Institute of Transport Economics
Norwegian Centre for Transport Research

Summary:

Future logistics solutions in Norway

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Changes in the organisation of industry and trade in the direction of fewer production units and more centralised wholesale in combination with increased population and purchasing power lead to more complex supply chains that require efficient logistics and transport solutions. At the same time it is a goal to reduce greenhouse gas emissions from transport, especially in the cities. To achieve the emissions targets while maintaining a competitive business environment, it is important that good logistics solutions be developed. This requires more efficient organisation, better utilisation of cargo capacity and the use of less emission intensive transport solutions than today.

Background

This report is the final documentation of the project "Logistics in Norway". It contains a synthesis of five earlier reports illustrating different paths in the development of logistics organisation and in levels of logistics costs in Norway, but with primary emphasis on the following:

1. Review of different ways of quantifying logistics costs
2. Trends and development patterns in the structure and level of production and consumption
3. Logistics costs for Norwegian industry and comparisons with studies abroad
4. Framework conditions in the transport and logistics market and their impact on price levels and competition
5. Development of logistics organisation

The environmental challenges faced by the logistics sector are also discussed.

Freight flow matrices for a national freight model have been developed in a parallel project, DEMOLOG (Hovi and Johansen, 2013). The two projects combined reflect complementary knowledge about physical freight flows in and to/from Norway and about the logistics that determine choice of location and mode. In addition, there has been major activity in EU projects during this period, particularly in connection with urban distribution. In relation to the transport agencies' suggestion to NTP (National Transport Plan) 2014–2023, TØI has delivered a factual basis regarding freight flows and has developed forecasts for freight transport.

Developing trends in logistics organisation

The developing trends in Norwegian logistics organisation are to a large extent parallel to the global trends, where the most important characteristics affecting organisation and efficiency have been seen for 20–30 years and stand out as particularly important for changes in the logistics sector:

- Changes in regulations regarding commodity production, international trade and international and domestic transport

- Increased international trade and, consequently, increased long distance freight volumes
- Changes in the organisation of industry and trade sectors in the direction of fewer production units and more centralised wholesale
- Changes in requirements for transport and logistics
- Technological development (engine and combustion technology, information exchange, automation of terminals and warehouses)
- Increased requirements for security and predictability in transport systems
- Expertise and working conditions in the transport and logistics sector

There is a categorical partition in the trend development of logistics concepts between low and high value commodities. Logistics for low value commodities and products with long durability have cost efficiency as a primary objective, with high consolidation and lower requirements regarding reliability of delivery. For high value goods and products with shorter durability the logistics process is characterised by high demand for delivery reliability (Just-In-Time - JIT), a lower degree of consolidation and more integration between the parties in each value chain.

These changes result in increased transport volumes and distances and can be observed in Norwegian domestic transport (Vågane, 2012). Additional consequences are: increased complexity in transport and logistics systems, increased greenhouse gas emissions related to transport activity, and increased requirements for infrastructure quality, hence increased needs for investment and maintenance.

Logistics costs

A survey examining logistics costs among Norwegian commodity supplying firms shows that logistics costs on average amount to 14.2 per cent of the turnover. The share is higher for wholesalers than for manufacturers. Transport and warehousing are the two main cost components. The survey also shows that the logistics costs ratio is higher for sectors delivering commodities with low value than for sectors delivering processed or high value commodities. This is the case despite the fact that commodities with low value are transported mainly over short distances, while high value commodities often have a more centralised production structure and are therefore often transported over long distances. This illustrates that efficient transport solutions are more important for sectors delivering low value goods than for those delivering high value goods, where high frequency and fast delivery are the most important criteria for choice of transport. This is also a factor explaining why sea and rail are often used for low value commodities, while high value goods are transported by truck.

The survey shows that the marginal costs of logistics services are decreasing for both transport and warehousing, and this is assumed to be an important driving force behind centralised production and centralised wholesale and warehousing.

External conditions

The ratio of transport costs that arises due to external conditions is estimated based on transport cost functions from the logistics model (Grønland, 2011). For long distance transport, wages and social costs amount to the largest share of the total

cost (40 per cent). Fuel and taxes/fees amount to 24 per cent and capital costs, including depreciation and interest, to 16 per cent.

Comparing wage costs for Norwegian drivers with those of drivers residing in one of the new EU countries, the cost difference is between 80 and 90 per cent. This corresponds to a difference of 34 per cent in total costs and illustrates why Norwegian road and rail modes lose market shares for border crossing transport. In addition to the fact that there are more imports to than exports from Norway, this cost difference contributes to offering Norwegian exporters cheap return transport out of the country. A factor limiting the exploitation of this capacity is that import shipments have destinations usually in the Oslo area, while most export shipments originate in the western parts of Norway.

Today's commodity flows

Many national suppliers have their main warehouses localised in the Oslo area, where shipments of general cargo from manufacturers in eastern Norway are received before commodities are distributed nationally. This leads to unbalanced freight flows, where domestic shipments of bulk are imported to the region, while general cargo is exported. There are also more imports than exports for this region.

Roughly speaking, Norwegian commodity export can be divided into five groups: (1) natural resources, (2) intermediate goods, (3) manufactured goods, (4) high-technology products, and (5) petroleum. Global demand for raw materials has meant increased prices of minerals and ores, which in turn has led to the reopening of mines and, as a consequence, increased transport volumes of minerals. A product that constitutes a large and increasing share of the export is gravel (crushed stone). According to NGU[1], a quantity of 21 million tonnes of gravel was exported to Europe in 2011 compared to 2 million tonnes in 1988. This increase explains much of the growth in total export volume from continental Norway, where Rogaland is the largest export county.

Intermediate goods are delivered by energy intensive processing industry, a sector where choice of location was originally based on availability of cheap energy. Many of the facilities are old with relatively low production capacity, and will probably be replaced by modern facilities with higher capacity. These may be located in Norway, but could also be moved to countries where production costs are lower or to locations where transport costs are less.

The sector for high technology products is growing. In 2012 this amounted to only 2 per cent of the total tonnes exported, yet it is an important export commodity group. These products require high quality transport. In an article regarding research and development in business activities by Bye et al. (2008), it is emphasised that high-technology exports will replace the traditional export oriented processing industry.

Imports of manufactured goods have almost doubled – as measured in tonnes – between 1999 and 2012, and are the commodity group with the highest growth in terms of imported tonnes. The growth in manufactured goods imported is to a large

[1] NGU is the national institution for knowledge on bedrock, mineral resources, surficial deposits and groundwater in Norway.

extent a reflection of the growth in domestic consumption, where foodstuffs, metal goods and cars are the main contributions.

Environmental challenges

Measures to improve energy efficiency and at the same time reduce GHG emissions are necessary in all sectors to mitigate climate change, and this also applies in the freight and logistics sector. The new White Paper for European transport (European Commission 2011) sets a target for GHG emissions from transport to be reduced by 60 per cent of the 1990 level by 2050 and by 20 per cent of the 2008 level by 2030. The target for the transport sector is less ambitious than for other sectors (80–95 per cent reduction to keep global warming below 2°C), which shows that transport is a serious challenge in climate politics. The White Paper also states that limiting mobility is not an alternative because freight is an important component of economic growth. Achieving the target requires better coordination between the different modes, but also significant technological development. In cities the target is more ambitious, i.e. CO_2 free city distribution within the year 2030.

How the transport sector can contribute

To reach the emission targets and at the same time maintain a competitive business environment, it is important that proper answers are found. Many transport and logistics solutions that are good for the environment turn out to be cost effective, too (Eidhammer et al. 2012), which is a driving force for development of environmentally friendly solutions.

In a survey about environmental challenges in the near future, the Norwegian transport companies were asked about their view on, among other things, what could be done to reduce fuel consumption. The following factors were specified in non-ranked order:

- Investment in transport material with the newest possible combustion technology
- Regular training of drivers in eco-friendly driving
- Systems monitoring fuel consumption
- Programmes for fleet management and route optimisation for transport planning
- Speed limiters mounted on vehicles
- The correct air pressure in tyres
- Use of sea and rail transport when this is convenient

The transport companies were also asked what the shippers could do to allow for more efficient exploitation of loading capacity and thus a reduction in vehicle kilometres driven. According to the transport companies, the shippers have to cooperate with their clients to a greater extent, delivery times and frequencies are determined mainly by the requirements of the clients. The trend towards smaller, more numerous and more frequent deliveries with equal delivery time for the whole country is said to explain the increased use of road transport with low utilisation rate. If the client were to order transport services at an earlier stage and accept lower standards for delivery time, so that the transport companies could exploit loading capacity more efficiently, it would be possible to reduce the total distance driven. It was also mentioned that transport users had to be willing to pay extra for transport

by hybrid cars or other environmentally friendly alternatives, if these are ever going to come into use.

Future development of freight volumes

On the demand side, important driving forces for growth in national freight volumes are population growth, increased purchasing power, industrial growth, degree of internationalisation and outsourcing of production to low-cost countries. Others are infrastructure development, access to and prices of inputs such as fuel and labour.

According to SSB (Statistics Norway), which provides annual forecasts, the population will increase in all counties of Norway up to 2040. Growth will be strongest in the largest cities, and there are expected to be approximately 400,000 inhabitants in Oslo and Akershus. Eighty municipalities in North Norway and in parts of South Norway have an expected population growth that is negative in the period up to 2025. If the population forecasts come true, volumes will increase and a larger share of commodities will be delivered to cities, resulting in a gain in efficiency on long distances, but a challenge when it comes to the target of CO_2 free urban freight transport by 2030.

In a future perspective, the largest unknown factor in addition to population growth will be the development of the industrial structure and how this will affect the demand for freight. The central question is what sectors will be predominant and what type of intermediate goods they will demand. If development continues in the direction of service production, with low domestic production of goods and high imports, an essential factor explaining modal distribution at the border crossing and domestic distribution will be the location of the most important commodity manufacturers. A further increase in imports from Asian countries and perhaps also from African countries will lead to increased transport by sea and possibilities for direct distribution of imports to a port near the final destination, rather than increased trade with Eastern Europe. In the latter case, a further expansion of inland transport is more likely, and it will be important to put more effort into finding solutions for rail. If, on the contrary, the development moves in the direction of domestic manufacturing industry with a high degree of autarchy and increased exports, pressure on the Oslo region as a transition between foreign transport and domestic distribution will be reduced.

Increased needs for transport coordination

Reduced freight volumes to the remote areas and higher costs will increase the demand for coordination of transport services between firms as well as sectors. This is a solution that may reduce costs as well as contribute to an environmental gain. The challenge is how to design a scheme leading to increased cooperation between competitors in the market.

The distribution of imports also has a coordination improvement potential. If commodities were cross-docked in containers in producing countries, the container could be transported to a point as close to the consumer as possible. This would increase the distance the commodities could be transported by sea and potentially disburden the Oslo area from its role as a centre for domestic distribution of imports. This method is utilised by some suppliers already, either by direct imports to

regional warehouses or by direct imports all the way to the retailer. Currently, this applies mostly to voluminous commodities with high durability and low value.

Effective and environmentally friendly urban distribution

Freight transport is indispensable to a city's economy, but at the same time it affects the quality of life of inhabitants. Urban areas are particularly challenging for freight transport when it comes to logistics and the environment. A key issue in logistics is the transition between long and short haul transport, which affects the modal distribution for long distance transport.

Currently, a range of ongoing pilot projects financed by the EU's framework programme for transport research focuses on more environmentally friendly urban distribution. Examples of these are:

- Distribution by electric truck or by electrically driven hopper trains based on cross-docking and co-loading in a freight terminal at the outskirts of the city centre
- Distribution by electric barge to shops, hotels, restaurants and cafés in cities with canals
- Distribution of small parcels by electric bicycle, and also the use of bicycles when delivering to places where other modes of transportation are prohibited
- Night time deliveries carried out faster and with less fuel consumption. This concept reduces the amount of both local and GHG emissions. The challenge is noise, which may be reduced by the vehicles being equipped with carpeted floors, a specialised lift system and low noise tyres.
- Semitrailers equipped with terminal facilities like loading ramps, shipment labelling, computer access, etc., functioning as mobile freight terminals. The semitrailer is loaded in the morning with commodities to be delivered near the city centre the same day and to a nearby place where they can be transhipped to electrically driven bicycles carrying out the last leg of the transport.
- Low emission zones limiting access to particular areas in larger cities. Heavy trucks usually prohibited in low emission zones; emission regulations tied to euro class; and exhaust abatement equipment mounted on vehicles.

In addition, it is important that terminals be better fit for purpose, because these constitute the node between long and short haul transport, affecting both urban distribution and modal split on the long distance leg of the transport.

How different parties affecting the transport chain can contribute

In the table below, measures that apply to different parties and that affect the transport chain are synthesised. They are meant to help the parties comply with emission reduction requirements and at the same time increase the efficiency of logistics. It is clear, however, that many of these measures can be expensive, in particular for the government, so they have to be evaluated against each other. No order of priority is imposed for the items in the table.

Table S. 1. Summary of measures affecting the value chain that different parties can conduct to comply with requirements for emission reductions and increased efficiency of logistics.

Transport companies:	Terminals:	Transport user (shipper):	Client (receiver):	Authorities:
Coordinate transports and increase utilisation rate.	Increase space efficiency.	Reduce frequency of shipments.	Make better plans for purchases.	Be a role model with regard to plans for purchases.
Increase the use of clean fuels.	Automate the terminals.	Fewer days per week with shipments.	Report how much transport is needed in decent time.	Prepare for production of second and third generation bio fuels.
Invest in material based on fuels other than fossil fuel.	Drivers gain access to loading and unloading outside business hours.	Increase shipment size.	Reduce requirements for delivery time.	Initiate distribution for clean fuel alternatives in the starting phase when volumes are small.
Optimise speed for reduced fuel consumption.	Administration of shipping arrival should be automated.	Use of packaging with standardised measures for optimal utilisation of capacity.	Transport companies must have access to supply of goods 24/7.	Capacity expansion in rail terminals and ports where there are bottlenecks.
Increased use of fleet control, tracking and route optimisation.	Real time monitoring of transport carriers via GPS.		Require environmentally friendly transport solutions.	Ensure recruitment for the transport and logistics sector through adapted educational facilities.
Regular courses in eco-driving and right tyre pressure.				Improve rail bottlenecks and road access to terminals.
Make emission amounts related to different transport solutions visible.				More effective planning.
Differentiate transport costs subject to requirements for delivery time.				More predictable financing of infrastructure projects.
	Increased information flow.			Economic measures for motivating intermodality.
	Status and deviations have to be reported and automated.			