finland is higher than for a similar project in Sweden. As a consequence of these differences, it may prove to be a challenge to develop sound cost-benefit analyses across the four countries in the Barents region in order to rank infrastructure projects in the area.

In addition to weaknesses that already exist in transport analyses, there are specific methodological problems connected to characteristics of the Barents region, where conventional methods for forecasting and cost-benefit analyses may prove insufficient. The area is remote, relatively sparsely populated with long distances between population centres and access to vast natural resources. For historical reasons trade and transport have been somewhat restricted across the Nordic/Russian border, thus failing to provide good empirical data. The climatic conditions are also a distinctive characteristic of the area that must be taken into consideration in the context of transportation. In the end, proposed infrastructure projects in the Barents region will compete with other national projects where needs are more obvious and seem more precarious and where effects of the project's socio-economic benefits presumably are easier to measure.

Summing up…

- There are no overall applied methods for forecasting and profitability assessment of infrastructure projects in the countries in the Barents region. National transport model systems and methods for cost-benefit analysis do not only differ between countries, but also between transport administrative agencies within countries.
- Passenger transport models: Swedish and Finnish national models include regional models. In Norway a new model system is to be developed in which regional models and foreign transports are integrated.
- Freight transportation models: The Swedish model system includes foreign freight transports between municipalities and “the world”. Foreign trade is divided into a large number of product groups. Forecasts are less precise than for passenger transport. Norway and Finland do not have sufficient transport models for forecasting freight flows.
- Cost-benefit analysis: Differences in methods imply among others that the countries in the Barents region have different requirements for an infrastructure project's profitability.

Table 1: Factors and estimation values in cost-benefit analyses by country. Railway and road projects. Swedish kr (SEK)

Factor:	**Railway – Sweden**	**Railway - Finland**	**Railway – Norway**	**Roads – Sweden**	**Roads – Finland**	**Roads – Norway**
Discount rate	4 %	6 %	4 % *	4 %	6%	5% *
Wear life length	60 years	30 years	40-75 years	40-60 years	20-30 years	40 years
Tax factor	I: 1,23 II: 1,3	-	1,2	I: 1,23 II: 1,3	-	1,2
Accidents:						
Death	14,3 mill. SEK	-	20,1 mill. SEK **	14,3 mill. SEK	13,0 mill. SEK	20,1 mill. SEK
Serious injury	2,6 mill. SEK	1,43 mill. SEK	6,0 mill. SEK	2,6 mill. SEK	1,39 mill. SEK	4,6 mill. SEK
Light injury	150 000 SEK	-	600 000 SEK	150 000 SEK	133 000 SEK	600 000 SEK
Material damages	13 000 SEK	67 000 SEK	18 000 SEK	13 000 SEK	66 400 SEK	18 000 SEK
Air emissions:						
Nitrogen oxides (NO_x)	109 SEK/kg	-	33 SEK/kg in densely populated and 66 SEK/kg in scattered populated areas	109 SEK/kg	7,4 SEK/kg	Depends on the level of reduction of emissions (50% reduction is worth 60000 per disturbed person, e.g.)
Carbon dioxide (CO_2)	1,4 SEK/kg	0,27 SEK/kg	0,37 SEK/kg	1,4 SEK/kg	0,26 SEK/kg	Internalised in gasoline taxes
Particles	700-7600 SEK/kg	-	0- 1 700 SEK/kg depending on population density	700-7600 SEK/kg	134 SEK/kg	Depends on the level of percentage change in emission (50% is worth 13000 per disturbed person)
Traffic noise:	Depends on indoor noise level and number of trains pr day	7 100 SEK/prs/year	9 800 SEK per person disturbed by traffic noise above 55 dBA	Depends on traffic noise level 50-75 dBA 0-5500 SEK/prs/year outdoor 0-8300 SEK/prs/year indoor	7500 SEK/prs/year 55-65 dBA, 33% annoyed by noise 65-70 dBA, 50 % annoyed by noise 70- dBA 100% annoyed by noise	Depends on the level of percentage change of noise (50% is worth 17000 per disturbed person)
Value of time - passenger traffic:						
Private trips	35-70 SEK/h depending on length of trip	8-14 SEK/h depending on errand	26 and 66 SEK/h for trips below and above 50 km respectively	35-70 SEK/ h depending on length of trip	68,1 SEK/h/vehicle	51,1 and 73,1 SEK/h/vehicle for commuting and leisure trips respectively
Business trips	110-190 SEK/H depending on transport mode	178 SEK/h	112 and 127 SEK/h for trips below and above 50 km respectively	110-140 SEK/h depending on length of trip	68,10 SEK/h/vehicle	171,2 SEK/h/vehicle

* The discount rate consists of a risk-free rate (3,5 %) and an additional risk component (in the range 0,5 and 4,5 %). For large projects, it is recommended that the risk component should be estimated separately.

** 1 NOK is assumed to be equal 1 SEK (in 1998/99)

2. SELECTED STUDIES OF TRANSPORT IN THE BARENTS REGION

2.1 Brief review

Six reports that deal with existing and future transport in the entire or parts of the Barents region are reviewed as part of this project. In general, the studies are thorough and based on empirical studies, and they all include recommendations regarding the transport system. The following reports are reviewed:

1. The Tacis North-West regional transport development project (1998)
This project is primarily a regional transport model development project. The study area is Northwest Russia. The report provides a comprehensive documentation of regional transport demand and factors that may influence transport demand, including macro economic and regional factors.

Focus in the study is freight transportation (passenger air transport is however included). The study presents surveys and analyses of existing transport flows for the respective transport sectors (including inland waterways) as well as commodity studies. Forecasts are made for potential growth of the economy and future transport flows are predicted.

2. Transport analysis of the Barents region (1999)
The Communications Group under the Barents Regional Council has conducted this report. It presents a "Barents Regional Transport Network" with links crossing national borders. The basic network interconnects the most populated areas within the Barents region.

The report is among others based on 3 comprehensive studies carried out by the Norwegian research institute SINTEF (one study of common conditions for analysis of passenger and cargo transportation in the Barents region and two sub-studies for passenger and freight transportation). The basic idea has been to identify a long-term transportation demand potential of the region in order to support a step-by-step infrastructure development.

3. Masterplan för logistik och infrastruktur på Nordkalotten (2000)
The Masterplan for Nordkalotten (northern parts of Finland, Sweden and Norway) is a project carried out within the framework of EU's structure program INTERREG IIa. The starting point of the plan is the manufacturing industry, and primarily the basic industry's needs. An object of the Masterplan is to create a dynamic area for co-operation between market players and authorities and a tool to enable an optimisation of goods transport solutions to and from this region.

Five (land- and sea-based) transport corridors are presented and proposed developed. The report describes present and expected transport flows in the area. Expected transport flows are estimated based on information from the largest companies in the area of expected production within the next 5-6 years (after 2000). Another main

assumption for indicating future transport infrastructure needs, which is regarded far more uncertain, is expected changes in the industrial structure.

4. The Bothnian Arc – communication system (2000)
The Bothnian Arc-Crossborder Co-operation in Spatial Development is an umbrella project and includes 3 separate sub-projects financed by the Interreg IIC-programme. This specific project deals with the interregional communication system in the region surrounding the inner part of the Gulf of Bothnia (Sweden and Finland). Focus is primarily the present situation for communications (transport, IT, telecommunications) and possible future changes. A main initial task for the project has been to define a preliminary vision for the communications system and main areas for continued planning.

In the continuing work, the aim for development is to offer transport connections and services in order to develop the regional structure, trade and industry and mobility for the population in an economic and sustainable way. A further aim is to develop transport policies within the entire area independent of national borders.

5. Communications between North-Norway and Northwest Russia (2000)
Finnmark County, in co-operation with Troms and Nordland counties, has worked out this report, which includes a strategy and action plan for communications between North-Norway and Northwest Russia. The main aim is to develop the potential for improvement that exists in present companies and infrastructure. A further aim is to reveal obstacles caused by framework conditions and propose solutions.

The potential for transport is regarded as significant, and transport volumes can, according to the report, increase as soon as the overall transport structure and economic conditions permit it. Critical assumptions underlying this conclusion are that existing transport flows are redirected and a positive economic development in Russia. According to the report, the railway from Narvik to Kiruna (the Ofot-line) does not have enough potential for transports between North-Norway and Russia. It is instead recommended to connect the Russian railway network from Nikel-Murmansk to the port in Kirkenes (Finnmark County) and develop a larger port.

6. East-West transports – Northern Alternative (2001)[1]
The international railway union has initiated this report, which is carried out by a consultant firm in Narvik in Nordland County. The project idea is to evaluate a container based and inter-modal transport route connection between the North-American East Coast and Central Asia via the Atlantic Ocean, inter-modal ports in Northern Europe (Narvik) and the railway network towards Eastern Europe and Asia.

The presented market area includes 16 countries. The report describes the new corridor and estimates potential container based transport volumes to and from three

[1] The final report was presented at The International Transport & Logistic Conference "More Effective East-West Transports" in Narvik, 9th-10th Oct 2001.

main market areas (North-American East Cost, Nordic countries and Russia and Asia). The corridor is compared with alternative (present and possible) corridors with regard to transport distances, transport times, price levels and quality – all assumed important criteria when choosing transport routes.

The report is concluded with a review of the northern alternative’s advantages, challenges and obstacles, as well as an evaluation of the alternatives, a business model and an action plan.

In Table 2 below the reports' main features are summarised. A more exhaustive presentation of the reports can be found in Appendix 1.

Table 2 Studies in the BEATA area - main features

	TACIS	MASTERPLAN	UIC (N.E.W)
Transport sectors	All	All	Sea and rail
Study area	Region (Northwest Russia)	Transport corridors (existing)	Transport corridor (new)
Number of countries	1	3	16
Type of transport	Freight transportation, air passenger transport	Freight transportation	Container based freight transportation
Applied method	Analyse the economy at the macro level, deduce main trends and likely transport trends Review regional economy, develop transport demand model Make forecast on the potential economic growth and predict future transport flows	Actual and expected transport flows – information form the largest companies in the area Expected changes in industrial structure Factors relevant for company's choice of transport corridor	Population and GNP per capita in market area Estimated transport volumes Illustrate container based cargo flow in and within the corridors Describe factors important for company's choice of transport corridor
Recommendations	Rail: Link Archangels-Komi-Perm, maintenance Road: Maintenance Air: Reforms, spoke-hub-system, re-open/re-locate small airports Develop inter-modal facilities	Develop existing railway, especially around the Gulf of Bothnia Improve road system (maintenance). Road link north-south Norway and west towards Lofoten Co-ordinate sea transport in the Gulf of Bothnia Develop the Atlant corridor Develop (concentrate) terminal system Improve framework conditions	Compare new corridor from US over Narvik port to Russia and Far East with alternative corridors regarding: - transport distances - transport time - price level -quality

Table 2 Studies in the BEATA area – summary (continued…)

	BARENTS STUDY	COMMUNICATION	BOTHNIAN ARC
Transport sectors	All	All	All
Study area	Barents region	Region (Norway/Russia)	Region (Finland/Sweden)
Number of countries	4	2	2
Transport type	Passenger and freight transport	Passenger and freight transport	Passenger and freight transport
Applied method	Gross domestic product (GDP) and population as variables to estimate future potential for transport Data for freight and passenger transport flows Gravity model calculations to estimate present and future regional transport flows	National statistics Collected data from interviews (market players, local authorities) Previous studies of transport and future potential flows	Description of present transport, planned measures, involved organisations and institutions Overall description as an upstart for further work
Recommendations	Establish a Barents Regional Transport Network Develop nodes and links in priority corridors Reliable and cost-effective cross-border transport services Establish a heavy freight network with access to major ports and railway systems Interconnect national airline networks within the region Improve cross-border public passenger transportation	Develop E6 through Norway Develop air traffic and airports Extend the Russian railway to Kirkenes port Develop the maritime sector, expand Kirkenes port Improve framework conditions System improvements (border passing, customs procedures, safety)	Improve main road network. E4 and E75 road connections New coast railway Sundsvall-Umeå-Luleå-Haparanda Gauge system between Finland and Sweden Improve public transport, terminals and ports Define transport policies independent of national borders

2.2 Transport and future transport demand in the studies

The reports that have been reviewed show that studies of the transport system in the Barents region vary significantly with regard to geographical areas that are analysed. Study area is in some cases the Barents region, but mainly a part of the region is analysed. This also has to do with the fact that some of the reports focus on transport corridors rather than specific regions.

A common feature in the reports is a main focus on freight transportation. In addition, expectations of the future market development are often based on information from local authorities and important companies in the region. The studies are to a large extent supply-side oriented in the sense that while projects and measures in the present transport system are proposed, the demand side – and especially future transport demand, has been difficult to observe and estimate. The main problem is to provide data that is needed in order to analyse trends. Uncertain future economic conditions, lack of historical data for cross-border transport flows and comparable data between countries result in severe difficulties in indicating future transportation demand.

Historical data for transport used as a basis for conventional transport analysis will according to some of the reports conclude that infrastructure investments in the area are unprofitable. It is however in any case assumed to be a potential for increased transport demand. The Tacis project and the transport analysis of the Barents region have collected data to estimate future transport demand. The Tacis project seeks to establish a regional transport model as a basis for forecasts – this is however a project within national borders (Russia). The forecasts are based on possible sets of macro-economic growth weights for the national economy and individual commodities that are typical for the industries in the area. One of the main problems that is reflected in this report is the uncertainties of future economic development, which in turn makes it difficult to estimate future transport trends. The analysis of the Barents region reveals on the other hand major data problems. In an effort to analyse transport flows between the sub-regions in the area – only approximately 25 percent of the basic data is retrieved. According to the empirical studies done for this report, the presented forecasts include so many uncertain conditions that they must be regarded as illustrations of possibilities for the future development.

Data problems start at the macro level. A commonly used measure for economic development, GNP, is for instance not always sufficiently comparable between countries. Furthermore, it is difficult to find sufficient historical data for cross-border transport within the Barents area, between the Russian and Nordic parts. Data for traffic counts from Nordic countries over the Russian border in the Barents region are in addition based on different types of surveys and not directly comparable. To a large extent, different data sources result in difficulties establishing models that can be used to forecast interregional transport demand. The quality of cross-border traffic data (counts) that has been collected is highest for road transport, for the other transport modes they are either naturally non-existing or of poor quality.

In one of the reports, transport volumes are estimated by adjusting national statistics to indicate the maximum potential based on transport in competing corridors. These statistics are combined with interviews of large companies regarding transported volumes. A commonly used method in the reports is interviews with important companies and local authorities. In addition to information about actual and planned production, interviews are used to reveal technical and administrative obstacles as well as logistical requirements. It is also reflected that infrastructure planners have too little knowledge of the industries' needs.

The recommendations in the reports for developing infrastructure are to a large extent general. A common reflection is that there is no obvious need for investments in new road connections. Maintenance of and/or removing missing links on the existing road and rail network, removing border barriers/technical barriers are on the other hand often mentioned as important measures. The studies to a very limited extent point out specific infrastructure projects. Examples are to build out the missing links on the railway Archangels-Komi-Perm and extend the Russian railway to Kirkenes port in Norway. On the other hand, it is frequently recommended measures directed towards removing administrative and technical barriers at border-crossings, to harmonise transport policies and regulations, to establish nodes, concentrate terminals and improve co-operation across borders. These are measures that would simplify cross-border transports and are suggested in order to encourage and increase transport demand, rather than being measures that reflect expected future transport demand. The benefits from such measures are connected with far lower costs than the larger infrastructure developments.

4. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

In the previous chapters, a general overview of the status for national transport model systems and economic valuations of projects, as well as studies of transport demand in the Barents region has been presented. The selected reports show large differences in choice of geographic area that is studied. They also differ with regard to approach, to whether they address the issue of future transport demand and if so, how future transport demand is estimated.

Only two of the six reports have used models to forecast future transport demand. One of these reports deals with transport flows within one country. The other one, dealing with the 8 sub-regions defining the Barents region, concludes that the forecasts only can be used as indications of future possibilities. This is due to a number of uncertain conditions, such as poor data quality and missing data. A main problem is the absence of data for traffic flows across borders.

The other reports have to a large extent based their recommendations on existing infrastructure. The infrastructure is viewed as a transport network or as corridors linking the countries in the region. Recommendations are directed towards optimising the basic transport network or corridors through concentration of main terminals, developing missing links in the network and reducing cross-border barriers. In the absence of data for future transport demand, theses studies are mainly supply-side oriented, based on perceived problems in the existing transport system.

The reviewed reports provide information that should be considered in the discussion of which direction to choose for the further work of developing a joint transport strategy for the Barents region. An important question is whether developing comprehensive forecasting models of transport demand in the Barents region is feasible and necessary as a starting point. In should be questioned whether there are alternative approaches that are simpler, but just as useful.

The discussion of choice of approach should be related to which data we are in possession of and costs related to obtaining new data. The empirical studies in the reviewed reports indicate a common challenge in that respect: Lack of data per se, of historical data and of comparable data for the area. A major challenge in developing transport demand forecasts is in other words first to work out relevant, comparable data for the defined area.

One of the main issues in the Barents region is transport across borders between the Nordic countries and Russia, formerly restricted through political reasons, inadequate border crossing facilities or missing infrastructure links. It is difficult to estimate transport trends across borders when historical data are inadequate or non-existing. In addition, predictions of economic development are needed for forecasting. While the use of historical data is difficult due to comparison problems across countries, the uncertain development of the Russian economy makes if

difficult to predict future transport flows. Transport demand models and forecasts cannot solve these problems.

The review of the national transport model systems in the Nordic countries show that part of the data input in forecasting models is of travel behaviour. Travel behaviour surveys include collecting data on travel activity and behaviour for passengers, as well as for type of cargo for freight operators, and includes all modes. If forecasts for transport demand were to be developed, travel behaviour surveys would have to be carried out that cover the entire Barents region, split into local zones (with for instance municipalities as geographical units). This would be a complicated and expensive task, as it involves four countries. It is difficult to see the purpose and desirability of putting so much efforts and resources into establishing a comprehensive forecast model for transport demand.

A tentative conclusion is therefor that developing a model for forecasting transport demand is not as yet a practical direction to work towards, and that alternative approaches could be more rational.

An alternative approach could be to combine present transport flows/traffic counts with the mapping of technical standards and quality of the existing transport network. Special focus could be made on cross-border transports. This would provide information of possible mismatches between infrastructure standards and present transport flows. Combined with a market survey of needs and obstacles as perceived by trade and industry in the Barents region, this could reveal important information for future infrastructure decisions.

Geographic information and network data is already collected through the work with the BEATA GIS database. Among others, this database contains information of transport volumes and road standards in the defined backbone transport network in the Barents region. Refinement of the GIS database will provide important data for the alternative approach, especially for cross-border transports.

A market survey of central market players and local authorities could provide additional information about needs and imperfections in the transport network. The recommendations in the reviewed reports seem to some extent influenced by local interests. This is understandable, since it is of vital importance for the areas in the region to attract transport flows to their area, in order to secure future growth and prosperity. Subjective and possibly biased information may in any case be a problem.

In order to avoid local strategies and interests from being predominant it should however be considered to carry out a market survey of trade and industry in the Barents region initiated from a "neutral" level. In other words, the national level should either be responsible for, or heavily involved in, the project. This would in addition secure necessary links to the national transport plans. A research institute, not the involved parties, should carry out a market survey. A possibility is to carry out a market survey as part of an INTERREG project.

Another possibility that can be combined with the above mentioned approach is to compare individual infrastructure projects between the countries in the Barents region. Co-ordinating projects and national priorities may be an important measure in order to reveal connections and missing links in the interregional infrastructure. Basically, this requires that infrastructure planners exchange information across borders in order to co-ordinate national priorities.

Recommendations:

- Review possibilities to carry a market survey of main market players (trade and industry) in the Barents region in order to map needs and obstacles, for instance through an INTERREG project.
- Map the technical quality/condition and capacity in the defined transport network compared to present transport flows (BEATA GIS database)
- Exchange and co-ordinate information about infrastructure projects and national priorities between sub-regions in the Barents region

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APPENDIX

1 SELECTED STUDIES - APPROACH AND METHOD

As a basis for comparison, the following six reports are reviewed:

- The Tacis North-West Regional Transport Development Project (1998)
- Transport analysis of the Barents region (1999)
- Masterplan för logistik och infrastruktur på Nordkalotten (2000)
- Bottenviksbågen – Kommunikasjonssystem (2000)
- Kommunikasjoner mellom Nord-Norge og Nordvest Russland (2000)
- East-West Transports – Northern Alternative (2001, preliminary report)

The reports cover all or parts of the Barents region, and are in general thorough and based on empirical studies. With one exception (Tacis), they are all based on a study of more than one country. The Tacis report is on the other hand the only report that has a thorough analysis of conditions for and analyses of transport in Northwest Russia. In the following, a brief summary of the reports is presented. Focus is approach and study (geographic) area, applied methods and final recommendations/ conclusions.

1.1 The Tacis North-West Regional Transport development Project

1.1.1 Approach and Study area

The Tacis project is primarily a regional model development project. The report provides a thorough documentation of regional transport demand and factors that may influence transport demand, including macro economic and regional factors.

The area studied in the project is the Northwest region of Russia, and includes the regional administrations (Subjects) of Archangels, Vologda, Murmansk, Novgorod, Pskov and Leningrad Oblasts; the Republics of Karelia and Komi; and Nenets Autonomous Okrug.

Two economic regions differentiate the Northwest region. The Northern Region, comprising the Republics of Karelia and Komi, Archangels and Murmansk Oblasts and Nenets autonomous Okrug is resource-rich, but thinly populated. In contrast, the Western region comprising Leningrad, Pskov, Novgorod and Vologda Oblasts, displays a more varied industrial infrastructure, with much higher population levels. The study area was split into these two economic regions. The Northern region is of interest in our project, comprising the Russian part of the Barents region.

1.1.2 Applied methods

The Tacis report focuses mainly on freight transportation (passenger air transport is included). The study provides analyses/surveys of existing transport flows for the respective transport sectors (including inland waterways) and product studies.

The studies are carried out in close co-operation with local experts, who particularly have contributed towards the analyses of existing transport flows in each of the transport modes, individual studies of particular products and the running of computer transport demand models.

The review of the regional economy and main productive activities in each Subject is based on questionnaires, visits to the Subjects, data collected from statistical handbooks from the Subjects, national statistics publications and reports from international agencies.

Further transport data was collected from various sources, including freight origin-destination (O-D) flows for railway divisions and for inland waterway network, and border crossing transport flows. Information on road OD-data does currently not exist in Northwest Russia. The study team carried out a computer simulation exercise based on the observed relationship between Gross Regional Product per capita and generated road transport (in tons) for each Subject of the Russian Federation (from Goskomstat data). The resulting generated road tons were calibrated using border crossing data and some limited traffic counts.

A review of macro economy and transport trends, regional economy and main economic activities is carried out in the study. This provides an understanding of the relationship between economy and transport activity in the Russian Federation in full and in Northwest Russia. Profiles were developed for each Subject in order to indicate important economical characteristics. Studies of important commodities transported on the transport network were also carried out, leading to forecasts for potential growth relative to domestic and international demand.

Alternative sets of growth factors were applied for forecasts of future freight traffic. Two sets were adopted; a high economic growth (6 percent growth rate in annual GDP) and a low economic growth (3 percent growth rate), reflecting general macro trends and potential demand for individual commodities. Growth rates for the national level is assumed representative for Northwest Russia.

With this starting point future transport flows were estimated to the year 2016. Possible future developments of the transport infrastructure has not been included in the forecasts, this is seen as an issue for further, more detailed studies. The investment potential for infrastructure within the two defined economic regions is for the Northwest region expected to follow existing patterns, with a continued exploitation of nature resources in the northern region (oil and gas, mining and forest), and for the western region "light" industry, consumer goods, cars etc.

For each commodity that has been studied (coal, metals, oil products, forest etc) future domestic and international demand forecasts have been estimated. In general

the demand for some products (such as oil) is expected to increase faster than average national economic growth, among others because of an expected strong export demand. For other products lower growth is expected (such as coal, ore), among others because of substitution of energy sources, environmental considerations, while others are expected to follow the national growth rate.

From interviews with actors in the industry, a main problem identified was delays in customs declarations (e.g. often between 7 and 21 days in St. Petersburg port). This is believed to be the most significant factor for diversion of containers via the neighbouring ports of the Baltic States and of Finland.

The methodology and approach in short is as follows:
- Review existing policies for the development of the general economy and transport (both federal and Subject level).
- Analyse the economy at the macro level and, from this analysis, deduce main trends in the economy and the likely impact on transport (transport trends)
- At the Subject level, review the regional economy and main economic activities
- Collect data on the characteristics of the existing transport network, including the identification of transport bottlenecks
- Collect data on the main freight flows and classify by origin-destination movements. This information, together with the transport system characteristics, forms the main components of the transport demand model
- Make forecasts on the potential growth of the economy (growth factors) and, based on this, predict future transport flows. These future transport flows are then checked, for consistency, with the results of the analysis of general transport trends
- Using a computerised model, present both existing transport flows and flows for the future years (2000-2006, 2006-2016).

The report highlights that forecasting transport demand is a difficult process. Given the current uncertainties inherent to the Russian economy, the economic growth forecast approach is seen as the preferred method.

1.1.3 Recommendations /conclusions

The report has general recommendations and proposed measures. Studies to identify these measures are regarded as a necessary requirement. According to the report:

- There is no greater request for any extension of the railway network. In year 2016 the rail traffic is expected to be back to the level for traffic seen in the early 1990's. One exception is the Archangels – Komi – Perm railway, which will provide for two missing links in the rail infrastructure. Maintenance, good business plans and modernisation of rolling stock is seen as a main priority for this transport mode.
- Potential capacity problems on the road network are only in the area of St. Petersburg and Corridor no. 9. For most other roads it is considered unlikely to be a need to upgrade or extend the road network for a time ahead. Maintenance continues to have high priority.

- Major organisational reforms in the air transport sector and financial constraints regarding planned re-opening of some local airports in the region makes it difficult to assess the future condition for this sector. However, given the forecasts for passenger and freight flows, air transport will remain important in the future, due to long distances in Northwest Russia and the need to maintain access to more remote areas. It is recommended to consider developing a spoke-hub system, i.e. smaller airports feeding international airports within the region. Re-opening or re-localising smaller airports should also be considered. Airport equipment needs to be modernised for safety reasons.
- The possibility for road transport to increase at the expense of rail (like the trends in the West) has implications for both environmental considerations and traffic congestion within cities. It is recommended to give high priority to develop good inter-modal facilities in order to maximise the use of railway, while road transport to a larger extent should be used for distribution purposes.
- Capacity limitations and possible future transport movements indicate that the facilities in St. Petersburg port, which are adequate today, may need to expand in the future. This should be considered in relation to competing efforts in the ports in the Baltic States and Finland in order to retain existing and attract new transit traffic.

1.2 Transportation analysis of the Barents region

1.2.1 Approach and Study Area

The Communications Group under the Barents Regional Council conducted a comprehensive transportation analysis of the Barents Region in 1999. The study area is Norrbotten and Västerbotten Counties, Finnmark, Nordland and Troms Counties, Lapland, Northern Ostrobotnia and Kainuu Counties, Archangels, and Murmansk Regions and the Republic of Karelia.

In the report a "Barents Regional Transport Network" is presented with links crossing national borders. The basic network interconnects the most populated areas within the Barents region, and comprises the following links:

- Kirkenes-Murmansk and the Northern Sea Route.
- Gulf of Bothnia-Murmansk, connecting the northern coastal areas of Sweden/Finland with Russia
- Gulf of Bothnia-Achangel connecting the northern coastal areas of Sweden/Finland with the Archangel Region
- Gulf of Bothnia-Narvik, connecting the northern coastal areas of Sweden/Finland with northern Norway
- Mo i Rana-Umeå-Petrazavodsk, also named The Blue Road

1.2.2 Applied methods

The report is among others based on three comprehensive studies carried out by the Norwegian research institute SINTEF. The main study covers common conditions

for analysis of passenger and cargo transportation in the Barents region, while the other two are substudies for passenger and freight transport. They are based on five major topics that the Communications group identified to be analysed particularly with regard to future transportation demand: Forestry and forest industry, ore and mineral mining and processing industries, transportation in the energy sector, freight transportation and distribution for manufacturing and trade and finally, passenger transportation.

The starting point is that almost all transports in the Barents region are organised in each country on a primarily north-south basis, where cross-border transportation is rather difficult at the regional level. The basic idea is to identify the long-term transportation demand potential of the region in order to support a step by step infrastructure development that will meet both present and short-term demand, as well as being capable of a developing rationally along with the region in a long-term perspective.

The main background report presents common conditions for analyses of future potential for transport of general cargo and passengers in the Barents region. The level of transport is assumed closely related to the economic activity in the area. Variables that are used in the analyses are population and Gross domestic product (GDP) per capita. GDP is used as a common indicator for economic activity in the area.

The report presents the sosio-economic situation in the eight regions in the Barents region. The quality and quantity of information presented varies among the regions. Data for the national level is used to estimate regional data. Regional differences are assumed constant over time.

Scenarios for development of population and GDP in each region are used as a basis for the analyses of future transport potential for passengers and freight transport. The scenarios are developed using historic developments and forecasts for demographic rates and population (data from US Census Bureau) for the period 1950-2050. At the regional level in Russia population forecasts for the nation level is used for Karelia, Archangelsk and Murmansk. Assumptions are made for migration. In the Nordic countries, the population is assumed to be stabile, developing equally to the period 1960-1994.

It is noted comparison problems between Eastern and Western Europe due to different definitions of GDP. The reports states a major statistical problem in Russia, among others because of assumed underreporting from companies for taxation reasons. Different sources show large differences in forecasts for Russian GDP. GDP at the national level is therefor uncertain. What the sources have in common is that they all expect increased GDP from 2 to 5 per cent after 2000. Based on observed forecasts it is assumed that GDP in Russia in 2000 has increased to 80 per cent of the level in 1989, in 2005 to 100 per cent of the level in 1989 and after 2005 an increase of 2 percentage points annually. The Nordic countries are expected an increase of 1 percentage point in GDP annually.

In the report on freight transportation, gravity model calculations are used to estimate present flows and future regional general cargo flows for three scenarios. The scenarios are based on alternative assumptions for economic development and border barrier levels. A description of development of internal transport corridors and corridors to outside markets is outlined. A more detailed study of present general cargo flows and traffic, emphasising the Russian subregions, is also presented. Effective logistic organisation in all links of the transport chain is seen as an integral part of modern enterprise economics. The report outlines a scheme for logistic requirements to be covered for adapting a competitive environment for trade and emerging manufacture based in the Russian parts of the region. The requirements depend upon product and production qualities. A description of present conditions is included in the report.

In the analysis, statistics from several sources are used, and estimations are based on a number of assumptions. The level and structure of the future cargo flow depends on many uncertain factors, especially connected to the future economic and social development in Russia. Modelling for future freight flows is according to the report primarily to be seen as an indication of the transport potential depending on the economic development in the regions. The estimates can be used to point out the most interesting connections and transport solutions in the future. A zone system is used, with 12 zones, including the "rest of" Russia and Nordic countries, in addition to the 8 regions in the Barents area. In the model these zones are reduced to 4: Russian Barents, the rest of Russia, Nordic part of Barents and the rest of Nordic countries.

Four model alternatives are analysed:
1) Present situation
2) Decreased additional distance between the Russian part of the Barents region and the Nordic countries
3) Increased gross product (GDP) in all zones
4) Both decreased distance and increased GDP

A traditional transport model with Origin and Destination volumes as a fixed trend is regarded not suitable to analyse future scenarios with possible large changes in the regional economy and trade pattern. Models that include economic parameters directly are most suitable. A rather simple model formulation regarding the uncertainty in the economic development is chosen (so-called "Direct Demand Models").

The report concludes that the economic development in the subregions is one important condition for the future potential for internal flows of general cargo in the Barents region, especially for the Russian subregions where the largest growth potentials lie. Another important condition is lowering of cross-border barriers.

The report on passenger transport states that it is difficult to obtain satisfactory information about existing passenger flows for the Russian part of the region. For Russia, transportation statistics from Goskomstat Archangels, Karelia and Murmansk are used. Obtained information for passenger flows for all transport

modes is presented. A zone system is also used for passenger flows, where it has only been possible to find data for 25 percent of the cells in the original matrix (12 zones). In the analysis of future transport flows, the forecasts and the calculations they are based on include so many uncertain conditions that they according to the report must be regarded as illustrations of possibilities for the future.

The main input in the model is GDP and the most optimistic scenario is used. The most important factor for increased transport flows between the Russian part of the region and the Nordic countries is according to the analysis reduced distances (i.e. general costs) and not so much increased GDP. This indicates that ground transportation must be improved to become more reliable and more cost effective. In the northern parts also seaborne transport supply could serve the same purpose.

1.2.3 Recommendations/conclusions

The Communication Group concludes that infrastructure investments, mainly focusing on missing links and technical upgrading, are fundamental but not sufficient prerequisites for a progressive development of the region. Given the present situation it is difficult to establish objective profitability criteria for ranking projects. It is therefore recommended instead to focus on the establishment of a Barents Regional Transport Network, with nodes and links in priority corridors, providing a good coverage throughout the region.

Equal attention must be given to the establishment of transport services that are reliable and cost-effective. It is also stated that there is an (obvious) need for procedures and funds that lead to conditions for the implementation of transborder transport activities that are similar to the conditions for domestic activities within each country.

The overall uncertainty requires strong central government support particularly for transborder transport issues covering the entire span from infrastructure investments to the support of transportation activities, including the administrative and organisational framework. This should include instructions for public procurement of transborder transport services.

The establishment of a heavy freight network is greatly needed for the dominating raw material extracting and processing industries in the Barents region. The network can be obtained by upgrading and completing the existing railway network. This would provide the region's industry access to major ports in the north Atlantic (i.e. Narvik), the Arctic Ocean (Kirkenes and Murmansk), the White Sea (Kandalasha and Archangels) and the Gulf of Bothnia (Luleå and Kemi), and the national railway systems in Sweden, Finland and Russia.

Cross-border passenger transport services in the Barents region need to be organised jointly in a planning environment, which allows for subsidies in the same magnitude as those provided for already existing domestic services. Joint marketing efforts and improved passenger information services should initially be given high priority.

It is stated that travelling should have at least a 10 times higher volume than present, which would correspond to 200-300 thousand passengers between each pair of existing population clusters. These figures are suggested as obtainable levels within 10-15 years. The travelling potential comprises all travelling, i.e. all modes and all travel purposes. A modal breakdown was judged to be of limited value, because of all the uncertainties involved. It is also stated, that the courses of action taken will heavily influence the outcome in terms of travelling volumes and modal split.

For air traffic the main task is to interconnect the existing national airline networks. These connections should be established within the region and not via the major airports in each country. Subsidies from public funding are judged as necessary over a number of years.

On the other hand, air transport is relatively expensive, and thus not sufficient as the only transport solution. Among others it is mentioned that car ownership levels in Russia will be low in the foreseeable future, a fact that stresses the importance of improving public passenger transportation between the four countries. The group states that cross-border traffic should operate under the same rules as domestic traffic, with public procurement and subsidies of a comparable size.

1.3 Masterplan för logistik och infrastruktur på Nordkalotten

1.3.1 Approach and Study Area

The Masterplan for Nordkalotten is a project carried out within the framework of EU's structure program INTERREG II a, and financed by EU and a partnership. The partnership consists of representatives from the basis industry and local authorities on "Nordkalotten" (Sweden, Finland and Norway). The Masterplan is a plan for joint action within logistics and infrastructure, where the needs and potentials for co-operation are regarded as most critical.

The starting point of the plan is the manufacturing industry, and primarily the basis industry's needs. Beyond this the plan directly and indirectly is said to favour the entire trade and industry in the region and contribute to a positive development of the society in general, as they depend on the survival of the basis industry. The logistic costs for enterprises in Nordkalotten are said to be about twice as high as competitors costs on the Continent. Good infrastructure and logistic solutions are therefor of highest importance in order to secure trade and industry in the region. An object of the Masterplan is to create a dynamic arena for a co-operation between actors and a tool to enable an optimisation of goods transport solutions to and from the region.

The report covers the area "Nordkalotten", which here is defined as Nottbottens län, Norra Österbotten and Kajana areas, (Västerbottens län) and Finnmark, Troms and Nordland counties.

1.3.2 Applied methods

The report describes present and expected transport flows in the area. Five transport corridors are used as a starting point: The Atlant corridor (sea), the Gulf of Bothnia corridor (sea), the Finland corridor (land north-south), the Sweden corridor (land north-south) and the East-west corridor (land corridor from Finnish/Russian border to the Norwegian coast).

Expected transport flows are estimated based on information from the largest companies in the area of expected production within the next 5-6 years (from 2000). The estimates are regarded as relatively reliable, as plans for increased capacity (which most of the companies have) require a relatively long planning horizon. Another main assumption, which is far more uncertain, is changes in the industrial structure. Expectations of structural changes are based on changes that already can be observed (for instance the concentration of timber industry in Finland, which also is expected to take place in Sweden). Globalisation and needs for structural rationalising is viewed as an important driving force. In addition, development tendencies in the logistic market are expected to spread to the companies in "Nordkalotten".

It is stated as impossible to give an exact answer about future goods volumes and an "optimal structure". This depends to a large extent on how efficient the mentioned corridors can be developed. Two factors are claimed to be certain to influence volumes: Increased production and changes in industrial structure. In addition, companies' decision to use the transport corridors are assumed to by influences by factors such as:

- Technical factors (gauge, track profiles, standards)
- Costs related to the transport modes (e.g. rail versus sea)
- Framework conditions (e.g. subsidies, taxes, environmental requests)
- Use of new technology
- Speed of development in the Russian market
- Financing and priorities of domestic resources (e.g. building new infrastructure)

It is also worked out a development plan for the railway on Nordkalotten. This report is based on surveys of the industries needs and demand for efficient rail transports. It is assumed that structural changes presently happening in the basis industry is the primary driving force behind the railway development.

1.3.3 Recommendations /conclusions

The Masterplan recommends in general that infrastructure capacity is developed and concentrated to a fewer number of constructions. This would increase sea transport's competitiveness, and would also be an advantage for rail transport. More specific, it is suggested to develop the railway around the Gulf of Bothnia, where also sea transport is co-ordinated and ports co-operate. The report also recommends a terminal system for Nordkalotten and that efforts are made to realise a few central specialised and integrated combined (multi-modal) terminals. An improvement of the road system is a further proposal, with regard to maintenance, snow ploughing

and continuous road connections north-south trough Norway and towards the west to Lofoten.

Eight specific projects for co-operation for further work are proposed, referring both to present needs and expected future challenges:

- Development of existing railways in Sweden and Finland, especially around the Gulf of Bothnia. Improved terminal techniques and gauge axles for east-west transports. There is an increased interest for freight of large volumes of timber, forest products and ore via rail over Tornio/Haparanda. The Swedish railway network is also of importance for North-Norway, since all transport by rail north of Bodø goes via Sweden.
- Co-ordination of the sea transport in the Gulf of Bothnia, co-operation between ports. There is a large potential for co-ordinating transport on Swedish and Finnish side, and it is necessary to develop a closer co-operation between ports and specialising.
- Improve the framework conditions for companies and operators (taxes, subsidies). The infrastructure charges for rail transport in Finland are for instance much higher than in Sweden, and sea transport charges lead to differences between the transport modes. Taxes and administration systems lead to differences as well. It is stated a potential for over 30 percent lower costs if framework conditions were harmonised.
- Descions for a terminal system for Nordkalotten. Terminals are developed as part of the national infrastructure and logistic. There are a number of technical solutions for managing freight flows, but no co-ordination with other terminals. There are many terminals in the region, which could be concentrated to fewer central high-productive specialised and integrated combi-terminals with the same equipment.
- Clarify the conditions for an Atlant corridor. The corridor plays an important role for the Norwegian coast and between Russia and the surrounding world. The potential will increase with exploitation of gas and oil in the Barents Sea and as an alternative corridor for input products like oil and coal to the basis industry. There are also large possibilities for exportation to overseas destinations via the Atlant corridor. The corridor must be considered as a genuine alternative to railway and sea transport in the Gulf of Bothnia.
- Improve the road system. Especially the raw material supply by truck is affected by the low road standard. In Norway a connected road link north-south through Norway and west toward Lofoten should be developed. Closed roads in the winter is another problem that prevents efficient logistics.
- Develop and implement information technology that can be utilised for common logistic planning. Lack of balance in goods transport result in low utilisation of capacity and prevents containerisation. Information technology would enable better planning and knowledge about transport alternatives.
- Develop high competence within logistic in collaboration with the Universities in Tromsø, Luleå and Oulu. There is a lack of local education and knowledge, such as in strategic logistics, especially regarding the development of small and medium size enterprises.

1.4 BothnianArc – Communication system

1.4.1 Approach and Study Area

The Bothnian Arc is an umbrella project named Bothnian Arc-Crossborder Co-operation in Spatial Development. The umbrella project consists of three separate projects, financed by the EU Interreg IIC programme. The project reviewed here deals with the interregional communications system, and focuses primarily on the present situation and possible future changes. Another main task has been to define a preliminary vision for the communications system and main areas for continued planning.

The aim for development of the Bothnian Arc's communication strategy is to offer transport connections and services that are demanded in order to develop the regional structure, trade and industry and mobility for the population in an economic and sustainable way. The aim is to develop transport policies within the entire area independent of national borders. A suggested structure of the content in a joint communication system plan is presented in the report.

The study area is the coastline in the inner part of the Gulf of Bothnia (Swedish and Finnish side), i.e. Norbotten, Lappland län and Uleåborgs län. This includes the largest cities; Oulu and Luleå, as well as other population centres such as Kemi, Haparanda, Torneå, the areas Brahestad, Piteå and Boden.

1.4.2 Applied methods

As the first part of the work the existing situation and need for development for all communication nets and transport modes have been analysed. A vision for the future system and a program proposal for further work have also been worked out.

The report gives a description of present passenger and freight transport in the study area, planned measures on the Finnish and Swedish side, and a summary of present organisations and actors in the two countries' transport planning system. Only to a very limited extent are forecasts presented. This is because the report is meant to be an overall description as an upstart for further work. Important factors for the development, repeatedly mentioned, are economic development, the structure of companies and competitiveness.

It is stated that the consequences of the development project in the communication system must be assessed during the planning with the support of various transport models. It is further stated that some sort of forecast model for the traffic is necessary in order to assess planned measures or projects.

1.4.3 Recommendations/conclusions

The preliminary vision is in its beginning and during the further work the vision will be defined more precisely. The aim is to create a communication system, which enables and guarantees terms for further economic growth in the area within the

frame of a sustainable development. A just and level distribution of growth regionally should be assured.

In the continuing work the aim is to carry out transport policies that is independent of national borders within the entire area. It is regarded as necessary to combine resources across the border in order to be able to meet future challenges and be able to utilise them in full. The further work can be divided into three parts; a more precise definition of the vision, strategic lines and an action plan.

The transport infrastructure in the area is regarded as to a large extent satisfactory. Parts of the existing main road network require measurements for improvement. There are capacity problems on the road network during peaks, especially in connection to Luleå, Kemi and Oulu. Building out a new coast railway on the stretch Sundsvall-Umeå-Luleå-Haparanda would to a large extent improve competitiveness for railway. Choice of gauge system for the rail transport between Finland and Sweden is put forward as a measure that would make border passing more efficient.

Already today it is regarded as important to prepare for a considerable increase in transit traffic in the area. Transit traffic depends to a large extent on the development in Russia. The development of air transport to a large extent depends on the economic development.

The large companies' transports mainly go by sea via the Gulf of Bothnia's nine ports. Almost all of the ports are specialised for a certain type of freight for neighbouring industries. Combined transports will increase in the future. As the extent of processing is increasing, transport time is often more important than price. Combined terminals exist in Lulea, Torneå, Kemi and Oulu. Combined freight transports between northern and southern Finland has increased in the recent years, in present demand is higher than supply.

The strategic work aims to define how different transport modes and networks can be developed in the long term. The plan's priority areas are the infrastructure consisting of E4 and E75 road connections, the Gulf of Bothnia's railway, public transport, terminals and ports (as well as IT and telecommunications.)

1.5 Communications between North Norway and Northwest Russia

1.5.1 Approach and Study Area

Finnmark County has in co-operation with Troms and Nordland counties worked out a report including a strategy and action plan for communications between North-Norway and Northwest Russia. The report includes substudies for road, rail, air transport and ports. The main aim is to develop the potential for improvement that exists in present companies and constructions. The project in addition has aimed to reveal obstacles caused by framework conditions in Norway and Russia and propose changes.

The study area is the main corridors from Norway to Russia recommended by the Communication group for the Barents region: The road connection Kirkenes-Murmansk, the Northern Sea Route and the connection Mo i Rana – Umeå – Petrozavodsk (E12 - the blue road) with ferry connections between Umeå and Vasa. In addition the report includes the air transport connections Tromsø/Kirkenes – Murmansk – Archangels, the ports of Archangels, Murmansk, Kirkenes, Tromsø, Narvik, Bodø and Mo i Rana and the railway corridors Narvik- Russia (via the Swedish and Finnish railways) and (potentially) Russia-Kirkenes.

1.5.2 Applied methods

According to the report, the use of historical data for transport as a basis for conventional transport analyses will conclude that transport investments are not profitable. The potential for transport is however regarded as significant, where transport volumes can increase as soon as the overall transport structure and economical conditions permit it. The potential applies especially to volumes presently transported by the Baltic and the Black Sea, that may turn into bottlenecks with the expected increase in transport volumes between Russia and the surrounding world.

It is stated that the traffic over the Norwegian/Russian border station in Storskog, which in 1999 was 131 000 persons, indicates there should be challenges for commercial interests within air transport and the road sector at both sides of the border.

Based on the traffic figures at Storskog, information from market players and a travel agency in Kirkenes it is assumed a considerable potential for air transport. An interviewed travel agency claims there could have been 10 000 passengers each year, and that there is a basis for daily flights and bus connections between Kirkenes and Murmansk.

The study of the road sector is based on interviews with 53 respondents (mainly in companies in addition to public institutions) concerning road conditions and road transport in the Barents region. The collected data show that the tradesmen in North-Norway have very different views as to what the challenges are. Visa regulations and custom clearance is pointed out as bothersome and time consuming, and a main challenge. The main impression is that the road standard on the Norwegian side is satisfactory. The road standard on the Russian side needs upgrading, as does facilities, customs clearance and border crossings.

In the study on rail transport statistics on border trade and transport flows are obtained from the National Bureau of Statistics Norway. The substudy on rail transport is in addition based on research studies from SINTEF. Among others, future potential flows of goods are modulated, where factors used are distance friction (reduced distance) and increased GDP. The models are assumed very uncertain.

The study of ports includes only actors who carry out Russian based freight transportation with North-Norway as a basis. In the north areas it is in the medium term (10-15 years) expected large changes in sea transport as a consequence of an international development where Northwest Russia will be stronger connected to the Continent, among others through the establishment of the Northern Maritime Corridor. According to the report, this makes it important to find positions.

The informants are port authorities, market players, transport companies and transport users (22 informants). The port authorities in several ports in North-Norway have investment plans based on expectations of a large increase in the sea transport to Northwest Russia. The commercial actors in the ports do not have the same expectations.

An observation from the project is that the maritime transport activity is relatively small and that there are few Norwegian operators (transport users) in this market. The operators are mostly satisfied with the facilities in the larger North-Norwegian ports, with some exceptions, including capacity problems in Kirkenes, lack of freezing terminals and system problems.

It is stated that only Kirkenes port has the potential to have a similar importance for transport to/from Russia as the ports of Archangels and Murmansk. This however presupposes that the Russian railway is extended to Kirkenes port.

1.5.3 Recommendations/conclusions

The proposed measures include the following areas:

1) Political influence and frame conditions. Includes starting a Norwegian-Russian project aimed to relieve transport flows presently to/from Russia through the Baltic and the Black Sea, and to introduce measures and systems to increase the understanding of Russian business and trade.
2) System improvements regarding border passing, customs procedures and traffic safety
3) Arrange for long-distance transports and improvement of road standard and constructions
4) Development of air traffic and airports
5) Arrange for development of the maritime sector
6) Extend the Russian railway to Kirkenes port
7) Further development of post, telecommunications and data
8) National and international profiles of transport nodes

The road standard is according to the report satisfactory, where customs clearance and border crossings are the most problematic. For long distance transports the report suggests that the road standard should be raised so that E6 would be a more natural transport route instead of transports through Sweden and Finland, when this is the shortest route.

It is assumed a large potential for air transport. The plan is to implement measures that improve the service for air companies between North-Norway and Northwest Russia. The group recommends that a buss connection to Kirkenes airport be established on the stretch Murmansk-Kirkenes-Murmansk.

Kirkenes is put forward as the most interesting Norwegian node port in a relief measure for Russia. In order to achieve accordance between a rail investment and the port's container capacity, a large port is required. This implies, however, that Russia wishes Kirkenes to be a central port node and long-term transport agreements.

The main goal for the railway project is to link Norway to the Russian railway net with further connections to the Far East and Europe. An extension of the Russian railway to Kirkenes is according to the report the only single measure that in a large scale can increase transported volumes between North-Norway and North West Russia.

The report concludes that present transport flows do not provide a foundation for rail transport on the stretch Nikel-Murmansk. This basis lies in turning existing transport flows that presently find other and, according to the report, more expensive ways of transportation, as well as the economic development in Russia. It is concluded that there is a considerable potential for rail transport of ore by future railway for freight on the stretch Murmansk-Kirkenes, based on a potential for production in the Northwest Russia. The link is assumed to be competitive relative for the Salla connection and out-shipping from Finnish port in the Baltic. According to the report, the railway from Narvik to Kiruna (Ofotbanen) does not have a large enough potential for transports between North-Norway and Russia.

The communication report recommends following up with a new report/research of a railway connection between Kirkenes and Nikel and an expansion of Kirkenes port.

1.6 East-West Transports – Northern Alternative (N.E.W.)

1.6.1 Approach and Study Area

At an international transport conference “More effective east-west transports” in Narvik in autumn 2000, the Director of the International union of railways (UIC) presented future prospects for the world container market and a corridor towards central Asia. The report is a result of the UIC initiative.

The project idea is to evaluate a container based and intermodal transport route connecting the North American East Coast (NAEC) and Central Asia via the Atlantic Ocean, intermodal ports in Northern Europe and the railway net to Eastern Europe and Asia.

The aim is to make use of ice-free ports in North-Norway as the gateway to/from northern parts of Scandinavia. The NEW corridor will link these regions to Russia, Asia via rail and US, Canada via sea transport. By utilising less congested ports at

the NAEC (Boston) and North-Norway (Narvik) and the eastbound rail system in Northern Scandinavia and Russia, the NEW corridor aims to be a supplement to existing east-west routes. A main premise for the report is thus to attract existing transports over to a new corridor with excess capacity.

The ambition of the project is to present a concept and generate interest for a new transport alternative. It is assumed important to prove commercial viability, indicate reliability norms and assess service level possibilities. Actual implementation is to be done by the market players and the project group intends to prepare realistic information.

Countries in the influence area of the NEW corridor are US, Canada, Greenland, Faroe Islands, Iceland, (UK), Norway, Sweden, Finland, Russia, Kazakhstan, Uzbekistan, Kyrgistan, Tajikistan, Turkmenistan, Mongolia and China.

1.6.2 Applied methods

The presented market area includes 16 countries. In the report a country brief with regard to location, government type and an overview of the economy is presented for each country. Relations to the NEW corridor and the rail structure are also briefly described. Data sources are World Bank Group, IMF, UN, and the World Fact Book, miscellaneous.

The population in the main market area, as well as Gross National Product (GNP) per capita is estimated. GNP per capita is used as an indication of the general economic condition in the countries. It is stated that even though GNP per capita in some countries may be low (in the eastern part of the area) this does not necessarily indicate that the level of international transport volume is low. In addition, populated countries like Russia and China in particular create large transport volumes. As a nation, China generates the second largest GNP in the world.

As part of the project, transport volumes in the corridor are estimated. The volumes are retrieved from public statistics, previous market studies and supplementary information obtained as part of the project.

It is stated that relevant volumes are difficult to retrieve. National statistics are based on different assumptions and customs statistics do not always indicate the final destination of the cargo. A major part of the cargo flow in the NEW corridor is large-volume bulk cargo (e.g. oil, gas and fertiliser) and not relevant for container based transport.

As a result total volumes are indications. Previous studies of the potential container based cargo flow between the Nordic countries and NAEC have indicated relevant volumes based on interviews and information from 80-90 companies in the region, and are included in this project.

Total flow to/from Nordic countries (tons) is not directly available from public statistics. In the project a stepwise approach is therefor used to estimate volumes:

1) Step 1 indicates the maximum potential (public statistics for import and export). The maximum potential is underestimated, because transit volumes are not included. In addition new markets that open to the industry when a new transport alternative is realised are not recognised (i.e. prediction of future market due to new transport corridor).
2) In step 2 irrelevant volumes are excluded. Focus is container transport, which means that a large part of volumes in the region is not relevant (e.g. large-scale bulk transport by ship and volumes to/from southern regions). Indications are made about population share, business structures etc. in the region. The rest of the volumes are weighted by the region's share of the total population in each country.
3) Finally, in step 3 the relevant short-term potential to the corridor is indicated by evaluating available micro conditions (interviews etc). The potential is reduced by a margin reflecting the element of uncertainty (e.g. public statistics)

When all figures are available, an origin-destination table will be used to illustrate the container based cargo flow in both directions and within the corridor. Then the new corridor will be compared with alternative (present) corridors, with regard to transport distances, transport time, price level and quality – all assumed important criteria when choosing transport routes.

The corridor is then described more in detail with regard to possible routes in the corridor, differences in power supply, technical standards (e.g. gauge), infrastructure plans (when links are expected accessible) and transport distances. With regard to speed, it is differed between technical (possible) and commercial (actual) speed. Assumptions are made regarding time for border crossing procedures and reloading (rail). Feeder transport and distribution is not included in the calculations. Price level for existing routes are based on available market prices. (This part of the report is not finalised).

The NEW corridor has several competitors. The project will indicate existing, possible and future competing routes. The strongest competitors (present routes) will be identified. Existing operators are expected to defend their routes as a consequence of large investments (infrastructure, marketing etc.)

1.6.3 Recommendations/conclusions

The report will be concluded with a review of the northern alternative's advantages, challenges and obstacles, as well as an evaluation of the alternative (regarding transit time, price level, quality, organisation), a business model and an action plan.

2 CASE - LOFAST

To illustrate methods applied to estimate the profitability of an infrastructure project it may be instructive to look closer at a present project. The infrastructure project LOFAST will link the Lofoten archipelago (Nordland County) to the Norwegian mainland. The first stage of the project on the E10 will be finished in the present plan period. The continuation of LOFAST consists of a 30 km new road stretch, including 4 tunnels and 8 bridges. Over the fjord Øksfjorden two bridges will be built with spans of respectively 250 and 300 meters. The project is a continuation of earlier constructions linking the islands to the mainland, among others the Raftsund Brigde with a main span of 298 meters, which crosses the strait between two of the Lofoten Islands.

The continuation of the project east of Raftsundet involves 3 municipalities and two counties (Nordland and Troms). The costs are in 2000 estimated to 930 mill. NOK. With an expected start in August 2002 the project is planned finished by the end of year 2007.

The final solution for the LOFAST project is based on a consequence valuation according to Norwegian legal provisions. This among others includes analyses of alternative solutions, compared to the present transport infrastructure. In this specific project, 12 alternative solutions were compared to the present situation.

The decision to link Lofoten Islands to the mainland is not based on a previous forecast of transport demand in the area, but on a political decision especially directed to improve the conditions for trade and industry in Lofoten. The positive effects are related to improved flexibility due to a ferry free connection and reduced transport distances. The effects for social life and welfare for the population are also regarded as positive. Still, all the alternatives have negative net benefits, i.e. the costs for society are estimated to exceed the benefits. The chosen solution has the lowest costs, estimated to exceed benefits by 220 mill. NOK.

The table below (Table 2) shows costs and expected consequences for environment, nature resources and society. The costs are shown as estimated mill. NOK discounted to the project's opening year. The costs are based on the assumptions that E10 becomes part of the national trunk road network (stamveg), that the ferry connection Svolvær-Skutvik is kept with a reduced service level, that the ferry connection Melbu-Fiskebøl is closed in the (chosen) Hadselfjord-alternative and kept with a reduced service level in the other alternatives.

Table: Summary of costs and consequences of alternative infrastructure solutions – LOFAST

ALTERNATIVE	**A**	**C**	**C-U**	**D**	**D-U**	**E**	**E-U**	**H**	**I**	**Hadsel-fjord**
COSTS										
Investment	580	760	900	1050	1280	950	1180	1500	1010	860
Benefit	350	350	340	350	360	340	330	280	410	580
Social cost	230	410	560	700	920	610	850	1220	600	220
ENVIRONMENT										
Valuable nature areas	----	---	---	---	--(-)	---	--(-)	--	-	0
Landscape	----	---	---	---	--	---	--	---	--	-
Culture areas	---	---	-	---	--	---	--	--	---	-
Air emissions	0	0	0	0	0	0	0	0	0	0
Water pollution	--	--	--	-	-	-	-	-	-	0
Barriers	+	+	+	+	+	+	+	+	+	0
Noise	0	0	0	0	0	0	0	0	+	0
NATURE RESOURCES										
Agriculture	-	-	-	-	-	-	-	-	-	0
Keeping reindeer	---(-)	---	---	--	--	--	--	--(-)	-	0
SOCIETY										
Traffic accidents, increase per year	3,5	3,4	3,0	3,0	3,0	3,0	3,0	2,9	2,5	2,6
Trade and industry, employment	+++	+++	+++	+++	+++	+++	+++	+++	++	+++
Development pattern	+	+	+	+	+	+	+	+	+	++
Public economy	++	++	++	++	++	++	++	++	++	++
Social, welfare	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++ (+)
Outdoor life	----	---	---	---	---	---	---	---	---	0
Road users' experience	+	0	--	0	---	0	--	0	0	--
Key to used symbols										
	Small	Medium	Large	Very large						
	-	--	---	----	negative consequences					
	+	++	+++	++++	positive consequences					
	0				none or marginal consequences					

The estimated preferred alternative in economic terms is the "Hadselfjord"-alternative. While the estimated costs are related to new investments and investments on the existing road E10, priced benefits are related to (reduced) transport costs, benefits of new traffic, maintenance costs and ferry costs. The alternative is the most profitable alternative because it gives the highest saving for the total road transport to Lofoten and eliminates a ferry connection. It is also regarded as the best alternative relative to (non-priced) environmental factors. Political considerations did however result in that another alternative was choosed.

Traffic estimations
The traffic flows through LOFAST are estimated on the basis of traffic figures from the ferry connections east of Lofoten. The measure point for road users is mapped through a questionnaire survey on the ferry connections. The traffic on the ferry connection Melbu-Fiskebøl was 425 vehicles per day. After the development of the connection to the main land it is expected that 80-100 vehicles is transferred from the ferry connection Svolvær-Skutvik to the main land connection. New traffic is expected to be between 140-200 vehicles a day, depending on alternative.

Figures from the ferry companies are used to find traffic development over time and daily traffic in the basis year 1992. These figures are accurate. Data from questionnaires are used to find expected traffic distribution in the respective alternatives. This is a weak link in the material. The material is scarce, especially for heavy vehicles, and coincidences may therefor have major impacts. The survey is carried out over two days, which is not enough to draw general conclusions. In addition, the traffic pattern changed after the survey was carried out.

It has been assumed a 0.3 percent annual increase in traffic for light vehicles from 1999 to 2000 and 0.4 percent increase from 2000 to 2008. In the period from 2003 to 2014 it is in addition calculated a long-term increase for light vehicles. For heavy vehicles is assumed a 1.9 percent annual increase through the entire estimation period. The figures for forecasting traffic growth are those used by the Norwegian road administration.