

## WHERE DOES THE GROWTH OF ROAD FREIGHT TRANSPORT END AND WHAT CAN POLICY MAKERS DO ABOUT IT?

Completed a masters degree in 2000 on Technological Culture. Currently senior advisor on the influence of road freight transport on road management at the Centre for Transport and Navigation of the National Road Authority Rijkswaterstaat.



Loes Aarts  
Rijkswaterstaat  
The Netherlands



G.R. ZOMER  
TNO, Business Unit Mobility and Logistics,  
The Netherlands

Gerwin obtained a Masters degree on Industrial Engineering and Management. He has over 10 years experience in logistics business consultancy and policy advise on logistics and freight transport. Currently he is a senior advisor on logistics and road freight transport at TNO.

### Abstract

This paper highlights the need to increase the efficiency of road freight transport. It starts describing the historic growth of road freight in Europe and the main drivers behind this growth. A critical review of the future outlook on these drivers puts future growth in perspective. Regardless how the growth pattern will evolve, striving for increased transport efficiency is generally in the interest of policy makers. Often also the transport and logistics industry is in favour of increased transport efficiency. However, logistics efficiency is preferred above transport efficiency and sometimes the two can be conflicting. Conflicts might also appear between industry needs and society needs or even between different society needs. The transport efficiency measures listed in the recent OECD report of the working group on Heavy Vehicles have been clustered into four categories and have been assessed in the light of these possibly competing needs and provide a useful base for effective policy measures with respect to road transport efficiency.

**Keywords:** Transport efficiency, forecast, payload capacity, logistics efficiency, ..

## 1. Introduction

The motivation to write this paper is the intensified attention of policymakers to the environmental impacts of road freight transport. Challenging objectives on reducing the carbon footprint of transport brings transport efficiency under increased attention. The OECD working group on Heavy Vehicles recently submitted a report on this subject. The authors want to highlight the importance to understand the role of transport in logistics strategies, thus providing guidance to policymakers to increase the effectiveness of their policies aiming at increasing road freight transport efficiency.

## 2. The development of road freight transport in Europe

Road freight transport has been growing almost uninterrupted in the past decades, whereas alternative continental modes like rail and inland waterway transport stabilize. Regarding to the transport modes on land, road is by far the most dominant and its importance is even increasing. The average yearly growth in the period 1995-2007 was 3.2% per year, which was higher than the average GDP growth in the same period.

The most recent forecast/foresight projects under the authority of the European Commission are Transvisions [13] and FreightVision. Transvisions provides a set of long term scenario's (2030-2050) for the future transport and mobility (freight and people) in Europe (2009). Freightvision ([www.freightvision.eu](http://www.freightvision.eu)) is a project in which all stakeholders work together to come to a long term vision and action plan for sustainable long-distance freight transport policy (March 2009 – February 2010). Both projects are based on the state-of-the-art European transport network model TRANS-TOOLS ("TOOLS for TRANsport Forecasting AND Scenario testing"). The European Commission's services agreed to use TRANSTOOLS as the main model for transport policy analysis.

FreightVision [14] estimated a 27% increase of truck tonne-km between 2005 and 2020 and 40% between 2005 and 2030 within the EU27. That corresponds to an average growth of 1.6% per year until 2020 and 1.0% per year between 2020 and 2030, which is considerably lower as in the past decades. The development in tonne-km differs heavily between the EU27 countries, due to the differences in GDP growth. In Eastern European countries the increase in GDP will be strong comparing to countries like The Netherlands, Denmark and Germany, where the growth in GDP is expected to be low.

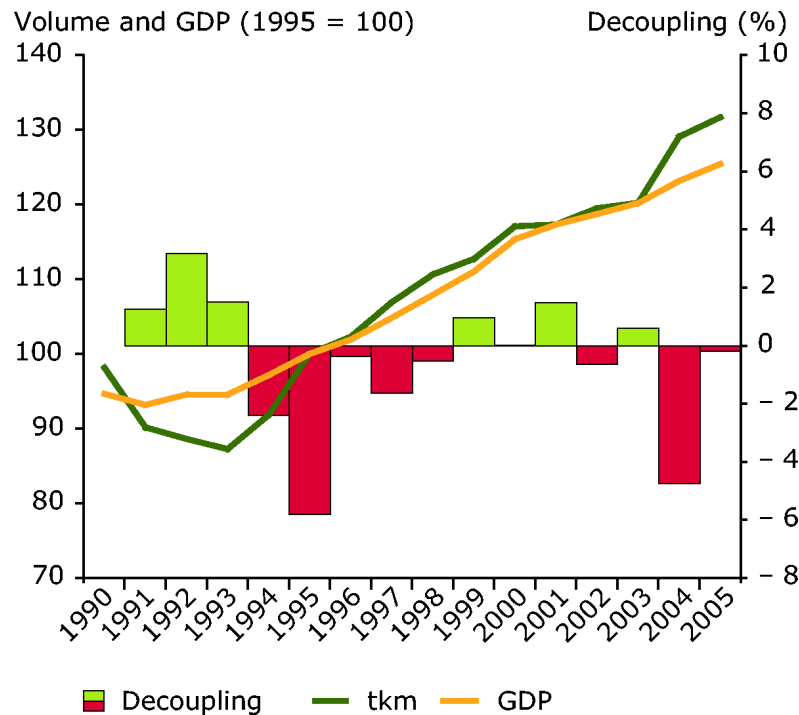
### 2.1 Drivers of growth

Transport is a derived demand. Logistic requirements determine the transport requirements. Starting with an analysis of the main drivers behind the historic growth, we try to see how future trends influence these drivers. The main drivers are clustered in three groups:

- Economic and welfare growth
- Changing patterns of production and consumption
- The evolution of transport costs

### *Economic growth and evolution of welfare*

Historically, there has been a strong correlation between GDP growth and freight transport growth in the European Union, though there have been periods of decoupling and periods of recoupling, see figure X. In Transvisions it is expected that the average yearly growth of road freight transport on EU territory will be 1.3% per year between 2005 and 2020, 1.7% between 2020 and 2030 and 0.7% between 2030 and 2050. Average GDP growth will be substantially higher, 2.4% per year between 2005 and 2020 and 2.2% per year between 2020 and 2030.



**Figure 1 – Decoupling tkm and GDP in Europe [5]**

Also relevant for the growth of freight transport is the GDP per capita. The purchasing power of the population determines the quantity and the range of products. Although the population of Europe will not increase very much anymore, the purchasing power is expected to be close to that experienced in the last four decades [8]. For all 27 countries of the European Union together, the evolution of GDP per capita in 1,000 Euros at 2000 prices from 2007 to 2050 shows an increase of 74% [1]. Again, there are strong differences in purchasing power growth rates between West European and East European countries.

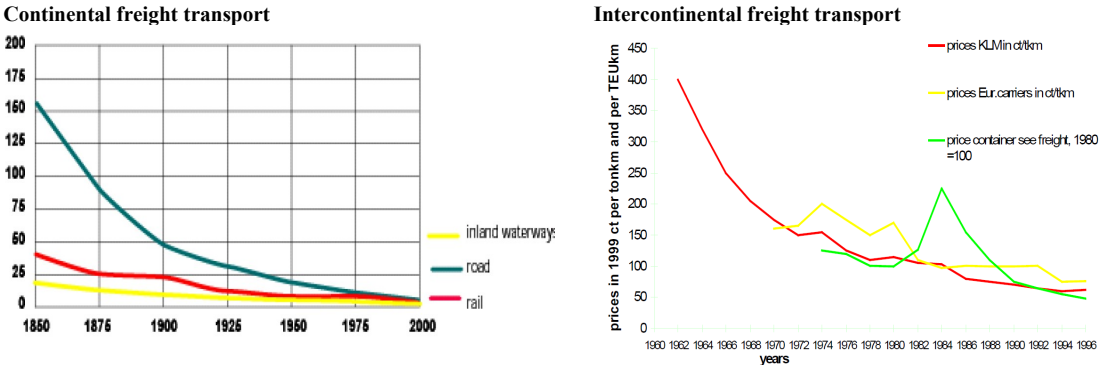
### *Changing patterns of production and consumption*

Globalization has been and will be a strong driver of freight transport. Europe's imports from China have grown by 21% per year in the period 2002-2007. Trade liberalization and the removal of trade barriers have been a stimulus for this development. In terms of overall supply chain costs, it appears to be more efficient to shift production, despite the increase in transport distances. The trend of specialization furthermore has contributed to more transport movements over longer distances.

In the baseline scenario of Transvisions for the European Union, for the period up to 2030, long distance freight by road and rail is expected to grow faster than short distance freight. The overall average growth in freight transport by road and rail is 1.6% per year, where as freight transport on long distance classes has an average annual growth of 1.75% [13].

*Evolution of transport costs*

The third main driver of road freight transport is the reduction in transport costs. Over the years the cost of transport, both continental and intercontinental, has dropped enormously.



**Figure 2 – Price development continental and intercontinental freight transport [2]**

State-of-the-art forecast (scenario) studies like TRANS-TOOLS and the Dutch Prosperity and Social Sustainability Scenarios [7], all assume a further reduction of the transport costs, due to technological developments and increased logistics efficiency. These studies reckon with a reasonable increase of oil prices in the future, but assume the impact on transport growth will be limited.

**2.2 Reflection on the growth assumptions**

Though the transport demand models assume a further increase of road freight transport in the future, the growth rates are flattening and seem to decouple from GDP growth. In regions with high GDP per capita, growth will be substantially lower. This indicates that after the economic catch up of East European countries, growth might also flatten in those regions.

Second, the changing patterns in production and consumption have caused a strong increase of long distance road transport. In the forecast models, this is expected to continue for the coming decades. However, there are also signs of a transposition to shifting production back from Asia to Eastern Europe or North Africa.

Third, the strong reduction in transport costs accelerated the process of globalization and induced freight transport growth in Europe. Though the forecast models assume a further reduction of the costs of freight transport, recent cost developments in road freight transport indicate we might have reached the bottom. Cost factors like wages and fuel prices are expected to increase quicker than the productivity improvements.

Also in recent scenario analysis, mobility and freight growth is no longer taken for granted in all scenarios. Some of the four scenarios for the 2050 horizon of future transport in Europe also take into account supply side elements like government interference and infrastructure investment bottlenecks. These scenarios are [13]:

- Induced mobility (Moving alone): this scenario is characterized by strong economic growth in a further liberated market and a small increase of population. High GDP growth allows high investments in technology and infrastructure to reduce CO<sub>2</sub>. There are risks for social sustainability.
- Decoupled mobility (Moving together): this scenario combines moderate economic growth with strong social sustainability. Public institutions and civilians work together in a new social contract. Cost-effective policies are applied to reduce negative effects of transport.
- Reduced mobility (Moving less): this scenario combines weak economic growth with strong social and environmental sustainability. Government interferes strongly into market processes with public approval, not in a cost-effective way, by reducing demand for transport, reduce long distance transport and force modal shift.
- Constrained mobility (Stop moving): in this scenario an initial strong economic growth comes to an end around 2030, due to structural failures like a lack of investment in infrastructure and the failure of implementation of new technologies. Regulations and bans are necessary to reduce emissions. A weak economic growth leads to weak social sustainability.

The ambition of Europe's transport policy has always been free mobility of goods and people within a framework of harmonized regulations. Road freight transport is a vital link in the economy, but it has another side. To minimize undesirable effects of road freight transport, and pushed by increased environmental awareness, increased transport efficiency seems to contribute to all of these policy objectives. From this perspective transport efficiency simply means we have fewer trucks on the road to move the same amount of goods. If there are fewer trucks, the accessibility of economic centers can still be guaranteed; there will be fewer fatalities by traffic accidents with the involvement of trucks; the maintenance of the road infrastructure will cost less money; and there will be a reduction of emissions. Transport efficiency seems to be in everyone's interest and it often is. However, in the next section it is showed that in some cases there are different perspectives on the concept of transport efficiency.

### **3. Transport efficiency perspectives**

The concept of transport efficiency is not unambiguous. There is no common understanding of what is meant by transport efficiency. Transport efficiency is quite generically (e.g. by Wikipedia) a measure of how much it costs (in dollars, time, energy or other kinds of overhead) to move a certain amount of something (goods, people, other types of load). There are many variations on the interpretation of this generic definition.

Transport efficiency is often not a goal in itself, but part of logistics efficiency, which in turn is a result of the business strategy of companies. The business strategy determines the logistic objectives (e.g. cost driven, service driven or a combination of both). The purpose of logistics efficiency is to realize the logistic requirements against the lowest total logistic costs. Total logistic costs are the sum of costs for transport, warehousing and inventory. So transport efficiency alone not necessarily contributes to logistics efficiency.

The road transport operator is interested in the cost of offering a transport service, executing the road freight transport efficiently and aiming to improve its productivity. The end user, often a shipper or importer, is interested in improving logistics efficiency. Though this is often in line with improving the efficiency of the transport leg, it is not always the case. The societal interest is to reduce and mitigate the negative impacts of road freight transport. These potential conflicting views will be discussed later on in this paper.

### 3.1 Logistics efficiency

Logistics efficiency and transport efficiency often go hand in hand. Basically, many instruments aiming to increase transport efficiency, result in lower transport costs per unit and contribute to logistics efficiency also. However, logistics efficiency does not consider the efficient execution of the road transport leg as such, but follow an overall logistics cost approach.

This leads to decisions on the chosen supply chain structure, which includes number, size and location of production, assembly and warehouse facilities. Given this structure, transport between different locations and final customers should be organized in an efficient way, either by the shipper himself or by a Logistic Service Provider. Main elements in transport logistics efficiency are service level requirements and logistics structures:

- The service level requirements contains the demands and wishes of the customer in terms of the requested delivery lead time (e.g. within 24 hours, next day delivery or in-night delivery) and the percentage of transport orders meeting these requirements. The service level requirements determines for the design of the logistics structure;
- The logistics structure (e.g. number and location of production and warehouse facilities) determines the handling factor. McKinnon defines the handling factor as the quotient of the weight of goods lifted and the weight of goods consumed and exported. A handling factor of 5 suggests that there are 5 links in the supply chain [9].

In some cases, logistics efficiency does not go hand in hand with transport efficiency:

- Choices for a logistic structure might result in a higher handling factor. This is often driven by logistics efficiency or specific service level requirements. A two tier model with first transport to a European Distribution Centre (EDC) and secondly replenishment from this EDC to national or regional distribution centers are in many cases contributing to logistics efficiency but often cause considerably more transport kilometers, although this transport can be operated in a relatively efficient way using full truck loads;
- A second possible conflicting situation is related to the order frequency and the trade-off between delivery costs and inventory costs. Increasing the order frequency and reducing the order quantity can result in a drop of transport efficiency and increased transport costs. However, the reduction of inventory costs might be higher, thus improving the logistics efficiency. Also the fulfillment of rush orders might be inefficient from the perspective of transport efficiency, but can be desirable economically.

In many logistics concepts, customer requirements lead to less efficient transport in smaller quantities using smaller vehicles. The enormous growth in vehicle kilometers driven by small vans confirms this development. Given the enormous growth figures in distant selling and home delivery, this trend will continue in the coming years.

### 3.2 Transport efficiency from the perspective of transport operation

In the transport operator's perspective, it is important to understand how efficient transport is being executed. It measures the productivity of road freight transport against the costs to provide the transport service. This is generally expressed in costs per ton km, which in turn depends on the costs per vehicle kilometer (production costs) and the payload per vehicle (productivity).

As can be seen in the figures below, in the past decades the average payload has increased and empty runnings declined. Moreover the substantially improved fleet utilization has led to a lower share of fixed costs in the transport unit costs per ton km. Since 1980 the yearly performance of a truck has been doubled.

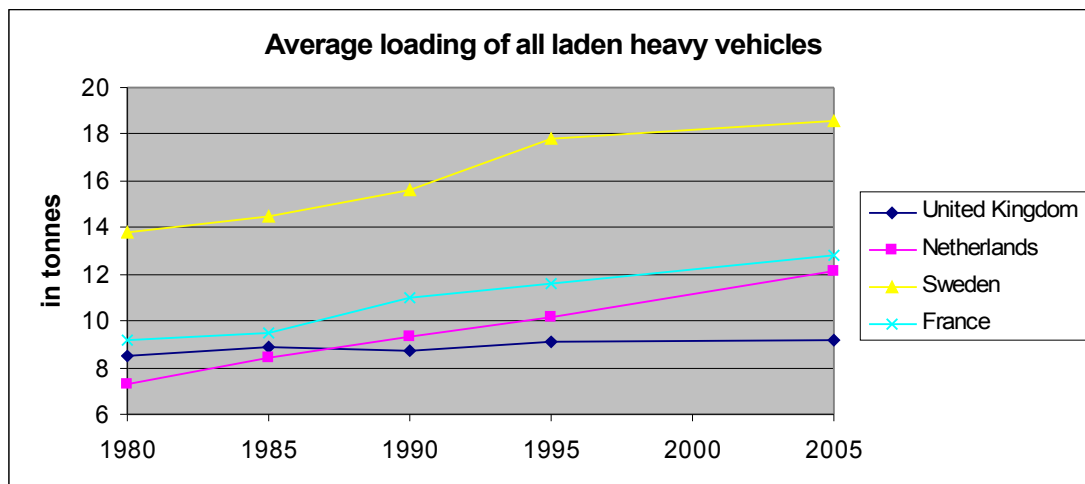
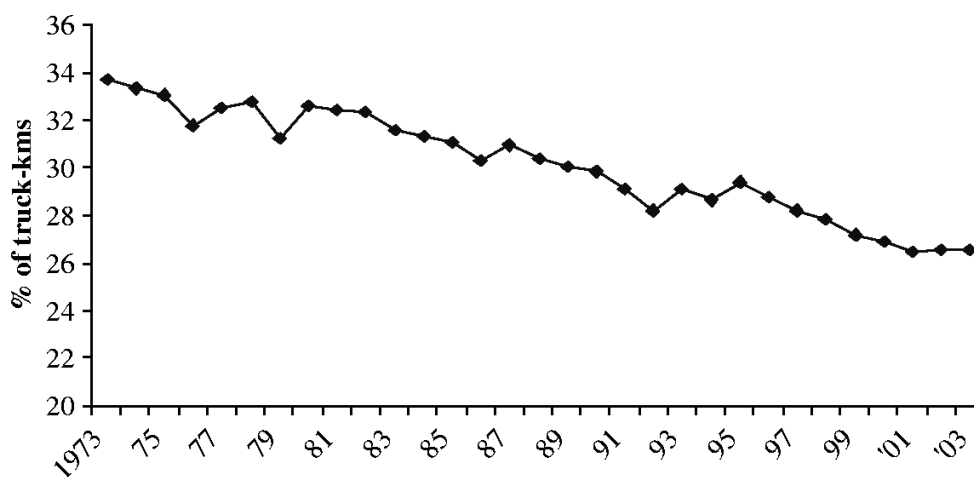


Figure 3 – Average loading of all laden heavy vehicles [10]



Source: Department for Transport, 2004

Figure 4 – Evolution of empty runnings in the UK [3]

Also empty runnings cannot be avoided always. It is often a result of structural imbalances between demand and supply on a macro level. Triangle backhaul operations can overcome these structural imbalances only to a certain extent.

The main cost element of the overall costs for providing road transport services include[11]:

- Fixed costs (e.g. depreciation, taxes, interest and insurances);
- Variable costs (e.g. repair, maintenance and fuel) → number of vehicle km per year
- Labour costs (e.g. wages and social premiums) → number of operating hours per year
- Specific transport costs (e.g. materials, quality controls and permits)
- General administrative costs (e.g. housing, other personnel and ICT)

All individual transport cost elements have increased substantially in the past 10-15 years, especially in the last 5 years. This is mainly caused by the steady increases in fuel prices and labour costs. The main drivers for the evolution in variable costs are the number of vehicle km driven per year and the number of operating hours for the truck driver. Though, as long as the productivity gains outweigh the increase in cost elements, freight rates can still decline. After a long period in which freight rates declined, due to strong increase of productivity, we experience an upwards trend as from the 1990s. Apparently, the productivity gains have flattened, whereas certain cost components like fuel and labour costs tend to rise.

### **3.3 Transport efficiency from the perspective of society**

The challenge for society is to reduce the negative external impact of road freight transport, and at the same time to facilitate road freight transport demand in order to maintain economic growth.

Generally, society benefits from increased road transport efficiency. A better productivity in road freight transport results in less vehicle movements, thus contributing to more sustainable transport. Therefore, policy makers have to develop measures for further improvement of road transport efficiency. To be sure taken measures are effective, it is necessary to be aware of the different perspectives on efficiency. Taking into account these different perspectives, can lead to approach different stakeholders that are able to realize efficiency gains, or can prevent overlooking essential keys for success or negative side-effects for other goals in public interest. Some examples of conflicting societal needs in relation to transport efficiency are:

- The quality of life versus transport efficiency: measures like time windows or access restrictions to keep up the quality of life in city centers can cause inefficiencies in urban distribution. More small vans are necessary to deliver the same amount of goods.
- Travel speed and traffic safety: The optimum speed for heavy vehicles from the perspective of emissions and traffic circulation is 90 km/h. Because of traffic safety the speed for heavy vehicles in Europe is limited to 80 km/h.

Furthermore, policy makers have to understand that the market is in some cases willing to accept and pay for the less efficient execution of these kinds of transports.



#### **4. Some examples from the OECD-report Moving Freight in Better Trucks, of shared and competing needs in transport efficiency**

In 2007 the OECD working group on Heavy Vehicles started her work on looking for measures for balancing the competing needs of society regarding long distance road freight transport. The purpose was to identify potential improvements in terms of more effective safety and environmental regulation for trucks, backed by better systems of enforcement, and to identify opportunities for greater efficiency and higher productivity. The results of the study of the working group can be found in the report Moving Freight with Better Trucks.

In the above section the concept of efficiency related to transport has been analyzed. In this paper this analysis is applied to a selected number of potential measures, mentioned in the OECD-report, to realize transport efficiency. These selected potential measures are taken as an example to illustrate the different perspectives on transport efficiency. The basic assumption is freedom of freight mobility with no interference in the demand of transport.

##### **4.1 Transport efficiency measures in OECD-report**

The potential measures of the OECD-report aiming transport efficiency can be divided into four groups, that means measures aiming:

1. to reduce fuel consumption;
2. to improve productivity;
3. to enlarge the capacity;
4. to improve the use of infrastructure.

##### *Reduction of fuel consumption*

A reduction of fuel consumption can be realized by improving the engines; optimize the aerodynamics of a truck; reduce the rolling resistance of tyres; optimise the driveline; reduce the energy that is needed for auxiliaries; and learn the driver to drive economically (eco-driving). None of these measures alone will lead to a substantial reduction, but all measures together can be of decisive importance.

A reduction of fuel consumption is of public interest because it leads to a reduction of CO<sub>2</sub> emissions. A reduction of fuel consumption is also in the interest of the transport sector, because it leads to a reduction in costs. In this case the measure is in everyone's interest, and there are no competing needs.

##### *Improve productivity*

The productivity of transport can be increased by improving the cooperation within the supply chain and vertical collaboration between companies with a similar profile. Such forms of collaboration can be facilitated by so called E-marketplaces. Regulations making legal constructions for a clear and fair allocation of profits possible, can encourage collaboration. Furthermore productivity can be improved by implementing Tracking & Tracing Systems, making moving freight a visible process. A more delicate potential measure is to encourage reconsidering of the urgency of Just-In-Time deliveries. In some cases a reconsideration of planning and engagements within the supply chain can lead to freight collection or transport outside rush hours.

The public interest of improving the productivity of freight transport is to reduce the volume of truck traffic to prevent congestion. Less freight vehicle kilometres means furthermore less fuel consumption and therefore a reduction of CO<sub>2</sub> emissions. These measures are in most cases in the interest of shippers, as long as their customer relationships are not harmed. The measures could be in the interest of transport companies as long as they will not lose income. So, measures to improve transport productivity are under certain conditions in everyone's interest.

#### *Enlarge capacity*

The weight and dimensions of trucks are regulated in consideration of traffic safety and the carrying capacity of the infrastructure. Enlargement of the capacity of freight vehicles can be realized by increasing the load capacity or increasing the maximum weights and lengths of heavy vehicles. Another possibility is to require a minimum of payload mass efficiency for freight vehicles.

It is obvious that in the first two examples such like measures are both in public interest as well as in the interest of companies. Fewer trucks are necessary to carry the same amount of goods: for society it means less freight vehicle kilometres and for shippers it means a reduction of transport costs. Transport companies can distinguish themselves from their competitors by offering innovative high capacity vehicle concepts. Requiring a minimum of payload mass could be against the interest of shippers and transport companies, if the required service level cannot be met.

#### *Measures to improve the use of infrastructure*

The quality of the infrastructure, good transshipment facilities between transport modes, and a minimum of time losses due to disturbances in the traffic flow, are essential for an efficient transport system. Several measures can be taken to improve the use of infrastructure: inventory and the tackling of bottlenecks in infrastructure and in transshipment of freight between transport modes; remove impeding rules between countries or within proceedings between transport modes; introduce smart (dynamic) traffic management systems to improve traffic circulation; introduce truck specific navigation for efficient route choices; construct dedicated lanes for truck traffic or upgrade routes with heavy truck traffic by for example good truck stop facilities; link the access to certain types of roads to the performance of heavy vehicles (Performance Based Standards); or create logistics parks near cities for efficient urban distribution.

All types of measures that reduce time losses are in everyone's interest. Society benefits from the influence of an efficient transport system on economics; companies benefit from a reduction in transport costs and the chance to meet required service levels. Measures that hamper the access to the infrastructure or economic centres are mostly not in the interest of companies and sometimes can conflict with the interests of society as could be seen in 3.3. In those cases cost-benefit analysis can provide a way out.

## 5. Conclusions

European road freight transport has shown a strong growth over the years, but growth is flattening the last decade. Transport policy no longer undisputedly aims to facilitate this growth. Pushed by increased environmental awareness and other policy objectives, recent transport forecast models also include scenarios with restrictive supply side elements, like government interference and infrastructure investment bottlenecks. Increasing transport efficiency seems to be the answer to cope with potentially conflicting policy needs.

Transport is a derived demand. Logistic requirements determine the transport requirements. Logistic requirements vary between different market segments and sectors. From the perspective of logistics increasing transport efficiency never is a goal in itself. Though transport efficiency often goes hand in hand with logistics efficiency, increased logistics efficiency can also cause transport inefficiencies. This reality has its consequences for the effectiveness of transport policy.

Transport efficiency has improved considerably in the past decades. Increase in average payload per truck and reduction of empty runnings, combined with a higher utilization of the fleet and corresponding truck performance have contributed to productivity gains. However, increase in cost factors like wages and fuel puts transport efficiency under pressure. Freight rates tend to rise again and possibilities for increasing transport efficiency have become more limited.

The good news is there is still room for improvement. With the right framework conditions and public interventions, policy makers can contribute to increased transport efficiency. The challenge is to improve transport efficiency by improving access, encouraging innovations, encouraging collaboration and supporting new technologies in information and communication systems. Understanding the potential conflicting policy needs and the role of transport in logistics efficiency is a necessity to develop a well balanced and targeted approach for different market segments; no one shoe fits all approach.

## 6. References

1. Anders, N., Knaack, F. and Rommerskirchen, S. (2009) FreightVision Deliverable 4.1, Socio-demographic and economic mega trends in Europe and the World – Overview over existing forecasts and conclusions for long-term freight transport demand trends in Europe, Funded by DG TREN.
2. Bleijenberg, A., (2008), “The driving forces behind transport growth and their implications for policy”, Paper presented on OECD International Seminar Managing the fundamental drivers of transport demand.
3. DfT (UK Department for Transport) (2006), Road Freight Statistics 2005, Transport Statistics Bulletin, London.
4. Directorate-General for Energy and Transport (2009) Statistical Pocketbook 2009.
5. European Environment Agency (2008) Maps and Graphs [www.eea.europa.eu](http://www.eea.europa.eu)
6. Eurostat (2007), Key Figures on Europe: 2007 edition, Eurostat.
7. Janssen, L., Okker, R., Schuur, J. (2006), Welvaart en Leefomgeving – een scenariostudie voor Nederland in 2040.
8. Kouvaritakis, N., Mantzos, L., Panos, V. and Tzelepi, N. (2009) Freightvision, Report on Transport related energy developments, Funded by DG TREN.
9. McKinnon, A.C., (1989), The Decoupling of Road Freight Transport and Economic Growth.
10. MTETM/SESP (Ministère des Transports de l'Équipement, du Tourisme et de la Mer/Service économie statistiques et prospective) (2006), Les comptes des transports en 2005. Premiers résultats. Paris.
11. NEA (2002) Factorkosten van het goederenvervoer
12. OECD (2009), Moving freight with better trucks – Improving safety, productivity and sustainability.
13. Petersen, M.S., Enei, R., Hansen, C.O., Larrea, E., Obisco, O., Sessa, C., Timms, P.M., Uljed, A. (2009), Report on Transport Scenarios with a 20 and 40 Year Horizon, Final Report (Transvisions), Funded by DG TREN, Copenhagen, Denmark.
14. Rich, J., Hansen, C.O. (2009) Freightvision Deliverable 4.3, Freight Transport Trends for 2020, 2030, and 2050, Funded by DG TREN.
15. Ruijgrok, C.J., & L. A. Tavasszy, (2007), “The development of International Freight Transport in Europe as a result of developments in International trade and Logistics”, paper prepared for the Canada’s Asia-Pacific Gateway and Corridor Research Consortium, Vancouver, BC, May 2-4.