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Can We Estimate the Impacts of Fixed Links Using Current Transport Models? Experiences from Concept Evaluations of Fixed Links on E39

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Abstract: Transport analysis and impact evaluations are important input for decisions about infrastructure projects. The impacts on transport from fjord crossing tunnels or bridges are the foundation for the cost benefit analysis, and also the basis for estimating the income from toll collection. Based on experiences from concept evaluations of several fixed link projects on E39, and an ongoing overall analysis, we question the results from transport analysis made by the official tools for such analysis: the RTM (regional transport model) which estimates the demand for trips below 10 km, the NTM (national transport model), for trips of 10 km or more, and the freight transport model. Both the NTM and the freight transport model are integrated in the RTM in the net assignment stage. We will demonstrate strengths and weaknesses in the transport models by showing contra intuitive or questionable results using the model as it is. The following questions arose as the initial results from the transport model were presented: Are the transport models able to capture immediate as well as long-term impacts? How would different assumptions about the monetary costs on these projects affect the forecasted demand and the cost benefit analysis? Are there other and wider ranges of impacts, if the analysis covers the total coastal highway as a whole, compared to evaluating impacts of each fixed link project individually? Do we have enough data to include transport effects of wider impacts of the fixed link projects? We had to deal with these questions in the concept evaluations carried out for the various fixed links project and in the current overall evaluation. We would like to suggest improvements in the analysis tools and emphasize requirements for knowledge about impacts of fixed links projects.

Key words: Transport models, transport analysis, evaluation.

1. Introduction

1.1 What Is a Concept Evaluation?

Evaluation of concepts has been a mandatory introductory part of planning activities of infrastructure solutions in Norway since 2005. Introducing concept evaluations should alleviate problems with poor cost estimates and lift the concept choice to a superior level before making decisions about public investments. Expected costs of 750 MNOK should from 2011 trigger a concept evaluation phase. The former threshold level determined in 2005 was 500 MNOK.

1.2 The Role of Transport Models in Concept Evaluations

Within the transport sector, several projects have been evaluated concept wise. Essential information for the actual choice of concept is how the travelers would change their travel pattern as a consequence of the evaluated concepts. These changes cannot be observed before the project is built, and thus need to be rendered probable by estimation done in transport models.

In Norway the RTM (Regional Transport Model), which is a transport model system covering all of Norway has been built up over 12 years. RTM is funded by the transport authorities, initially to be the transport analysis model intended to go into the processes of developing the NTP (national transport plans), but in later years also prepared to enter into other (or almost all) transport analysis processes. The model developing

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work also has included making input data available; transport network and land use situation, for the current situation and prognosis. The software used to implement the model is CUBE, distributed by Citilabs, allowing the development of a most user friendly and intuitive design. The calculation design and the accompanying input data are freely and easily available making it possible for a wide range of professionals to make use of the model system.

1.3 Earlier Evaluation of the Transport Models

The NPRA (Norwegian Public Roads Administration) carried out interviews among their employees in order to get feedback about the concept evaluation phase [1]. The discussion in the report concerns the activities in, and results from concept evaluations. The use of transport models as part of the process is briefly mentioned. The overall view is that the transport models are complex, challenging to use both practically and because it is time consuming though it was also mentioned that is used to be even worse with previous model systems. The model design in the RTM is claimed to perform better for evaluating corridors and road stretches compared to city analysis. The detailing level in the transport models is said to be too overwhelming for this strategic level, making the transport model calculation time consuming making boundaries for the progress of the analysis.

The report by NPRA also refers to a previous report made by the Transport Economic institute about concept evaluation and impact analysis [2]. This has the viewpoint that it is not necessary (should not be) to construct specific models for this superior planning level, and recommends that as a principal rule the existing tools should be used. Amongst them is the RTM.

Both these reports emphasize the use of transport models as part of the analysis, but are not going into details in evaluating the RTM and its applicability for the various analysis. In 2009 an evaluation of the transport model was carried out [3], albeit almost four years ago, but is the most recent review of the RTM. The evaluation even dealt with two ferry replacement projects (Krifast and Skålavegen, both located on branch roads to E39), and certainly supports the use of RTM for such projects from the comparison between calculated increase in traffic and traffic counts.

All in all, based on previous model evaluations, there has been no indication that transport models in general or the RTM has had or have irregular problems regarding ferry replacement projects.

1.4 Concept Evaluations of Fixed Links Projects on E39 as an Experience Basis

In later years the RTM has been used for several analysis of ferry replacement project. Rambøll and SINTEF have cooperated on doing some of these, and have gained experience with using RTM that we want to share. We use the experience to discuss the qualities of the current RTM and suggest improvements with the model and the model operation.

In the next chapter we present the main features of the RTM. Chapter 3 presents the concept evaluations of interest along E39. Chapter 4 deals with various aspects of the RTM and how it was used in the concept evaluations. The last chapter gives recommendations about improvements in the model and the application of it.

2. The RTM

2.1 RTM Design with Various Sub Models

The RTM is assembled by several sub models; which are dynamic regarding the demand, and fixed matrices; expressing fixed demand (see Table 1). The two major parts of the model consist of the NTM (national transport model), for long distance personal trips, and Tramod_by, for shorter personal trips. Whether long trips are represented by fixed matrices, for instance for a basic situation or it is run for each scenario, is optional and this depends on the analysis.

Freight traffic is temporarily given by a fixed matrix which is estimated from a truck survey and continuous traffic counts; isolating long vehicles from these and assuming that they are trucks. This matrix will soon be replaced by a matrix originating from the national freight transport model.

The school model produces trips to and from schools on all levels from elementary schools to universities.

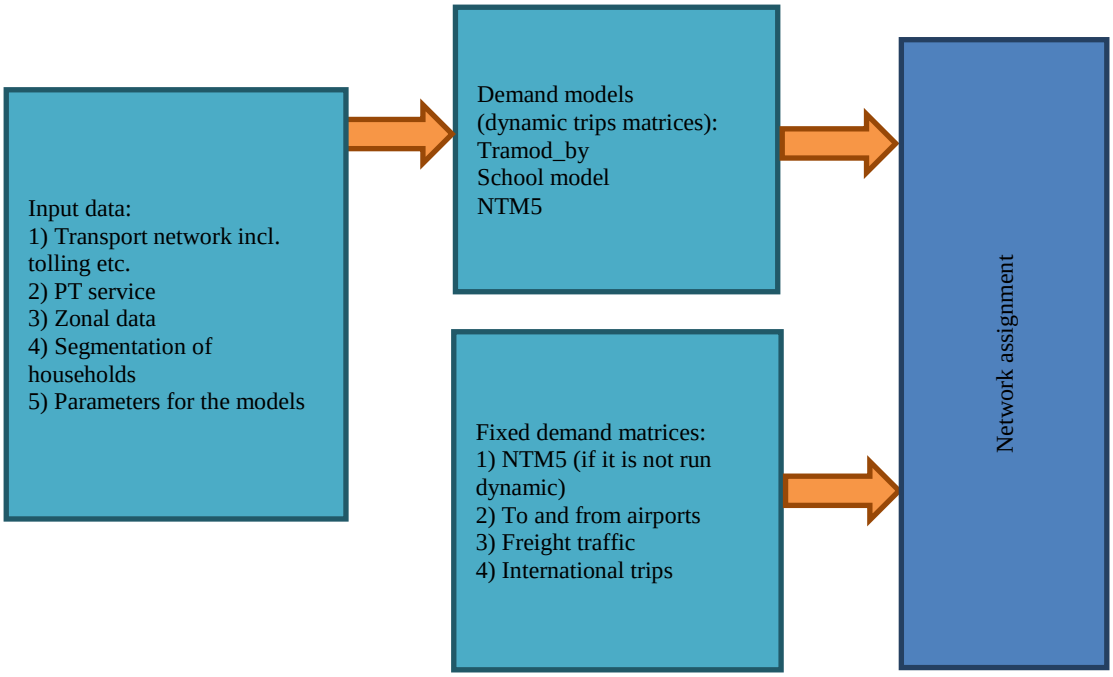

Fig. 1 The construction of the Norwegian RTM with sub models and fixed matrices.

Table 1 Trip categories in the RTM.

Model	Trips	Purpose	Mode
NTM	Private trips ≥ 100 km	Work Visit Leisure Other	Car Bus Train Boat Plain
Tramod_by (The demand model in RTM)	Private trips < 100 km	To and from work At work Leisure Private (incl. shopping) Accompanying other	Car driver Car passenger Public transport (bus, train, boat) Cycle Walk
School	Schools, college and universities	To and from school	Bus Public transport Soft modes
Fixed matrix: International trips	Trips to and from Sweden		Car Bus Train (Truck) Freight
Fixed matrix: To and from airports	Trips to/from 12 airports		Car Public transport
Fixed matrix: Freight	Trips by trucks		
Not in the model system	Foreigners in Norway Local commercial trips	Weekend trips Vacation trips Stroll trips	Other modes than defined by Tramod_by

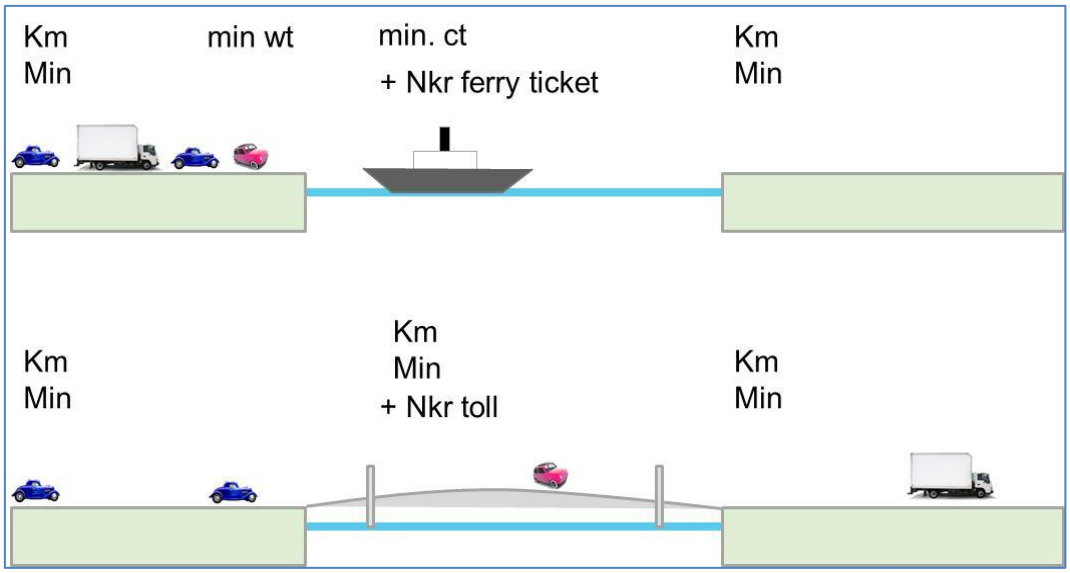

Fig. 2 Cost components used to represent ferry connections and fixed links replacing ferries.

The airport-trips model is giving the ground part of the flight trips; trips to and from airports. Only the 12 largest airports are included in the model. The matrices are fixed, and include car and public transport.

2.2 How Are Ferries Represented in the RTM?

Fig. 2 illustrates how ferries and fixed links, in this case a bridge, are represented in the RTM.

Ferries are part of the transport infrastructure for cars and public transport. Ferry passengers are defined as public transport travelers if they are on board a bus link in the ferries, but also if they use soft modes, walk or bike, to the quay. The ferry parts of a car trip include waiting time and crossing time. The ferry ticket is given for the cars and the car drivers and car passengers separately. An overall factor states the discount level. The waiting time is set according to the headway, assuming uniform arrival distribution. Heavy vehicles have the same cost as passenger vehicles on the ferry.

Discounts are not included for car traffic in NTM. Also in the net assignment phase, in which the total traffic is distributed on the transport network, prices are assumed to be full; without discount.

Costs are multiplied with a discount factor, one for ferry costs and one for toll costs. This means that the discount factor expresses the share of passengers paying full price, thus the name in itself is misleading. Table 2 shows discount factors found in a travel survey on one ferry across the Romsdalsfjord from 2003. The left column (a) is used as a foundation for parameters in the model, as shown in Table 3. The average payment is however shown in the right column in Table 2, and reflects the experienced cost in a better way.

2.3 How Are Bridges and Tunnels Represented in the RTM?

Fixed links are represented by an ordinary link, with a distance, a capacity and a speed limit, often with toll costs on it. As the model for the time being is not taking vertical curvature into account, bridges and tunnels are represented the same way in the model. In reality a bridge would mean a straighter road, because a tunnel across a fjord in most cases would have to go quite deep, given the current technology.

There are three main differences between ferries and fixed links in the RTM.

(1) Waiting time
(2) Crossing time
(3) Distance

Table 2 Discount factors found in a travel survey on a ferry connection between Molde and Vestnes from 2003.

	Discount factor *a*	Traveler covers costs themselves *b*	Discount factor regarding that some trips are paid for *a*×*b*
Holiday or weekendtrip	0.83	0.80	0.66
To/from work/school	0.62	0.41	0.26
Shopping	0.83	0.75	0.62
At work	0.67	0.08	0.05
Weekly commuter	0.75	0.61	0.46
Other	0.81	0.61	0.49
All trips	0.72	0.39	0.28
All trips except for at work	0.77	0.63	0.48

Table 3 Discount factors in the RTM.

	Ferry car+car driver	Ferry Car passenger	Toll road Car driver	Toll road Car passenger
To/from work	0.6	0.83	0.75	-
At work	1.0			
Leisure time	0.7	0.9	0.8	0.9
Follow others	0.7	0.9	0.8	0.9
Private	0.7	0.9	0.8	0.9

With the ferry the waiting time and crossing time is set previous to the calculation. It is not affected by the demand, queuing or knowledge to the timetable. Crossing the fjord on a ferry means that the vehicles are not driving and thus the distance contribution is zero from the ferry trip.

In analysis it is also required to have a formal political decision about tolling before including it to the transport analysis, unless the purpose of the analysis is to estimate the income from toll collection. This means that the tolling is left out of the concept evaluation in many cases, but would be present in most cases if the project is of such interest that it would be part of the NTP.

2.4 How Is the Reaction Pattern to Changes in the Infrastructure in the RTM?

A test of the elasticities in RTM was carried out and is documented as part of the demand model documentation [4]. The test only includes public transport and not ferry trips.

Several studies have dealt with price elasticity of various transport modes. The perhaps most comprehensive Norwegian survey was undertaken by Odeck and Brå then [5] of 19 Norwegian toll projects. They found a short-term elasticity for trunk roads from -0.24 to -0.75. Short-term elasticity was defined as the effect of tolls on travel demand within one year of toll change. Traffic calculations in the RTM show a higher decrease in traffic demand than found in Odeck and Brå then [5]. This is especially evident for lower tolls (see Tables 4 and 5).

Around 2007 the new RTM was tested unofficially on several projects. The feedback from these tests was, among other things, that the model generated too little traffic on ferries. These tests were sadly not documented. An impression that the model was too elastic for disbursements was established even if this was not proven or documented. One of the parameter in the RTM controls the length distribution of trips, and it was assumed that the trips probably went further if a ferry crossing was part of the trip, and so this parameter was altered as a test. Because this parameter applies to all trips and not solely ferry trips, the test was not successful. All trips became longer in the model giving unrealistic results in other parts of the model, especially in city centers.

Table 4 Traffic calculations in RTM (vehicle trips per day]).

Toll station	0 kr	10 kr	20 kr	30 kr	40 kr	50 kr
E134 Damåsen	10,115	9,117	8,719	8,235	7,819	7,462
E134 Gammel trase	1,908	1,605	1,410	1,200	1,061	925
Fv 286 Grossvoldveien	1,023	877	795	701	639	573
E134 Saggrenda	5,478	5,216	5,084	4,925	4,817	4,712
SUM	18,524	16,814	16,007	15,060	14,336	13,673

Table 5 Traffic calculations using price elasticity = 0.5 (arc elasticity) (vehicle trips per day).

Toll station	0 kr	10 kr	20 kr	30 kr	40 kr	50 kr
E134 Damåsen	10,115	9,731	9,362	9,021	8,701	8,402
E134 Gammel trase	1,908	1,836	1,766	1,701	1,641	1,585
Fv 286 Grossvoldveien	1,023	944	872	811	759	713
E134 Saggrenda	5,478	5,201	4,938	4,577	4,146	3,681
SUM	18,524	17,713	16,939	16,110	15,247	14,438

The impression that the model is too dismissive of trips that imply direct costs, including ferry trips and tolls in general, has grown stronger since it was first suggested in 2007.

It was not until last year we started looking at the discount factor which might be responsible for the situation.

2.5 How about Wider Impacts Represented in the RTM?

Investments in infrastructure, like fixed link projects, might cause spillover effects, in a collective term named wider impacts. This is additional impacts on top of initial changes in the travel pattern, but caused by the new infrastructure.

A study carried out by Lian and Rønnevik [6] of 102 major road projects opening between 1993 and 2005 showed a small effect on population growth, but no effect on employment, income levels commuting or industrial growth, from road investments.

Last year COWI presented a review of the treatment of wider impacts in impact assessments in the transport sector [7]. They define "wider impacts" as impacts from transport infrastructure projects that are not already part of the methods used by the transport model and cost benefit analysis. The study calls attention to impacts in the labor marked. Large shifts in the transport service, like a fixed link as replacement for a ferry, could cause radical changes in the labor marked and added value for business and industry.

An approach based on the same principles, but tied to a specific case, was carried out by Heum et al [8]. They assessed the impacts for labor markets and the added value of a ferry-free E39 from Nordfjord to Kristiansund (the current ferry crossings in Møre and Romsdal county, which is the northern part of the western Norway). Heum et al. [8] made an analysis with a similar approach but for the southern parts of the western Norway. In both studies they estimate the added value, measured in increased total income due to increased profits of higher productivity.

The definition from COWI: "all impacts not already in the model" would thus cover effects like population growth, labor market expansion and increased productivity. We could include these in the impacts analysis if we knew that there was not any risk of counting the effects twice.

Population growth is represented in the RTM by demographic prognosis which are not affected by infrastructure improvements. If we find a method that gave probable size of such effects, we did not have to worry about counting this effect twice in the transport analysis.

Labor marked expansions would probably work as illustrated in Fig. 3. Reduced transport cost across a fjord would imply changes in trip frequencies, destination choice and mode choice. This is part of the transport

model already, and some of these changes are short term while other changes are more long term. It is often assumed that all adjustments to new infrastructure have happened after about a year. This is illustrated in Fig. 3 by shorter distances, wider labor marked and more trips on the new fixed link than on the ferry it replaced. The higher productivity could also attract more investments, expand existing or arrange for new business and widen the job marked more, increasing the number of trips on the fixed link beyond the initial increase. The additional increase is wider impacts according to the definition from COWI, because this effect is not already accounted for in the current transport models.

An example on a situation very likely to arise along E39 can illustrate the effect. A factory is located on one side of a ferry connection, and is producing furniture. It is located close to the sea because of the transport by boat of intermediate goods to and goods from the factory. On the other side of the ferry connection is a smaller town. Easier access to the factory helps recruit more workers, increase productivity and increase the traffic on the fixed link.

Fig. 3 Impacts on the labor marked from ferry replacement projects.

In the transport model land use data (or zonal data) are given exogenously. The number of residents, students, workplaces within categories, parking policy etc. is given for each basic district. This goes into a basic year calculation, used to calibrate and validate the model. Prognoses for the development of settlement pattern taking trends about birth rates, death rates, migration pattern and immigration pattern into account are made by Statistics Norway and publicly available. Prognosis for development in workplaces is not prepared the same way.

Up until now the transport analyses actually have been carried out without prognoses for changes in the employment structure. This means that the current labor market structure is input also in prognosis for trips to and from work and at work. The number of trips is decided by the number of workers, thus there will be an increase in trips if there is an increase in residents in an area, but the trips are attracted to places where the current companies are located. Where the trips are attracted is decided by the generalized cost distribution from where the people are resided to the location of the workplace. An infrastructure project might alter the generalized costs and thus cause changes in the trip attraction. This means that we might not be able to separate between impacts already taken care of in the model and the so-called wider effects. This can only be done by getting estimates about new workplaces due to the infrastructure investment, and then we probably need an alternative zero (basic scenario) to compare this to, to measure these wider impacts.

3. Evaluations of Norwegian Ferry Replacement Projects

3.1 Concept Evaluations along E39

The coastal highway E39 has been object of many concept evaluations carried out recently. These are shown in Fig. 4 with green circles around the cities and blue around road stretches. The three on top included four ferry replacement projects. The concept evaluations for Aksdal-Bergen (2011) and Boknafjorden (2007) also included ferry replacement projects. All of these used the RTM as analysis tool. The concept evaluation for Boknafjorden was done almost eight years ago, so comments in the report about the model from that analysis are regarded as less interesting than the other four.

As a supplement to the three concept evaluations Bergsøya-Valsøya, Ålesund-Bergsøya and Skei-Ålesund, a superior concept evaluation covering Valsøya-Skei was carried out as well.

The ferry connections are shown to the left in Fig. 5. The crossing time on each fjord is given in the map to the right in the same figure. In the right map Voldafjord is not mentioned, and this is because alterations in the road network have made another route choice, around Kvivsveien which opened in September 2012, more convenient for through-traffic.

3.2 Ferry Replacement Projects in Recent Concept Evaluations

Four concept evaluations carried out in 2011 included ferry replacement projects. All of them used the RTM. The assumptions made in the transport analysis are given in Table 6.

3.2.1 Representation of Ferry Traffic in the RTM

As row three in Table 6 shows, the traffic on the ferry is well represented in the model. Still there have been concerns that on some ferry connections, especially those in proximity to larger cities, the traffic in the model is lower than it should be.

3.2.2 Tolls on the Fixed Link

Even if it is highly likely that the fixed link will imply a toll collection around the amount of the current ferry ticket price, most of the fixed links are analyzed in the RTM without tolls. This is a distinction between how the calculations are done for projects that enter into the NTP and in these concept evaluations.

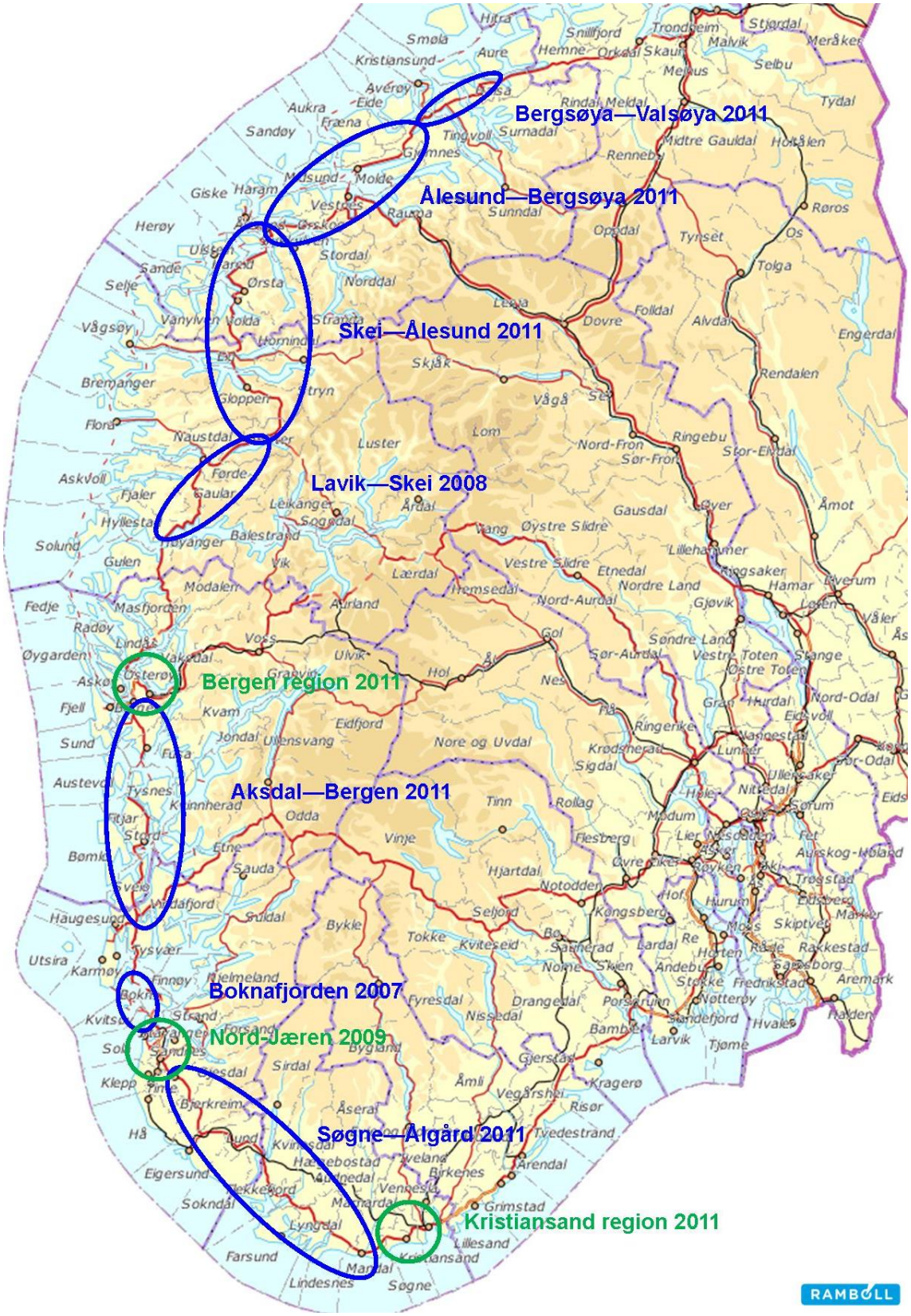

Fig. 4 Concept evaluations carried out along the coastal highway E39.

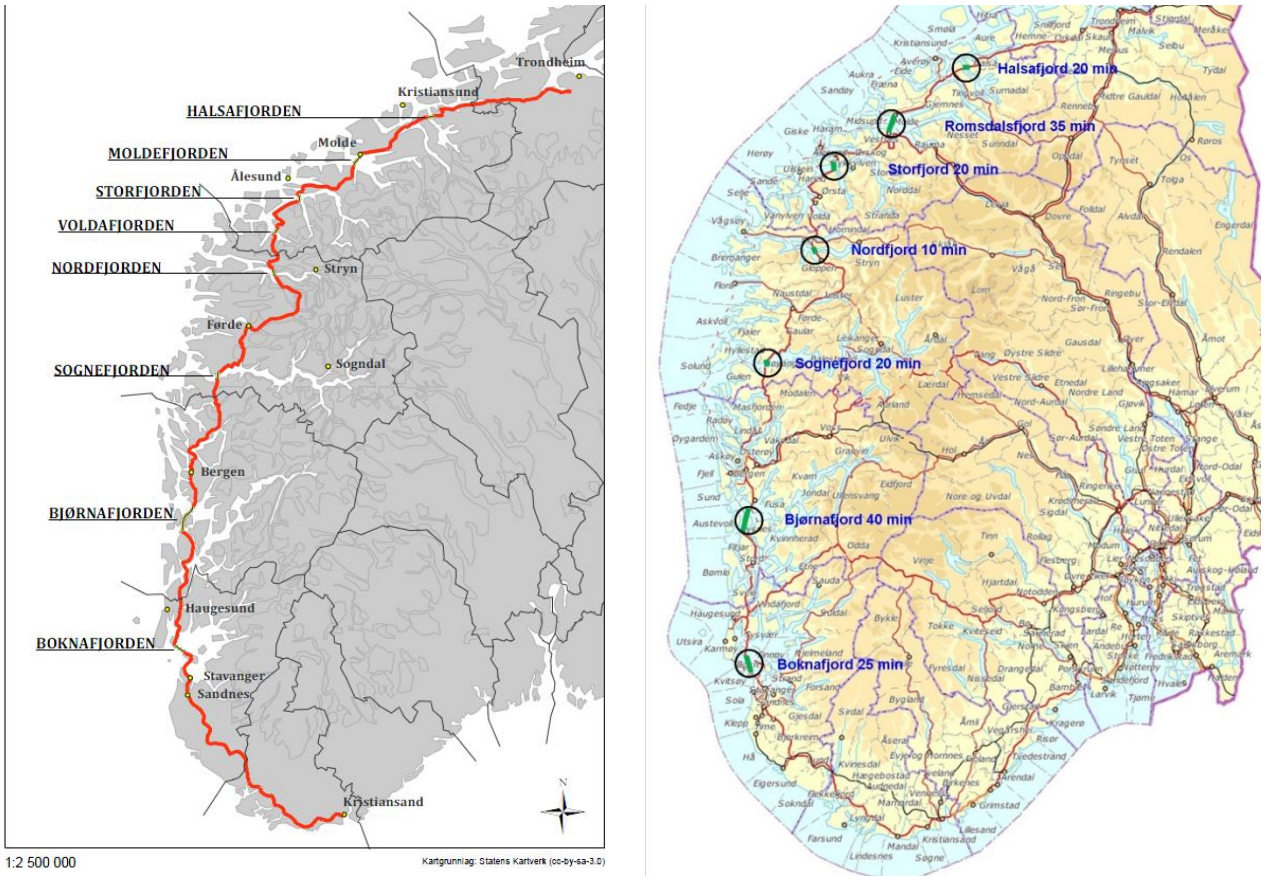

Fig. 5 Fjords with ferries on the coastal highway E39.

This naturally overestimates the traffic on the link. The explanation for this practice is that toll collection should not be assumed on links in transport analysis unless it is decided by the national assembly. In the early planning process, like concept evaluations, this has not been discussed by the authorities at all, and thus tolls are not assumed. Sensitivity analyses testing the effects of toll collection on fixed links are requested, if the time frame allows it. In Table 6, one of concept evaluations included sensitivity tests with toll collection, while the others did not.

Not using toll collection on the fixed links in the transport analyses has also been justified by the view that toll collection is too discouraging.

3.2.3 Assumptions regarding the NTM and Influential Area

The NTM produces private trips of 100 km or more. If it is expected that the project affects the trip generation, the trip pattern (origin destination pattern) or the mode choice for long trips, the NTM should be used to estimate the demand changes. If not, the analysis can use fixed matrices (one for each mode) for the basic situation, allowing only for changes in the route choice.

As we can see from Table 6 calculation with the NTM was carried out in three of the concept evaluations.

An ongoing project uses RTM and NTM (and even the freight transport model) to study effects of ferry free coastal highway all the way from Trondheim to Kristiansand. The effects on NTM traffic can be viewed in Fig. 6. Ferry free connection can imply reduction in travel times using the E39 all the way of 7-9 h. The reduction causes huge effects for long trips; less traffic chooses inner routes and more traffic chooses the coastal highway E39. This effect is only possible to reveal if we assume that the influential area is wide enough.

Table 6 Facts about the concept evaluations carried out with a recent version of RTM, which included one or more ferry replacement projects.

	Bergsøya-Valsøya	Ålesund-Bergsøya	Skei-Ålesund	Aksdal-Bergen
Fjord	Halsafjord	Romsdalsfjord	Storfjord and Nordfjord	Bjørnafjord
Year of concept evaluation	2011	2011	2011	2011 2018-42
Observed traffic/estimated traffic on ferry (2010)	835/1,100	1,917/1,800	1,548/1,300 (Solevågen-Festøya) 1,235/1,400 (Anda-Lote)	2,406/2,361
Toll calculations on fixed link	No	Sensitivity analysis	No	No
Calcuation of waiting time	Headway/2	Headway/2	Headway/2	Headway/2
Calculation in national model	Yes	Yes	No	Yes
Freight traffic	Calibrated matrix	Calibrated matrix	Calibrated matrix	Fixed matrices
Annual traffic growth factors	used different growth rates (high, medium, low)	used different growth rates (high, medium, low)	2%	SSB

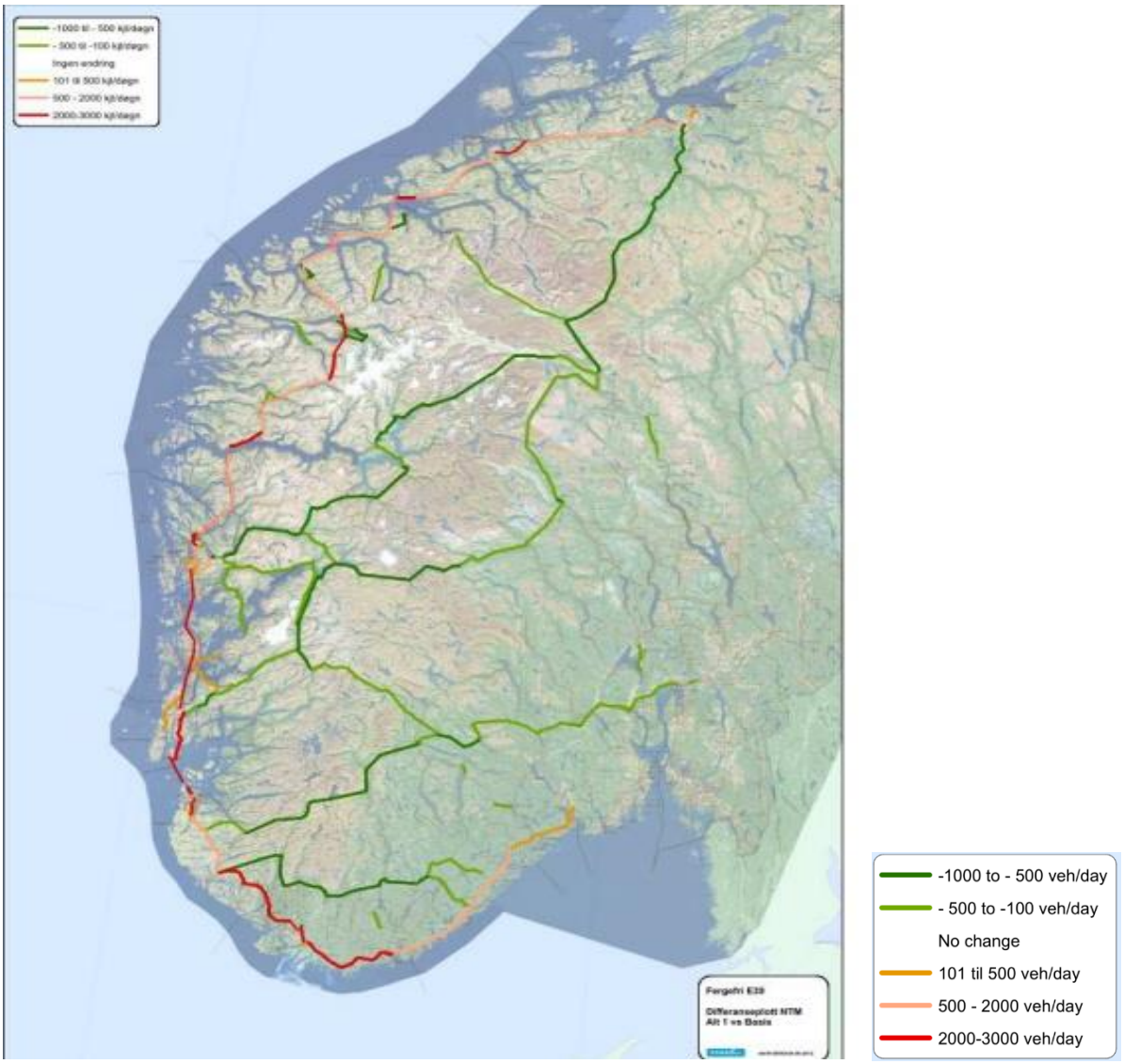

Fig. 6 Change in travel route and demand for long trips Scenario year 2020. The coastal highway ferry free (red = increase in travel demand, green = decrease in travel demand).

3.2.4 Assumptions regarding Freight Traffic

The national freight transport model was not prepared for use as an integrated part of RTM as the concept evaluation was carried out. Consistency checks against counts indicated that the fixed matrix for freight traffic was not good enough to represent the real traffic in the north western part. We then made a new freight matrix for the main arterial roads based on counts as a calibrated matrix. The concept evaluation for Bergen-Aksdal used a fixed share based on the other traffic.

3.2.5 Prognoses

Statistics Norway prepares prognoses for the population growth, taking migration, immigration, birth rate and death rate into consideration. Prognoses exist at regular intervals until 2060. Also it is possible to use the current transport situation and use growth factors prepared for EFFEKT (the cost benefit analysis tool developed by NPRA). In Table 6 the three concept evaluations to the left in the table used fixed growth factors while the Bergen-Aksdal concept evaluation has used prognoses from Statistics Norway.

The difference between using fixed growth factors and prognoses from SSB is that the last-mentioned allows for the trend that people move to centers. This is illustrated in Fig. 7.

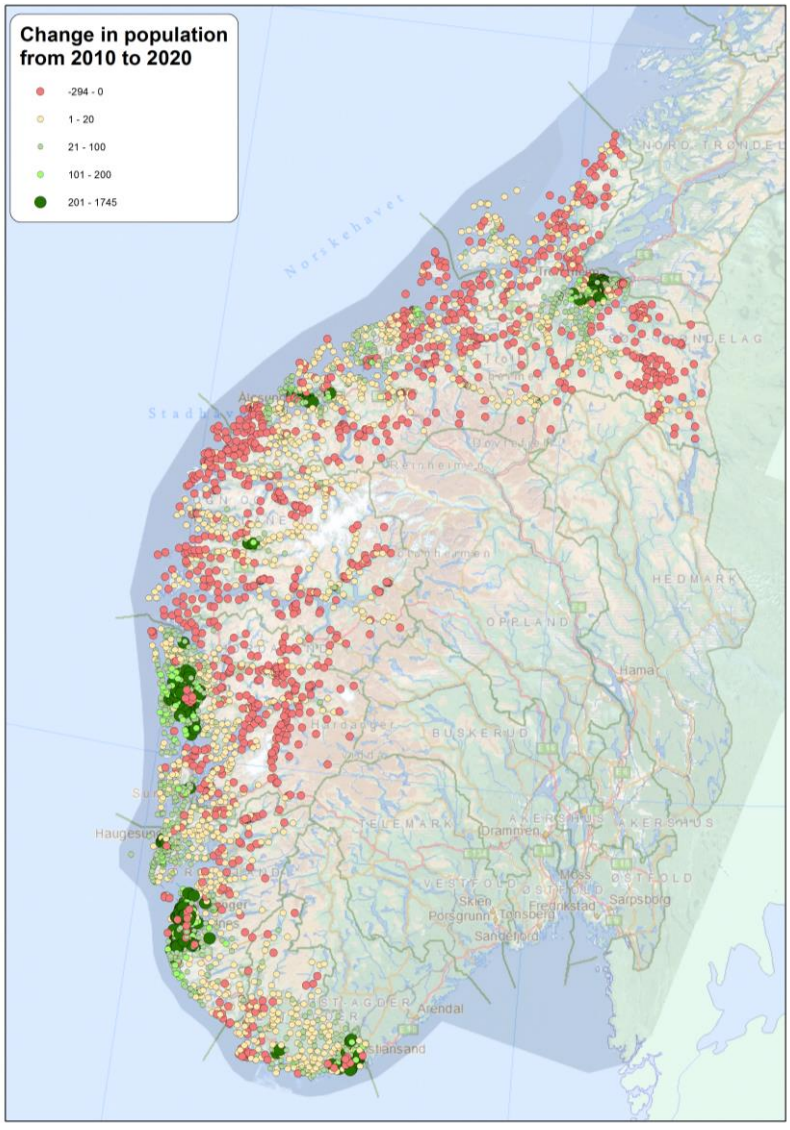

Fig. 7 Population growth from 2010 to 2020, showing the centralization trend (red = reduction, green = growth).

For the ferry replacement projects the difference in method is probably not crucial, but the centralization trend probably gives overall reductions in the traffic on the ferry crossings.

3.3 How Was the Modeling of the Ferry Replacement Projects Received by the Quality Assessment Process?

The concept evaluations carried out have all been objects of quality assessments. The team that assessed the concept evaluations was given the opportunity to assess the model used and how.

The three concept evaluations regarding projects in Møre and Romsdal were assessed together. Terramar and Oslo Economics [9] had the following comment: "The method used is assessed as suitable. The method has been used for each road stretch and not for the whole distance. That could have been done to reveal if all kinds of measures for the corridor have been identified."

The concept evaluation for Aksdal-Bergen got no comments about the transport analysis [10].

The comment from the assessment of the concept evaluation of Boknafjorden was: "Our experience is that the models give reasonably realistic results when used to assess the impacts of measures in the transport system." [11-13].

To sum up, not one of the teams doing quality assessment was negative about using the transport model or the assumptions made for the specific analysis.

4. Concerns about Using the Transport Model

In addition to elements with the model system related to the concept evaluations, we also want to draw attention to other aspects with the transport model, which can be challenging in the current model. These are:

- Lack of validation data
- Description of the ferry trips
- Division between Tramod and NTM5
- Modeling commercial traffic

4.1 Lack of Validation Data

Many analysts have experienced and reported that some ferry connections get too little traffic in the basic situation. The reason has not been studied in detail, but the discount factor, the lack commercial traffic or the distance distribution may be plausible explanations.

Other suggestions have been that people who are used to being dependent on a ferry connection has a higher willingness to pay than the general population. Also is it is said that a ferry replacement project can be seen as an investment in the future for the residents in the area, since the fjord crossing will be free of charge eventually when the fixed link is paid for.

4.2 Modeling Ferries

The description of ferry trips in the model seems inappropriate. It is unlikely that one description fits all the ferries. It should be possible to specify each ferry crossing to fit the real service as good as possible. For some ferry connection, as an example, it should be possible to include capacity in the model calculation to represent the waiting time in a more realistic way.

4.3 Division between Tramod and NTM5

The short distance model Tramod produces trips shorter than 100 km. Longer trips are modeled by the NTM. Ferry trips imply time use on the ferry but not distance traveled by car, which controls which model should be used. When the ferry is replaced with a fixed link, the fjord crossing implies that the border for Tramod and NTM changes, and moves closer to the ferry connection. This is not realistic. It is not realistic that people travel shorter due to a fixed link, it is more likely that the reaction goes the other way.

4.4 Modeling Commercial Traffic

Freight traffic is included in a fixed matrix in the model, but this contains only trucks. Other commercial traffic, made by craftsman or home care local delivery services or local distribution of goods is not part of the

demand model in RTM. If the vehicle is smaller than a truck; like a van or smaller, the vehicle is not part of the freight matrix, and thus not represented in the RTM at all. This can become a substantial number of vehicles on some ferry connections.

5. How Could We Improve the Transport Analysis of Ferry Replacement Projects?

5.1 Including Wider Impacts

Transport infrastructure is an imperative for daily life and business participation. Getting a fixed link across a fjord implies an improvement with around the clock possibility to cross the fjord and a huge increase in the capacity and reliability. We can perhaps catch some of the transport related effects in the transport model, but probably not all of them.

We will expect to find all the previous traffic from a ferry on a new fixed link. Changes in destination choice are generally the other most prevailing behavioral effect in the transport model of a fixed link. Changes in route choice are rarely an alternative. The consumer surplus calculation will consist of savings in time use for all travelers on the fixed link, due to no waiting time, and faster crossing time. The longer driving distance on the fixed link is a secondary effect and amounts to a smaller cost than the earnings from reduction in time use.

Major improvements in the infrastructure might give considerable impacts for residents and business close to the fjord, beyond those that normally are included in analyses of changes in the transport pattern. In the KVU some those effects are, as an experiment included in the analyses. The impacts are however only concerning wider labor marked. This is an effect which is difficult to implement in the transport analysis. If this effect is put on top the already estimated effects from redistribution of trips to and from work, we risk double counting. New business, increased activities in existing businesses given in a number of work places, and moving pattern among residents, as a direct impact of a fixed link, would be better variables to include in the analyses.

5.2 Surveys

A contribution to improving the model would be to do surveys on ferry connections and on fixed links already built. The data collection could also include expansions in the work marked, the number of residents and other adjustments made by people and business to adapt to a fixed link instead of a ferry connection.

Current surveys are to a certain extent accommodated to be compared with transport models. Especially for the traffic not in the current model, local commercial distribution, home care services and craftsmen should be separated from the purpose “at service” in the model, to help estimate the number of trips not estimated in the model.

Since the national travel survey has too few data with ferry trips, the sample sizes should have been extended in municipalities or counties were ferries an important part of the transport infrastructure.

5.3 Description of the Ferry Trip

It seems unlikely that the rough way the ferry crossing is represented in the model, reflects how people perceive a trip with the ferry. Waiting times in real traffic are controlled by the capacity of the ferry and are expected to vary by trip purpose, while the model uses half of the headway to represent waiting time. The estimation process of Tramod_by [4] reported that the national travel survey used in the estimation, consisted of too few trips on ferries, and demonstrated the need for more data about the perception of ferry trips. Representing ferry trips in a better way was claimed to be the second most important improvement with the demand model, after city related challenges.

An impression that the model is too elastic regarding expenses has been introduced in discussions. This is not documented anywhere, and none of the ferry connections in the concept evaluation in this paper has

shown any weaknesses like that for the present situation. This could be because the traffic on the ferry was calibrated as part of the preparation of the model.

It is likely that the concept evaluations were done without assuming tolls on the fixed links, to overestimate the traffic on the fixed link, and it seems unfair to compare a free fixed link to a ferry trip which include ticket costs.

We think that the reason why the fixed links are assumed without costs is related to the impression about the elasticities. Another plausible explanation is that the concept evaluation process is rather new and that the recommendation about analyzing tolls on fixed links has not been developed yet.

5.4 Documentation of the RTM

Talking to analyst at the NPRA, they recognize the problem with too little traffic on some ferry connections. Part of the problem might be that the discount factor was not calibrated to each ferry connection, and that the expenses were too high in the model compared to real life.

The documentation about setting the discount factor could also have been more informative. An improvement in the model would imply to open for a differentiation in defining the discount factor for each ferry connection individually.

References

[1] The Norwegian Public Road Administration. 2012. *Evaluation of Concept Choice Investigation: Quality Assurance Phase 1*. Oslo: The Norwegian Public Road Administration, The Road Directorate.

[2] Minken, H., Larsen, O. I., Braute, J. H., Berntsen, S., and Sunde, T. 2009. *Concept Choice Evaluation and Impact Assessments*. Oslo: Transport Economic Institute (TØI).

[3] EconPøyry. 2009. *Evaluation of Passenger Transport Models. Report 2009-2010.* Oslo: EconPøyry.

[4] Rekdal, J., Larsen, O. I., Løkketangen, A., and Hamre, T. N. 2012. *Tramod_by Part 1: Establishment of a Newmodel System.* Molde: Møreforsking Molde.

[5] Odeck, J., and Bråthen, S. 2008. "Travel Demand Elasticities and User Attitudes: A Case Study of Norwegian Toll Projects." *Transportation Research Part A* 42: 77-94.

[6] Lian, J. I., and Rønnevik, J. 2010. "Wider Economic Benefits of Major Norwegian Road Investments."

[7] COWI. 2012. *Wider Impacts of Investments in the Transport Sector*. Oslo: Report for the Ministry of Transport and Communication.

[8] Heum, P., Norman, E. B., Norman, V. D., and Orvedal, L. 2011. *Labor Market Impacts of a Ferry Free Connection Bergen-Stavanger.* Bergen: SNF.

[9] Terramar, and Oslo Economics. 2012. *Quality Assessment of the Concept Evaluation of E39 Skei-Valsøya.* Oslo: Terramar AS og Oslo Economics AS.

[10] Dovre and TØI. 2012. *Quality Assessment of the Decision Basis for the Concept Choice.* Stavanger: Dovre group and the Transport Economic Institute.

[11] Torgersen, P., Larsen, O., Olaussen, S., Rekdal, J., and Stake, G. 2007. *Quality Assessment of the Concept Evaluation of E39.* Metier and Møreforsking: The Coastal Highway Boknafjord.

[12] Skjetne, E., Levin, T., and Norvik, R. 2008. *Transport Analysis of Ryfast.* Trondheim: SINTEF.

[13] Transport Economic Institute. 2010. *TØI report 1065/2010*. Oslo: Transport Economic Institute.