ASSESS

Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010

FINAL REPORT
ANNEX IX SLAM TOOL MODEL RESULTS

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Preface

This is ANNEX IX of the final report for *'Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010'.*

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Scope

Scope of the ASSESS project

The ASSESS study is about the ***"Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010"***.

The European Commission's White Paper of 12.9.2001 "European transport policy for 2010: time to decide" aims to promote a sustainable transport policy. The White Paper proposes to achieve sustainability by gradually breaking the link between transport growth and economic growth, principally in three ways: changing the modal split in the long term, clearing infrastructure bottlenecks and placing safety and quality at the heart of the transport policy.

As foreseen, the White Paper on Transport undergoes in 2005 an overall ***assessment concerning the implementation of the measures it advocates and to check whether its targets*** - for example, on modal split or road safety - ***and objectives are being attained or whether adjustments are needed.***

ASSESS provides technical support to the Commission services for the above mid-term assessment of the White Paper.

The analysis accounts for the economic, social and environmental consequences of the proposed measures and their contribution to sustainable development objectives. It provides also a detailed analysis of those effects of enlargement likely to affect the structure and performance of the EU transport system.

The study takes a three pillar approach based on the use of analysis, indicators and models. National transport policies are reviewed for compatibility and coherence with the White Paper objectives. The models used allow a detailed analysis of the freight market, the passenger market and their infrastructure networks under a number of scenarios.

Scope of this Annex

In the White Paper logistics receives quite some attention in terms of developing "freight integrators" (besides the effects of Marco Polo are also to be included). The effects of the se measures on logistics are modeled using the SLAM (SCENES Logistics Appended Module) tool for the SCENES model.

In brief, the role of the SLAM is to allow a representation of logistical chains to be modelled. The result of SLAM is that, based on the original matrix transport derived from the SCENES, an indication of the logistical component is obtained: i.e. that part of 'trade flow' which does not go directly from its first origin to its final destination is split among various logistical chains. The major role of SLAM is improving the representation of freight traffic. This enhances the capability of the model to represent the transport performance in terms of tonnes-km derived from the overall amount of trades in terms of tonnes and tonne-kilometers.

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ANNEX IX Logistics

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IX.1. Introduction

The growth in freight transport presents governments with a challenge. Transport and economic policy plays an important role in maintaining, or enhancing economic competitiveness. Governments are also committed to reducing the negative effects of transport upon the environment. Policy measures designed to mitigate the undesirable effects of freight transport demand need not be aimed at vehicle or infrastructure alone, but can also be designed to influence the structure and behaviour of the supply chain and individual company's logistics strategies. The identification of different angles from which to develop individual policies requires an understanding of where they will impact on the relationship between economic activity and freight traffic demand at the most effective point. This understanding must be derived from insight into the drivers, barriers and enablers that affect individual firms logistical decision-making. These can be exemplified by examining the current trends in logistics and supply chain management.

One of the most obvious manifestations of logistics activities is the growth in freight transport measured in tonne-kilometres. As the lengths of haul, rather than increases in the number of tonnes lifted, have been the main past force in creating the increased demand for goods transport. As this is amongst others strongly influenced by changing logistic structures it becomes important to study effects of logistics. In the White Paper logistics receives quite some attention in terms of developing "freight integrators". These new emerging stakeholders in the transport sector are of relevance in developing tailor made solutions for shippers. In this sense a win-win situation could be obtained; i.e. lower cost solutions with lower external cost can be developed, due to efficient combinations; i.e. the longer transport time of intermodal solutions can be compensated by the lower cost and other service characteristics. The approach to analyse logistics effects in freight transport is to combine the SCENES results with the SLAM logistics model. The results for logistic developments included in this report are a supplement to the SCENES forecasting results, as such the results are distinctive; i.e. within the forecast of freight transport an estimation of the logistics activities therein are given.

The freight component of the SCENES transport model is composed of the Regional Economic Model (REM), which generates the transport demand, and the transport module, which performs modal split and assignment of transport demand. The REM uses a combination of Leontief input-output (I/O) structures in conjunction with a spatial allocation procedure and a matrix of transport dis-utilities to produce a matrix of trade in terms of value. These values are then converted to volumes by commodity type and origin-destination pair in order to produce origin/destination matrices of tonnes by flow of transport. In the transport module, origin/destination matrices are then assigned to the transport networks in a more 'conventional' fashion. Modal split and route choice are determined in the transport assignment module based on the characteristics of the flow type.

In brief, the role of the SCENES Logistic Appended Module (SLAM) is to allow a representation of logistical chains to be modelled (see chapter 3 for details). The matrix of flows produced by the Regional Economic Module (REM) is a matrix of economic trades translated into volumes (in this and in the following paragraph, the term 'trade flow' will be used for the amount of goods traded between two zones in terms of tonnes as produced by the SCENES model). However, when two zones trade a certain amount of goods, the shipments which will be generated could not be just between the two zones themselves. Instead part of the shipments can pass through third zones, e.g., where a warehouse is located. At the same time one or more changes of mode can take place, e.g., the final distribution from the warehouse normally uses road transport even if the shipment started by train.

The result of SLAM is that, based on the original matrix transport derived from the SCENES, an indication of the logistical component will be obtained: i.e. that part of 'trade flow' which does not go directly from its first origin to its final destination is split among various logistical chains. The major role of SLAM is improving the representation of freight traffic. This should enhance the capability of the model to represent the transport performance in terms of tonnes-km derived from the overall amount of trades in terms of tonnes and tonne-kilometers.

In terms of understanding the mechanisms that underlie the different performance indicators, such as tonnes transported, ton-kilometres and finally vehicle-kilometres, the following framework included in Figure 1, as derived from the Redefine report, is useful. The figure shows the relationship between the value of goods produced and road freight traffic demand as a series of key ratios.

- Value density: This ratio is used to convert the value based data recording economic activity into a weight based measure of production output. The ratio is derived from trade data. Though it bares some similarity to the density (i.e. kg/m3) of goods, it does not, necessarily, indicate any change in the physical density of goods in the economy.
- Handling factor: The ratio of tonnes-lifted to the weight of goods produced. Each item of production may be loaded onto a transport means several times during its movement along the supply chain (no doubt, on some occasions as part of a consignment): the item can therefore be recorded in transport statistics several times. The handling factor is a measure of this multiple counting and can be regarded as a rough index of the number of separate links in the supply chain. An item transported from a factory to a warehouse, from where a second truck delivers it to a retailer, would illustrate (part of) a supply chain with two links, and a production item with a handling factor of 2.
- Modal split: The division of the tonnes transported by the various modes of transport (e.g. sea, air, rail, and road) is called the modal split. A change in road transport's share affects the relationship between economic growth and road freight traffic demand. Road's share was expressed as the tonnes of production moved by road against the weight of all production.
- Average length of haul: This is the average distance of a loaded lorry's journey and, therefore, the average distance that each unit of freight moves on a single journey. This ratio is considered to be an average measure of the length of each link in the supply chain.
- Load factor (or lading factor): This is the ratio of what a lorry actually carried (in terms of weight)compared with what it could have carried if it was loaded to its maximum weight, weighted by the distance the lorry covered while carrying any load.
- Empty running: This is the proportion of vehicle-kms run empty against total vehicle-kms.

If each of these ratios remained stable, road freight traffic would be perfectly correlated with changes in the value of goods produced. In practice, each of these ratios can vary independently. By estimating changes in each of the key ratios through time, it should be possible to establish how much of the growth of lorry traffic is a function of economic growth and how much is attributable to logistical changes. This example is given for road freight transport, but also holds for other modalities.

Figure 1: Linking economic activity and road freight traffic

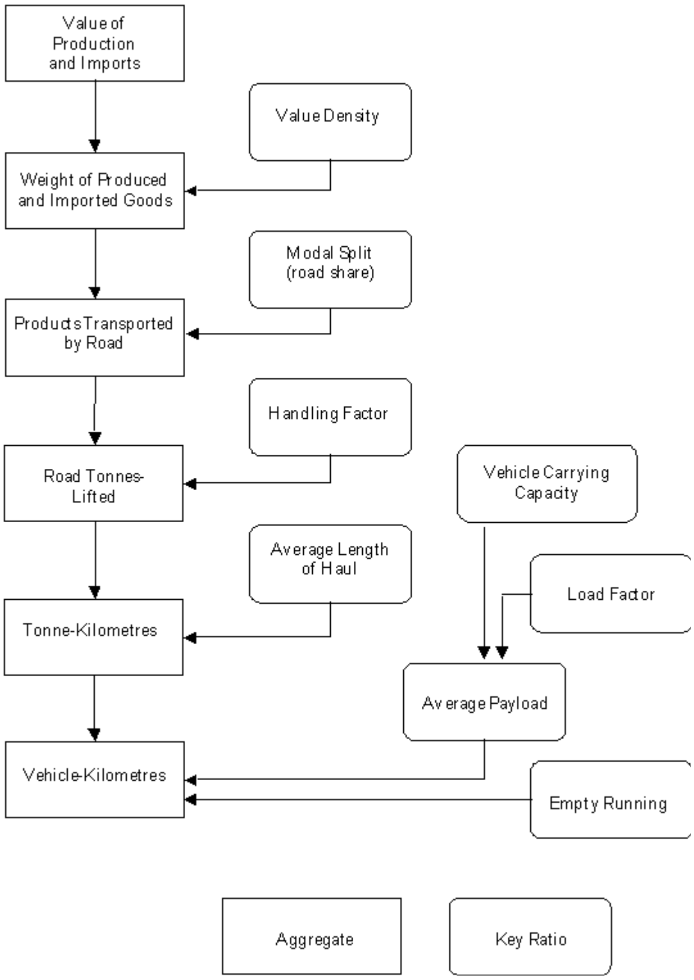


Table 1: Growth of road transport explained in the period 1985-1995

	France	Germany	Netherlands	Sweden	UK
Value of production and imports	28%	14%	17%	82%	-4%
Value density	23%	-2%	-3%	51%	-32%
Weight of produced and imported goods	**4%**	**16%**	**21%**	**21%**	**-7%**
Modal split change in favour of road	10%	20%	0%	11%	1%
Products transported by road	**14%**	**33%**	**21%**	**34%**	**1%**
Handling factor	2%	-2%	3%	-20%	18%
Road tonnes-lifted	**16%**	**31%**	**25%**	**8%**	**18%**
Average length of haul	36%	4%	29%	37%	24%
Tonne-kilometres	**57%**	**33%**	**60%**	**48%**	**46%**
Vehicle carrying capacity	15%	N.A.	24%	28%	9%
Load factor	7%	N.A.	-3%	-4%	-4%
Average payload	23%	N.A.	20%	22%	4%
Empty running	-21%	N.A.	-7%	-7%	-5%
Vehicle-kilometers	**28%**	**N.A.**	**30%**	**18%**	**37%**

Source: NEI et al[1], 1998 based on McKinnon

In the table above different factors are influencing the growth of road transport measured in tonne-kilometres. Also it can be observed that these developments are different for the countries in the table. It should be noted that the table above gives the dynamics (i.e. relative change) in a period of 10 years time.

[1] NEI et al (1998), Redefine; Relationship between Demand for Freight transport and Industrial effects, final report

For example, the handling factor has in some countries increased and in others decreased, the Redefine report does not give clear explanations for the reported changes which are to some extent obtained from expert vision. What is not stated in the Table 1 is the actual handling factor, the number of times when a good is loaded onto a transport means during its movement along the supply chain. With SLAM we actually give an estimation of the handling factors and lengths of haul and thereby giving an explanation of the reported SCENES tonne-kilometres. Eventually what is also important is the performance on infrastructure in terms of vehicle kilometres (actual use of the infrastructure).

Implications for transport policy analysis

It is a convenient coincidence that the autonomous trend of demand driven logistics dictates a movement towards decentralization of inventories; the internalization of external costs will –according to the laws of total logistics costs – support this trend and can therefore be seen as beneficial to the consumer. Innovations in intermodality are needed which are fully synchronized (or even engineered together) with logistic chains. Transport policy makers can expect an increasing demand from the sector for the support of technologically and environmentally sustainable innovations – not only ICT related, but also in the area of e.g. transport and handling equipment.

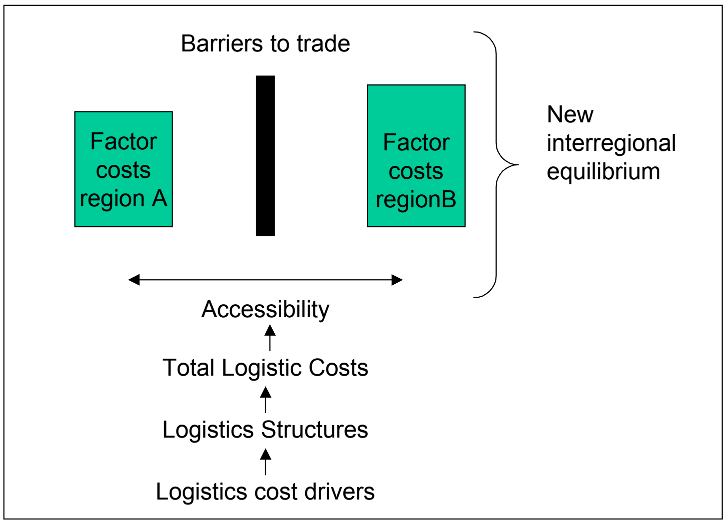
A second important category of relevant issues concerns the requirements for the evaluation of transport projects and policies. Logistic chains cross many borders and intermediary support activities like storage are spread out globally. For an impact analysis it is important to know how these chains move geographically. On the one hand, for example, improved infrastructure may to a large part accumulate in other countries than those where goods are consumed: at intermediate points of storage or in the regions where producers of goods are located. On the other hand, however, the internalization of external costs of transport may increase the rate of decentralisation of inventories, pushing the costs and benefits of improved transport infrastructure downstream in the logistic chain.

In this annex the aim is to show the impacts of the trends and processes upon the transport volumes and the spatial development. However some of the important determinants such as interest rates (related to inventory) and the speed of technological development, supported by government programmes, in emerging economies are difficult to forecast, accordingly assumptions have been made to deal with these. The outcome of these processes can be crucial for regions that depend on (or suffer from) the intensity of freight flows in the transport network (e.g. ports or new inland distribution regions).

IX.2. Methodology

The development of trade is influenced by differences in factor costs in the respective regions as well as by the barriers to trade, both regulatory and generated through the distance between these regions (see Figure 2). From this picture it becomes clear that neoclassical equilibrium theory can also be applied here. The only extension with this theory is that, instead of distance and transportation costs being used as measures of resistance between regions, one now introduces the concept of total logistics costs. These costs do not only reflect transportation related elements but all relevant logistic costs which also include storage, handling and inventory costs. In a situation where travel costs decrease and differences in factor costs remain high, one can expect globalisation to proceed. If production cost differences diminish, while at the same time transport cost would increase, the reverse would be likely.

Figure 2: Relationship between logistics and the spatial economy



Logistics, as a business competence, is dealing with the achievement of customer satisfaction at the minimum level of (logistic) costs. Customer satisfaction, or improved customer service, is reached as the suppliers of goods and services succeed in achieving the growing needs of consumers to deliver their products according to the ever emerging demands of the customers, not only with regards to the physical nature of these products (strawberries in winter time), but also with regards to their demands of reliability and flexibility of the logistics organisation.

In the logistics management literature (Christopher, 1998 and Cooper, 1991) emphasis is normally given towards the possibility to achieve efficiency and effectiveness simultaneously. Efficiency is then interpreted as minimizing logistics costs and effectiveness to the extent at which customer satisfaction is reached. Logistics costs are normally focussing on the total expenditure related to the changing location (in the right quantity, at the right time, in the right condition) of physical objects. However, these costs are interrelated with another determinant of product costs, being the actual production costs. In this sense, one can say that in optimizing global logistics, supply chain managers try to minimize the total sum of production costs, logistic costs and management cost, given the level of customer service that is required.

Production costs do vary around the globe, partly because of differences in climate, but also and more importantly, because of wage differences and exchanges rates. In the last decades we have seen the relocation of the production sites of multinational companies, especially for their labour intensive activities towards low wage countries. These trends (which are of course a clear example of the mechanisms with regards to labour division) started some centuries ago, but recently have intensified. Countries like China are explored because of their vast amounts of cheap labour available.

In some cases the trend towards these low wage countries is not a lasting one, as the emerging economic activities in these countries lead to a quick adaptation towards western living standards. And even when this has not lead to complete equilibrium, there are often other factors that make these countries less attractive in the eyes of these multinationals. Shortly after the fall of the iron curtain, many West European companies have moved production location towards former communist states, such as Hungary and Poland. The wages in these countries have been growing since then, but another important factor was the level of flexibility of the labour force, which was considered to be inadequate. This has led to a movement away again from these countries; companies like Philips and Microsoft recently have moved production plants from East European countries towards locations in East Asia.

In summary, despite the importance of factors like barriers and factor costs, accessibility remains the key linking pin between logistics and the spatial economy. We propose to apply the concept of total logistic costs as accessibility measure, in order to be able to describe spatial restructuring effects of logistics trends. Below we explore in more detail how changes in total logistic costs follow from changes in spatial structures of logistics activities.

Logistics costs and logistics structure

A key mechanism by which logistics structures change concerns the trade-off between transport and inventory costs, which determines the degree of centralization of inventories (see Figure 3). Structures with many depots, small and frequent shipments will emerge when firms are primarily service oriented, and will generally be preferred when transport rates are high. The decrease of transport costs has, on the one hand, placed increasing pressure on firms to centralise their inventories. On the other hand, the increasing orientation of firms on service quality leads to a growing pressure to decentralise operations. One should take care that inventory costs do not explode because of the multiple stock locations. A well know rule of thumb says that the total inventory cost in a situations of m warehouses is related to the inventory costs in a situation of n warehouses as the square root of the ratio m/n.

Figure 3: Classical transport/inventory trade-off

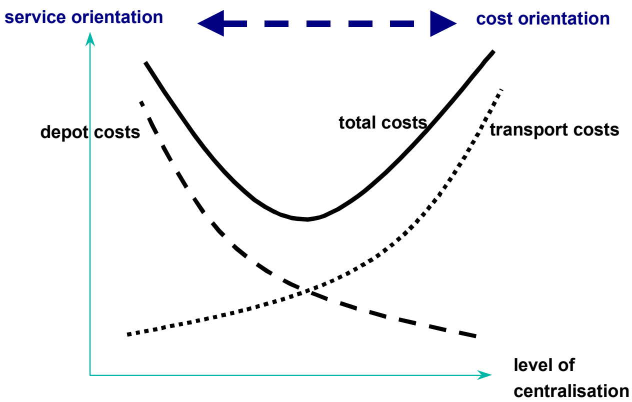
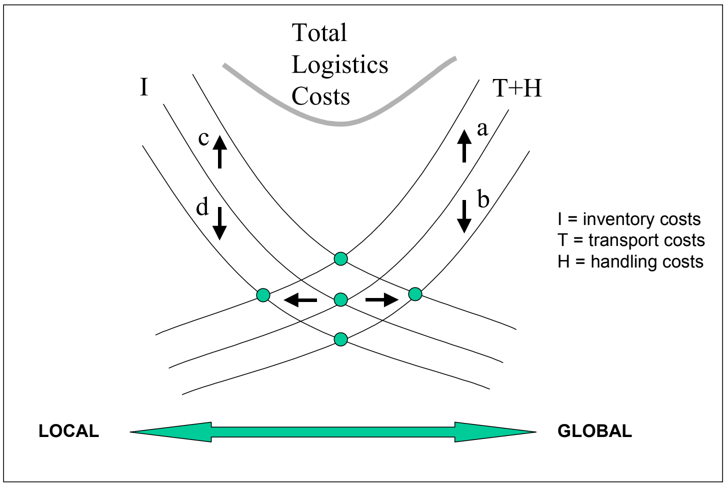


Figure 3 can also be used to reflect the impact of localized versus globalised operations. In economies that tend to be organised in a self sufficient way transportation costs tend to be low, as well as the possibilities to generated a large variety of products through the limited scale of the local operations. Global production tends to lead to long supply chains and therefore high transportation costs.

Besides this general notice of spatial equilibrium caused by this tradeoff, it is illustrative to investigate the stability of the equilibrium when a number of external influences changes the situation around this equilibrium. This is visualised in Figure 4.

Figure 4: Changes in the inventory/transport equilibrium



There are circumstances that tend to increase costs (a or c), others that will decrease its level (b or d). An explanation of each of these categories follows below:

a) increase of transport + handling costs

- internalisation of external costs
- congestion
- unreliability of transport systems and their related waiting times
- reductions in lead time and the responsiveness requirements of demanding customers

b) decrease of transport + handling costs

- the consolidation of freight flows
- the design of integrated networks
- the improved quality and professional standards of logistics service providers
- the implementation of IT systems that improve efficiency

c) increase of inventory costs

- value density of products
- interest rates
- product explosion
- focused factories (factories that are specialised on a type of products only)

d) decrease of inventory costs

- reduction of "pipeline" length
- reduction of inventories through reduction in the number of inventory points and reduced levels of safety stock
- Supply Chain Management techniques.

As a result of this one can infer that the further reduction of transport costs, coinciding with increased inventory costs will lead to a further globalisation of production and inventory locations, while an increase in transport costs combined with an decrease of local inventories would result in the contrary. In general, one could argue that some of these external circumstances are not completely independent and therefore in designing scenarios one should look for plausible and consistent combinations of these circumstances.

IX.3. SCENES results

As the SCENES results are an input to SLAM, we first reiterate the main conclusions for freight transport. The SCENES model is a European-wide multi-modal integrated passenger and freight transport model. SCENES uses standard European nomenclature and NUTS2003 GIS data to define the geographic areas. For the purpose of this project, all New Member States are incorporated within the model as internal zones. The Base Year of SCENES has been updated from 1995 to 2000. This means that all main input data underpinning the Base Year modelling have been updated accordingly, including the national accounts and the associated input-output tables (for EU15), population size and profiles, and transport networks and road vehicle operating costs. The model provides transport demand forecasts for both 2010 and 2020, based on a set of macro-economic and trade assumptions derived from DG TREN's GDP forecasts, and road vehicle operating costs derived from DG TREN's fuel price assumptions.

The freight demand model for the EU15 countries is based on a sophisticated regional economic model using spatial input-output techniques, whereas for the EU10 it adopts matrices of goods movements estimated by DG-TREN's TEN-STAC study (TEN-STAC, 2004). Eurostat's COMEXT trade matrices have been used for estimating the freight movements between countries in the new Base Year 2000. For 2010 and 2020, four scenarios have been run as specified by the project. They are the 'Null', 'Partial', 'Full' and 'Extended'.

Overall growth in freight transport demand 2000-2010-2020: the 'Null' and 'Part' scenarios

The table below presents for the Null (do-nothing) scenario the SCENES results for percentage change in freight transport demand among inland transport modes for the time periods between 2000 and 2010, and 2000 and 2020.

Table 2: Tonne-km % change, Null scenario, inland transport modes

Region	Mode	Null Scenario	
		% change over the period	
		2000-2010	2000-2020
EU15	road	18%	42%
	rail	-4%	-4%
	iww	9%	22%
	ship	3%	13%
EU15 Total	**Freight Total**	**10%**	**27%**
EU10	road	66%	131%
	rail	-6%	-11%
	iww	-3%	4%
	ship	20%	86%
EU10 Total	**Freight Total**	**31%**	**76%**
EU25	road	23%	52%
	rail	-5%	-6%
	iww	8%	21%
	ship	5%	23%
EU25 Total	**Freight Total**	**13%**	**34%**

SCENES suggests that, among the inland transport modes, road freight grows strongly (in EU25 the growth rates from 2000 to 2010 and from 2000 to 2020 are respectively 23% and 52%; in EU15 the rates are 18% and 42%, and in EU10 much stronger rates of 66% and 131% are likely). Rail freight declines in general, whilst inland waterway gains a modest growth in some countries mainly for bulk goods.

Compared with previous SCENES runs (i.e. prior to the ASSESS project), the current freight demand forecast for the Null scenario is lower for road and inland waterways, and there is a sharper decline in rail freight t-km. First of all, this is the result of generally lower GDP growth assumptions (the GDP growth in EU15 is about 0.5% lower per year than assumed by the earlier SCENES runs, although there are some variations between countries). Lower GDP growth implies lower rates of growth in the production and consumption of goods, and in the imports of raw materials and the exports of components and finished products. Secondly, we have taken on board the findings from the recent Green Paper on energy needs, which suggests the volume of consumption of both coal and petroleum products is likely to decline through time. Thirdly, we have also assumed that the trend of rail decline in a number of countries, which is observed in the recent years, will continue in the Null scenario, as a result of the evolution of freight logistics, land use changes, and the constraints upon the supply of rail freight services. These assumptions have led to the declines of rail freight traffic for 2010 and 2020, even under the assumptions of constant travel times and cost assumptions in the Null scenario. The model forecast has been done at the broad geographic and commodity sector levels, and it cannot take into account each and every detail of the rail freight operations in the Member States.

Compared with the Null scenario, the policies implemented under the Partial scenario appear to lead to a lower rate of growth in road freight demand (around 6% lower), and to some of this freight switching to rail, inland waterway and shipping. The table below shows the percentage change in the tonne-kilometres of the Partial, Full and Extended scenarios, each compared with the Null scenario.

Table 3: Tonne-km % change: The alternative scenarios vs Null

Region	Mode	% change from the Null Scenario					
		2010			2020		
		Partial	Full	Extended	Partial	Full	Extended
EU15	road	-2%	-3%	-4%	-6%	-10%	-13%
	rail	6%	9%	11%	14%	25%	37%
	iww	0%	1%	2%	1%	2%	4%
	ship	4%	9%	10%	7%	12%	14%
EU15 Total	**Freight Total**	**1%**	**2%**	**2%**	**-1%**	**0%**	**-1%**
EU10	road	-4%	-8%	-10%	-5%	-10%	-15%
	rail	11%	23%	29%	28%	33%	43%
	iww	2%	2%	4%	3%	4%	8%
	ship	5%	8%	9%	5%	9%	11%
EU10 Total	**Freight Total**	**2%**	**3%**	**3%**	**3%**	**3%**	**2%**
EU25	road	-2%	-4%	-5%	-6%	-10%	-13%
	rail	8%	13%	17%	18%	27%	39%
	iww	0%	1%	2%	1%	2%	4%
	ship	4%	9%	10%	6%	11%	14%
EU25 Total	**Freight Total**	**1%**	**2%**	**2%**	**0%**	**0%**	**0%**

Impact of the Full Scenario on freight demand

Under the Full scenario, the SMCP is comprehensively introduced for trucks in all Member States. This appears to have a significant impact on the modal balance between road on the one hand, and rail and inland waterway on the other. Compared with the Null scenario of a 42% increase, in the Full scenario trucks overall will reduce to a 28% increase in tonne-kms by 2020 across the EU15. In EU10 there are slightly smaller reductions in the growth in road tonne-kms. Rail freight tonne-kms are likely to increase (+19% for 2020) across the EU25.

The road and rail percentages indicate that freight tonne-kms are transferred from road to rail under SMCP. The tests by the model suggest that a significant proportion of road freight demand reduction is through a shortening of the average lengths of road haulage. In other words, only a limited range of goods (such as the weighty goods like bulk building materials, metals, and some chemical products, plus certain long distance movements of containers from sea ports) can be transferable from road to rail. For the other products, particularly the voluminous goods such as food and finished consumer products, the road demand reduction is likely to result mainly from an adjustment in the geographic patterns of sourcing (i.e. suppliers from within a shorter distance range will be expected to provide the goods required by consumers).

Freight demand, internal market, and economic growth

The evolution of the European economy in the next two decades is likely to erode further the traditional base of rail freight market, such as coal and other bulk products and raw materials. To compensate for this, rail freight operators need to adapt to the changes in the commodities mix, and need to win new customers through improving reliability, responsiveness and general quality of service. Furthermore each country should enable and support the interconnectivity and interoperability of national networks as well as the access to such networks. This will help to develop new markets in the medium to long distance transport of finished products and components, e.g. to/from the sea ports and major manufacturing/distribution sites. The realisation of this potential for rail freight development could contribute significantly to the broadening of the catchment for both producers and consumers in the internal market, support the GDP growth of the Member States, and reinforce the trade ties between different regions within the EU, whilst maintaining the long term environmental sustainability of freight transport.

Impact of the Extended Scenario on freight demand

The SMCP on trucks under the Extended scenario is applied fully (50% by 2010 and 100% by 2020). As a result, truck operating costs have risen by 30-40%, and tonne-kms reduce by 13-15%. The changes predicted by the model appears to be consistent with the road freight demand elasticities.

IX.4. SLAM explained

The main objective of the SLAM module is to transform transport flows into a logistical component by taking into account the logistics costs and bundling possibilities of freight flows. The logistic module identifies the typical distribution structures for chains, based on the characteristics of the region, products, and the network. The appended module calculates the number and the potential locations of distribution centres (DC's) throughout Europe on a regional level by re-assigning tonnes per Origin/Destination (O/D) in relation to possible alternative chains. Regions that are attractive for the location of a DC will have a higher throughput in tonnes based on logistics activities as within the O/D patterns. So the outcome of the module is an O/D table for transport in which some regions will benefit and attract more tonnes based on logistics activity, compared with the O/D table based on transport flows (as obtained from SCENES). By comparing the throughput per region in the trade flow O/D table and the revised transport O/D table, conclusions can be drawn in terms of attractiveness of regions providing logistics services.

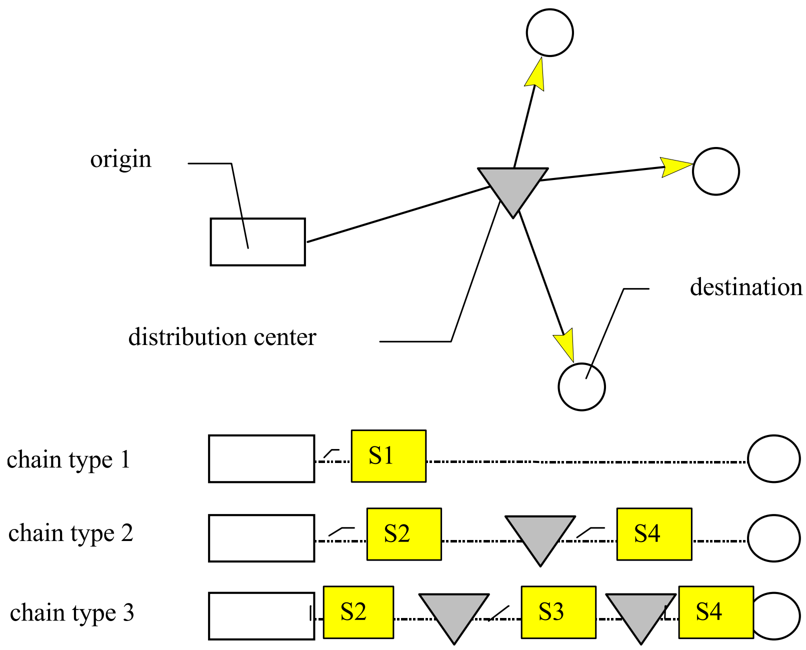
The SLAM module consists of three submodules:

1. Location scores module: computes for every region a score for the attractiveness of the region as a possible location for a DC. This module results in a ranking of regions for all of the 13 SCENES freight flows.

2. Chaining module: this module calculates the probability of using a specific alternative chain, based on the location scores and the total logistical costs of using a specific chain.
3. Reassign module: this module assigns volumes of the total commodity flow for an O/D-relation to chain types.

The SCENES model provides the input in the form of O/D matrix in tonnes for every O/D relation and freight flow. Within the SLAM, the modal split data, transport times and costs are also derived from the SCENES model. These data are extracted in separated files and used in the SLAM for computing the segment costs per chain type and chain segment. The transport database contains these data. In Figure 5 below the analysis as carried out is shown, from SCENES we obtain the origin and destination as these are based on observed transport flows obtained from DGTREN and EUROSTAT (and other sources). The observed transport statistics do already cover the transport resulting from logistic patterns; i.e. the transport to and from a distribution centre is in present transport statistics measured as 2 separate transports: a) from the origin (shipper) to the distribution centre and b) from the distribution centre to destination (customer). In the lower part of Figure 5 three possible solutions, i.e. chain types, are shown to bring a good from the origin to its final destination. Chain type 1 represents direct transport (as is the case for most bulk transport within Europe). Chain type 2 and 3 respectively use 1 or 2 distribution centres, in case one distribution centre is used and sometimes, mostly in international transport, a European and a national distribution centre (respectively EDC and NDC).

Figure 5: Appended Module - Distribution channels and segments



Transport costs

The calculation of transport costs, modal split, distances and valuae of time (VoT) for the different chain types are derived from the assignment module of the SCENES transport model. A simple weighted cost function (with weights according to the shares of different modes) is implemented to approximate transport costs as calculated during the network assignment. A condition limiting the calculation of weighted costs is provided by the modes that are allowed on different segments. On the last segment, S4, for example, only road transport is allowed. The logistics approach requires that also inventory and holding cost are analysed, since these are part of the door-to-door cost.

Inventory costs

Inventory costs are specified for every freight flow and contain the inventory costs for the actual stock necessary for the demand of a period and the safety stock. To calculate this several steps are taken:

$$c^v = a_f X_{ij} (i + k)$$

i = interest costs

k = fixed warehousing costs

a_f = stock ratio per freight flow

Warehousing/Holding costs

Warehousing costs are independent from the product and are divided into handling and holding costs.

$$c^m = a_f X_{ij} w(h_f + o_f)$$

c^m = warehousing costs

$X_{ij,f}$ = trade flow on O/D-relation per flow type

o_f = holding costs per m^3

h_f = handling costs per m^3

Z = average inventory volume (tonnes)

c^o = handling cost per ton

w = volume to weight ratio

So the the integral logistic costs per alternative chain and per flow type have then the above mentioned three components:

$$c_k = c_k^t + c_k^v + c_k^m$$

c_k = logistic costs

c_k^t = transport costs

c_k^v = inventory costs

c_k^m = warehousing costs

k = alternative chain

The result of the analysis is that out of the total amount of freight shipped from each zone an estimated amount of logistics activities is found as part of the freight flows goes through a distribution centre it is shown twice in the estimations; first when it is shipped from the region of production and again for the distribution centres (i.e. the handling factor). SLAM chooses from the different alternative chains the ones with the lowest logistics costs by using a logit method.

IX.5. SLAM results

As we have seen in the previous section transport costs are a main driver in the total logistics costs. Table 4[2] summarises the effects of the packages in the three scenarios at 2010 and 2020 on the main variables for the SCENES model input, these figures mainly concern the development of transport costs. As such the development of transport costs are relevant for SLAM besides other logistic cost categories. The transport costs usually make up one third of the total logistics cost. (Vincke,2005[3]). Table 4 is built using values as elaborated for the individual policy packages, however, in such a table many packages include different values across demand segments, countries, etc.. In those cases, to give a single value, averages have been considered. Furthermore, the percentage changes due to those packages quantified in absolute terms (e.g. SMCP) have been computed with reference to average costs/tariffs, even though such costs and tariffs are very variable. Therefore, it should be noted that in specific countries the effects can be higher or lower than those indicated in the table and that some values in *Table 4*.

Finally, measures affecting emission factors, vehicle fleets and infrastructures are not included in the tables as these are directly implemented in the models. This means that effects on times, costs, etc. derived from the TEN projects (e.g. fastest connections, congestion relief) are not considered in the table but are included in the SCENES result. Concluding, *Table 4* serves only for a quick overview on the overall effects of scenarios on the main variables.

Table 4: Effects of scenarios on main variables (indicative average values)

Scenario	Null	Partial		Full		Extended	
Variable	2010/20	2010	2020	2010	2020	2010	2020
Road Freight cost	0%	15%	17%	14%	21%	21%	33%
Road Freight time	0%	-1%	-1%	-2%	-3%	-1%	-2%
Rail Freight cost	0%	-1%	-3.5%	-6%	-8%	-7%	-10%
Rail Freight time	0%	-7%	-13%	-10%	-18%	-14%	-24%
Ship cost	0%	4%	8%	8%	16%	16%	32%
IWW cost	0%	1.5%	1.5%	0.5%	2.0%	0%	2.4%
IWW time	0%	-1%	-2%	-2%	-3%	-3%	-5%
Freight Terminal / Border cost	0%	-4%	-8%	-9%	-15%	-10%	-16%
Freight Terminal / Border time	0%	-13%	-22%	-19%	-29%	-20%	-31%
Road load factor	0%	2%	2%	4%	4%	4%	4%

Thus the transport costs of road will rise significantly. In terms of total logistics cost this increase will be less prominent in the light of the development of the other logistical cost components. Besides, the increase of the load factor will increase the efficiency of road transport and thereby reduce as well the effect of increasing road freight cost. The reduction of border times will be a stimulus for international distribution and increases consolidation of freight flows. Below we give an overview of different developments in the determinants of logistics costs:

[2] Derived from the Annex V on quantification of modeling scenarios

[3] Other estimations range from 40 to 60% share of transport in total logistics cost.

a) effect on transport + handling costs

- effect of congestion will be reduced due to internalisation of external cost, also better use of the network in off peak periods due to an increase of the 24 hour economy
- unreliability of transport systems and their related waiting times, however will be reduced to better forecasting mechanisms and better information supply
- reductions in lead time and the responsiveness requirements of demanding customers leading to a demand for a more flexible network
- consolidation of freight flows, leading to larger volumes and economies of scale, other modes than road become more attractive.
- design of integrated and even collaborative networks, thereby creating economies of scale and use of other modalities
- the improved quality and professional standards of logistics service providers
- the implementation of IT systems that improve efficiency

b) effect on inventory costs

- value density of products will increase leading to higher inventory costs
- We assume that interest rates will rise from current low rates, this will lead to an increase of inventory cost
- A continuous reduction of inventories through reduction in the number of inventory points and reduced levels of safety stock, also driven by production on demand, this will lead to lower logistics costs
- Supply Chain Management techniques: we assume that there will be a continuous innovation in techniques leading to lower inventory costs.

We assume that the increasing and the decreasing developments in inventory cost will offset for all scenarios (the economic scenario does also not differ for the null till preferred scenario). This means that there will be no changes in inventory cost in all scenarios elaborated. Also in handling cost there will be an offsetting movement, so we will only analyse the influence of transport costs as derived from the transport scenarios on logistics. A technological innovation is supply management techniques will though be initiated through higher transport cost so that the least cost mode will be more intensively used in finding low cost solution in terms of logistical cost. In the Netherlands for example experiments with collaborative networking have been carried out wherein producers share a logistics network (i.e. competition is in the product-market not in transport therefore shippers will be able to collaborate in networks (Groothedde 2003). In Germany similar ideas have been developed for railway transport[4]. Due to synergy an economy of scale is obtained whereby low cost and high capacity modes (i.e. inland waterway and railways) can be used in markets that are dominated by road transport.

Table 5 shows the extra tonne-km produced by logistic movements for each scenario for the years 2010 and 2020. Table 6 shows the share of logistic tonne-km in total tonne-km produced.

[4] (the rolling shelf project as developed by Kessel&partner http://www.kesselundpartner.de)

Table 5: Extra Tonne-km produced by logistic movements (in 1000 mln)

			Null		Partial		Full		Extended	
	mode	2000	2010	2020	2010	2020	2010	2020	2010	2020
EU15	road	446	578	746	568	699	558	669	550	642
	rail	48	48	56	55	73	60	90	65	106
	iww	11	14	17	15	19	16	21	17	22
	ship	36	32	45	33	47	35	48	34	46
	total	541	672	865	671	838	669	828	665	817
NMS10	road	23	37	116	35	110	34	103	32	94
	rail	3	2	11	9	24	15	31	19	37
	iww	0	0	0	0	0	0	0	0	0
	ship	1	1	2	1	2	1	2	1	2
	total	26	40	128	45	135	49	135	53	133
EU25	road	468	615	862	603	809	592	772	582	736
	rail	51	50	67	64	97	75	120	84	143
	iww	11	14	17	15	19	16	21	17	22
	ship	37	33	47	34	49	36	50	35	48
	total	567	712	993	716	974	718	963	718	949

Table 6: Share of logistic tonne-km in total tonne-km

			Null		Partial		Full		Extended	
	mode	2000	2010	2020	2010	2020	2010	2020	2010	2020
EU15	road	34%	37%	40%	37%	40%	37%	40%	37%	40%
	rail	19%	20%	23%	22%	27%	23%	30%	24%	32%
	iww	8%	10%	11%	11%	12%	11%	13%	12%	14%
	ship	4%	4%	5%	4%	5%	4%	5%	4%	4%
	total	21%	24%	27%	24%	26%	24%	26%	24%	26%
NMS10	road	13%	13%	29%	13%	28%	13%	28%	12%	27%
	rail	2%	2%	10%	7%	17%	10%	21%	13%	23%
	iww	0%	0%	0%	0%	0%	0%	0%	0%	0%
	ship	0%	1%	1%	1%	1%	1%	1%	1%	1%
	total	6%	7%	17%	8%	17%	8%	17%	9%	17%
EU25	road	31%	33%	38%	33%	38%	33%	38%	33%	37%
	rail	14%	14%	19%	17%	23%	19%	27%	20%	29%
	iww	8%	10%	11%	10%	12%	11%	13%	11%	13%
	ship	4%	3%	4%	3%	4%	3%	4%	3%	4%
	total	19%	21%	25%	21%	25%	21%	24%	21%	24%

From Table 5 it can be concluded that the logistic tonne-km show a significant increase from 2000 to 2020 in all scenario's. This effect is there for all members of EU25. However, the percent increase is stronger for the new member states.

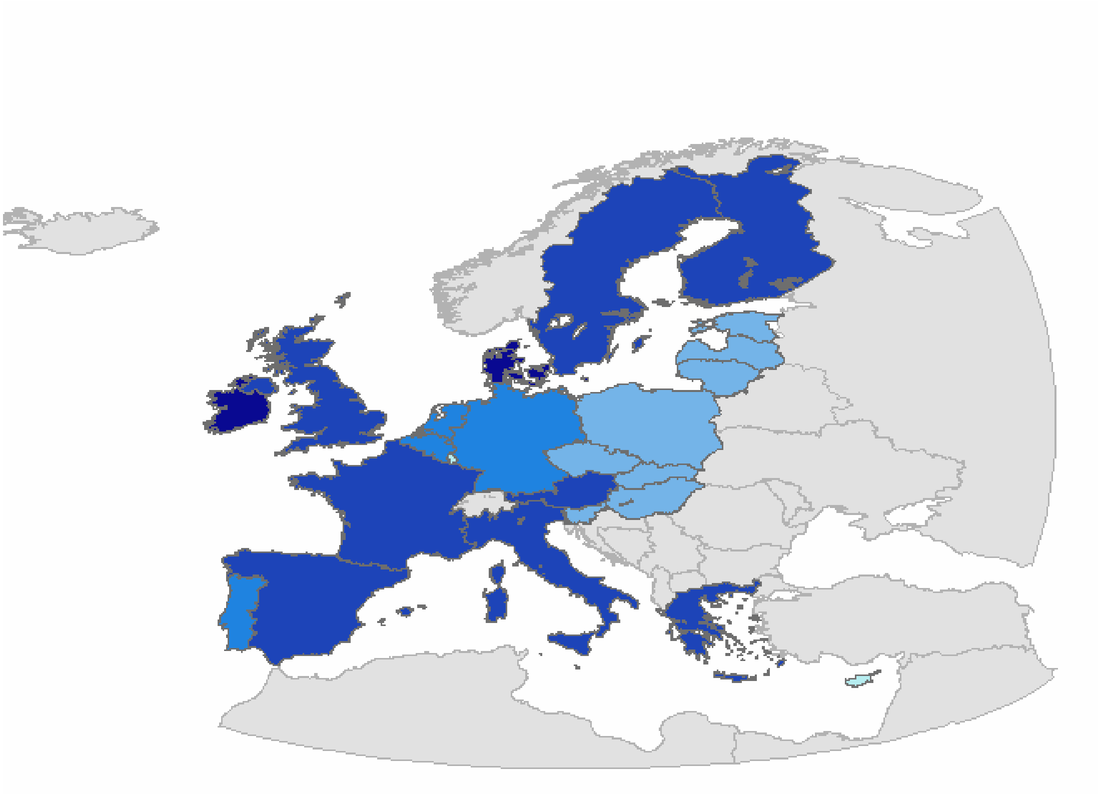
In general there is an increase of about 6% percent points in all scenario's from 2000 to 2020 in the share of logistic tonne-km in total tonne-km and in 2020, the level of logistics in the new member states will approach the level of logistics in the EU15. This can be seen from Table 6. The increase in logistic tonne-km is partly explained by the increase in total transport (tonnes lifted) and is partly the result of extra logistic activities. This result is inline with the trends in logistics as described in (Black, 2004). In this document it is explained why the tonne-km have grown faster than the tonnes lifted. Thus the average length of haul has shown an increase in the past. Further it states that it is difficult to give accurate forecasts, but that most forecasters tend to assume that the increase in average length of haul will continue.

The increase in logistic tonne-km is the largest in the Partial scenario, followed by the Full and then by the Extended scenario. However the differences between the scenarios are very small.

In the Null scenario the growth of logistic tonne-km by road is stronger than the growth of the logistic tonne-km by rail. This means that the share of the road in the modal split increases compared to the situation in 2000. In the Partial scenario the modal split doesn't change much trough the years and in the Full and Extended scenarios the modal split changes in favour of rail. In the Extended scenario this effect is the strongest. The share of logistic tonne-km by road in the modal split decreases from 83% in 2000 to 78% in 2020 and the share of logistic tonne-km by rail increases from 9% to 15%. The shares of 'IWW' and 'Ship' in logistic tonne-km remain unchanged over the years and scenarios.

In the appendix a table similar to Table 5 is included on a country level. Malta and Cyprus are not included since these can not be modelled properly by SLAM. Further Figure 6 shows the share of logistic tonne-km in the total tonne-km for each country in the Null scenario for 2010 (a darker colours implies a higher a share). Countries which already have high volumes in the original state and that lie centrally in Europe have a relatively high throughput via distribution centres. This also holds for Spain, Sweden and Finland. In 2010 the throughput via distribution centres in the NMS is still relatively low compared to EU15.

Figure 6: Share of logistic tonne-km in the total tonne-km in 2010 (Null scenario)



IX.6. Conclusion

In this annex report we have indicated the influence of logistics in the different scenarios of the study. As is shown the handling factor is in some case quite high notably for countries that have a central position in European distribution such as Denmark. It might give the wrong impression that goods are moved unnecessarily (as exemplified with the well known example of Parma Ham), the handling factor is in most cases driven by consolidating freight flows and lowering logistics costs leading to a more efficient use of vehicle park etc. Interfering with this pattern could certainly lead to less optimal use and lead to more transport movements than necessary.

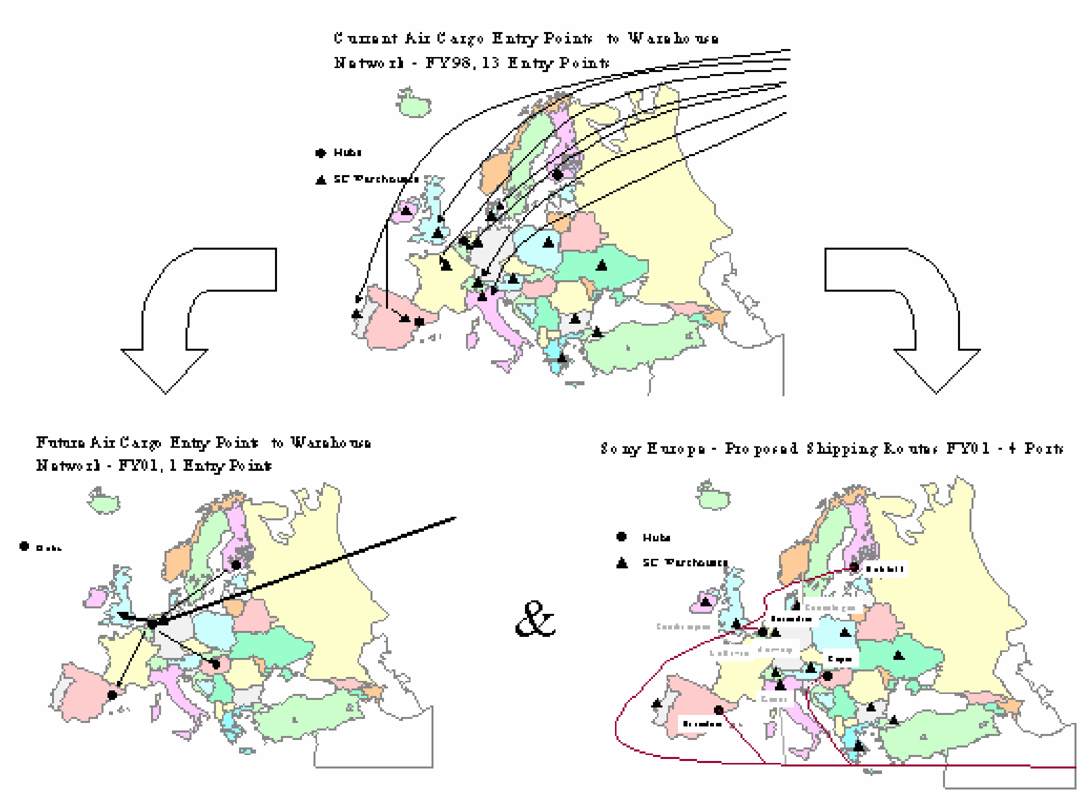
The long term evolution of production networks leads to new demands on distribution structures which can be characterized by an increased pressure on reliability, customization and flexibility. Nowadays we see rapidly increasing vertical disintegration within product columns, and as a result a much more specific set of agreements between the shipper and its logistic service providers. As these chains are becoming more complex, more intricate distribution structures are needed to tailor final products in all their facets to the customer's preferences.

The improved interconnectivity of companies through advanced logistics information systems has opened up the way for the introduction of collaborative planning and execution of logistics operations. Connectivity and transparency are enabling factors for improved planning and scheduling of operations and for real-time adjustments to changed circumstances. Internet technology is crucial in this: instead of time consuming and cost intensive EDI communications systems the present systems can guarantee a fast and easy access to their web-enabled communication systems.

These developments have also a major impact on the way inter- and multi modal operations can take place. Whereas in the past these operations required lengthy and time consuming interactions between all parties concerned (shippers, carriers, intermediate parties (forwarders, agents, expeditors), logistic service providers, terminal operators and so on); the new web-based technologies enable a much quicker and more reliable management of all information flows and interaction between these parties. Current practice in multi modal environments was up till recent that parties could only start to act as the (unexpected) events occurred. Now, through timely information exchange and improved planning of theses operations, a large part of the unreliability of these systems can be removed and unnecessary buffers can be avoided.

This has opened up the possibility for a complete reconfiguration of logistic systems. Whereas in the past many last minute requirements left no openings for slow modes of transport, nowadays the improved planning opportunities lead to possibilities for integrating slow and fast modes of transport into one integrated system that can guarantee that customer requirements are met. An example of this can be seen in the figure below with the integration of air and sea transport (i.e. high valued consumer electronics from Japan to Europe), the integration of short sea transport and road transport for intra European transports. This is also the goal of the Marco Polo programme.

Figure 7: Changes in Sony distribution network lay-out 1998-2001 based on TRILOG



The main goal of Marco Polo is to reduce road congestion and improve the environmental performance of the whole transport system by shifting freight from road transport to short sea, rail and inland waterway transport. Logistics can contribute directly to the objectives of the Commissions White Paper: European Transport Policy for 2010 : Time to decide through:

- contributing to mode shift (from road to other modes);
- reducing the demand for transport (de-coupling);
- reducing the environmental impact of transport (e.g. improved vehicle utilisation).

The continuation of Marco Polo after 2007 with an enlarged budget tends to make the programme more effective, in Marco Polo II also limited capital infrastructure investments are possible. Given the proposed budget of 750 mln Euro over 7 years, a target for reduction of road tonne-kilometres of (1 Euro is targeted to a reduction of 500 tkm road) about 54 billion tonne kilometres per year results.

Another option is the introduction of an integrated collaborative planning system where producers, retailers and logistic service providers work closely together through the sharing of information of production, sales and logistics. This can lead to the reduction of safety stocks, the stabilisation of physical flows and the reduction of logistics costs while improving the customer service to the clients. A nice by-product of these integrated multi-modal logistic systems is that they lead to higher levels of sustainability because the slow modes of transport that are used in this relaxed logistics process use less energy then their panicking, ill-informed, improvising competitors from the past.

The idea behind these optimization processes is not very complicated: it asks for a certain level of co-operation of all parties concerned and also of the vision of a central key person (sometimes called "orchestrator" or chain manager) that can design smart solutions for integrated logistics problems. It seems that there exist many potential possibilities for such logistics improvements and the research proposal is therefore to trace these possibilities and to find some general tools for problem solving.

In this annex the effects of these trends in logistics have been quantified. It can be concluded that in all scenarios there is a significant growth in tonne-kilometres. This growth in tonne-km is partly explained by the growth in tonnes lifted and partly by extra logistic activities. In 2020, the level of logistic activities of the NMS10 will approach the level of logistics in the EU15. The four scenarios don't show many differences. The increase in logistic tonne-km is the largest in the Partial scenario, followed by the Full and then by the Extended scenario. However the differences between the scenarios are very small. To give an impression of magnitude: in the Extended scenario the share of logistic tonne-km increases with 5 percent points from 2000 to 2020. This is the case for total freight transport. In the Full and Extended scenarios the modal split changes in favour of rail. In the Extended scenario this effect is the strongest. The share of logistic tonne-km by road in the modal split decreases from 83% in 2000 to 78% in 2020 and the share of logistic tonne-km by rail increases from 9% to 15%. In the Null scenario the growth of logistic tonne-km by road is stronger than the growth of logistic tonne-km by rail. This implies that the goals of the White Paper (wherein a modal split towards 1998 values is proposed) can be reached. Developments in logistics tend to be oriented on using the road mode. However, the scenarios show that there is a reduction in tonne-kilometres from the null scenario to the extended scenario From the perspective of Marco Polo it is possible to reduce road freight transport in logistics induced transport by 32 bln tonne-kilometres in 2010 (from 615 in the Null to 582 in the Extended Scenario for EU 25), this entails that the Extended scenario is adopted.

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APPENDIX

Table 7: Extra Tonne-km produced by logistic movements (in 1000 mln)

				Null		Partial		Full		Extended	
Country	Member	Mode	2000	2010	2020	2010	2020	2010	2020	2010	2020
Aus	EU15	road	8.4	12.4	16.6	12.0	15.4	11.4	14.0	11.0	13.1
		rail	4.3	5.7	6.9	6.0	7.6	6.3	8.1	6.5	8.7
		iww	0.2	0.3	0.4	0.4	0.5	0.4	0.5	0.4	0.6
			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		Total	13.0	18.5	24.1	18.4	23.6	18.1	22.7	18.0	22.4
Bel	EU15	road	9.3	12.9	16.8	12.7	16.1	12.3	15.2	12.0	14.8
		rail	1.3	1.5	2.0	1.7	2.3	1.8	2.8	1.9	3.1
		iww	0.6	0.9	1.0	0.9	1.2	1.0	1.3	1.1	1.4
			1.6	1.2	1.7	1.3	1.8	1.4	1.9	1.3	1.9
		Total	12.9	16.4	21.5	16.6	21.5	16.4	21.1	16.4	21.1
Ger	EU15	road	110.8	125.5	152.3	125.1	143.7	123.6	142.8	122.5	137.5
		rail	5.9	5.1	5.9	6.3	8.1	7.0	9.1	7.5	10.9
		iww	4.5	5.8	7.8	6.1	8.6	6.4	9.0	6.7	9.7
			4.6	3.5	4.2	3.6	4.5	3.7	4.6	3.7	4.5
		Total	125.7	139.8	170.3	141.2	164.8	140.7	165.5	140.4	162.6
Den	EU15	road	9.6	12.4	15.1	12.0	14.4	11.8	13.8	11.7	13.4
		rail	0.6	0.7	0.8	0.9	1.3	1.1	1.6	1.3	1.9
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			10.6	3.3	4.0	3.4	4.1	3.5	4.2	3.5	4.2
		Total	20.9	16.4	19.9	16.4	19.9	16.5	19.6	16.5	19.6
Spa	EU15	road	48.2	79.6	115.9	75.7	108.9	74.2	104.2	73.1	100.6
		rail	2.1	2.2	2.9	3.0	4.4	3.7	5.5	4.2	6.6
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.7	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6
		Total	51.0	82.4	119.3	79.3	113.9	78.5	110.4	77.9	107.7
Fin	EU15	road	9.7	13.1	15.1	12.9	14.4	12.7	13.8	12.3	13.3
		rail	2.9	3.1	3.6	3.2	3.8	3.4	4.1	3.5	4.5
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			1.8	1.2	1.7	1.2	1.8	1.3	1.8	1.3	1.8
		Total	14.4	17.4	20.4	17.3	20.0	17.4	19.7	17.1	19.6
Fra	EU15	road	100.1	129.6	162.6	126.5	153.4	123.9	144.2	122.2	137.9
		rail	18.0	15.3	15.9	16.7	21.4	17.6	29.8	18.3	35.3
		iww	0.7	0.9	1.1	1.1	1.5	1.4	1.9	1.6	2.2
			0.7	0.8	1.0	0.8	1.0	0.9	1.0	0.9	1.0
		Total	119.6	146.7	180.6	145.2	177.5	143.8	177.0	143.0	176.6
Gre	EU15	road	4.8	8.0	11.8	7.9	11.3	7.9	10.8	7.8	10.3
		rail	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.2
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.8	1.1	1.9	1.2	1.9	1.2	1.9	1.1	1.8
		Total	5.7	9.2	13.8	9.2	13.5	9.2	12.9	9.1	12.4
Ire	EU15	road	4.3	8.7	11.9	8.4	11.1	8.3	10.3	8.1	9.7
		rail	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.8	0.7	1.1	0.8	1.2	0.8	1.2	0.8	1.1
		Total	5.2	9.5	13.1	9.4	12.5	9.3	11.8	9.2	11.1
Ita	EU15	road	59.9	79.5	107.5	79.0	93.7	77.8	87.0	75.9	81.5
		rail	5.0	3.9	3.2	5.4	7.5	6.5	10.8	7.6	14.8
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			6.8	9.3	13.4	9.5	13.9	9.7	13.7	9.3	12.9

		Total	71.8	92.7	124.2	94.0	115.1	94.1	111.5	92.8	109.1
Lux	EU15	road	0.2	0.6	0.6	0.5	0.6	0.5	0.6	0.5	0.5
		rail	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	0.3	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6
Ned	EU15	road	14.7	17.5	21.4	17.4	20.7	17.1	19.8	16.8	19.3
		rail	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.1
		iww	4.7	5.8	6.9	6.1	7.4	6.4	7.9	6.8	8.4
			0.4	0.4	0.5	0.4	0.6	0.5	0.6	0.5	0.6
		Total	20.2	24.0	29.2	24.3	28.9	24.3	28.5	24.4	28.4
Port	EU15	road	2.0	3.1	5.1	3.1	4.9	3.1	4.7	3.1	4.6
		rail	0.3	0.4	0.8	0.5	0.9	0.5	1.0	0.6	1.1
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
		Total	2.4	3.7	6.0	3.8	6.0	3.8	5.9	3.8	5.8
Swe	EU15	road	10.1	15.1	22.6	14.8	21.1	14.4	19.9	14.2	19.1
		rail	5.6	7.4	10.1	7.8	11.0	8.4	11.9	8.8	13.3
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			1.3	0.8	0.9	0.8	1.0	0.8	1.0	0.8	1.0
		Total	16.9	23.3	33.6	23.5	33.0	23.6	32.8	23.9	33.3
UK	EU15	road	53.3	59.7	71.0	59.7	68.8	59.3	68.2	58.6	66.6
		rail	1.4	2.5	3.6	2.8	4.1	3.1	4.4	3.6	5.0
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			5.9	9.1	13.8	9.5	14.6	10.1	15.2	9.8	14.5
		Total	60.6	71.3	88.4	72.0	87.6	72.5	87.9	72.0	86.2
CZR	NMS10	road	4.6	6.8	19.5	6.6	18.6	6.0	17.3	5.9	16.4
		rail	0.3	0.3	1.0	0.4	1.9	0.7	2.1	0.8	2.5
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
		Total	4.9	7.1	20.5	7.1	20.6	6.8	19.4	6.8	19.0
Est	NMS10	road	0.6	0.8	1.5	0.8	1.3	0.8	1.2	0.7	1.1
		rail	0.5	0.6	1.5	2.0	3.8	3.5	5.3	4.5	7.0
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
		Total	1.1	1.5	3.2	2.9	5.4	4.4	6.7	5.3	8.2
Hun	NMS10	road	2.1	2.3	6.3	2.2	6.0	2.1	5.8	2.1	5.8
		rail	0.2	0.1	0.7	0.5	1.4	1.0	1.9	1.4	2.6
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
		Total	2.4	2.5	7.2	2.9	7.6	3.2	8.0	3.6	8.6
Lat	NMS10	road	0.7	1.5	4.5	1.4	4.0	1.3	3.4	1.1	2.0
		rail	0.6	0.2	2.0	2.4	5.4	4.3	7.6	5.7	9.0
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.1	0.1	0.3	0.1	0.3	0.2	0.3	0.2	0.3
		Total	1.4	1.9	6.8	3.9	9.7	5.7	11.3	7.0	11.3
Lit	NMS10	road	1.2	2.1	16.4	1.9	15.1	1.8	13.4	1.6	9.4
		rail	0.3	0.1	1.4	1.5	3.3	2.7	4.4	3.6	5.3
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.1	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.5
		Total	1.6	2.5	18.3	3.7	19.0	4.8	18.4	5.5	15.1
Pol	NMS10	road	10.5	19.5	54.9	18.6	52.4	17.8	49.7	17.3	47.6
		rail	0.8	0.4	3.0	0.8	5.1	1.2	6.0	1.6	6.8
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

			0.2	0.1	0.3	0.2	0.3	0.2	0.3	0.2	0.3
		Total	11.4	20.0	58.3	19.6	57.8	19.2	56.0	19.0	54.7
Slk	NMS10	road	2.8	3.6	11.3	3.5	10.9	3.4	10.5	3.3	10.3
		rail	0.3	0.2	0.6	0.3	0.7	0.4	0.8	0.5	0.8
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
		Total	3.0	3.9	11.9	3.9	11.6	3.8	11.3	3.8	11.2
Slo	NMS10	road	0.4	0.4	1.5	0.4	1.5	0.4	1.4	0.4	1.4
		rail	0.1	0.1	0.5	0.6	1.9	1.0	2.7	1.3	3.1
		iww	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
		Total	0.5	0.5	2.0	1.0	3.5	1.4	4.2	1.7	4.6