EFORWOOD
Tools for Sustainability Impact Assessment

Identification of existing transport methods and alternative methods or new approaches with data about costs, labour input and energy consumption

Elisabeth Le Net, Fahrudin Bajric, Diana Vötter, Staffan Berg,
Gert Anderson and Stéphanie Roux

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Preface

This report is a deliverable from the EU FP6 Integrated Project EFORWOOD – Tools for Sustainability Impact Assessment of the Forestry-Wood Chain. The main objective of EFORWOOD was to develop a tool for Sustainability Impact Assessment (SIA) of Forestry-Wood Chains (FWC) at various scales of geographic area and time perspective. A FWC is determined by economic, ecological, technical, political and social factors, and consists of a number of interconnected processes, from forest regeneration to the end-of-life scenarios of wood-based products. EFORWOOD produced, as an output, a tool, which allows for analysis of sustainability impacts of existing and future FWCs.

The European Forest Institute (EFI) kindly offered the EFORWOOD project consortium to publish relevant deliverables from the project in EFI Technical Reports. The reports published here are project deliverables/results produced over time during the fifty-two months (2005–2010) project period. The reports have not always been subject to a thorough review process and many of them are in the process of, or will be reworked into journal articles, etc. for publication elsewhere. Some of them are just published as a “front-page”, the reason being that they might contain restricted information. In case you are interested in one of these reports you may contact the corresponding organisation highlighted on the cover page.

Uppsala in November 2010

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EFORWOOD

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WP 3.3 – Transport systems

Project Deliverable PD3.3.2

Identification of existing transport methods and alternative methods or new approaches with data about costs, labour input and energy consumption

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Summary

In this report, the main wood transport systems for wood procurement are outlined. Four country profiles (France, Germany, Sweden and UK) are used to identify specific approaches and promising new alternatives that could be introduced into future organisational and technical solutions. The proposed country profiles illustrate the diversity of practices and seem to be sufficiently representative of various European conditions of wood transport systems. Chapter 1 (plus and cons of Eurostat data on flows - tonnes and tonnes-km) and chapter 4 (cost, energy, employment) propose some evaluation that could be of interest for other FWC flows. Chapter 2 and 3 are more wood oriented.

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1 Introduction

1.1 Objectives

In the context of transport wood is a bulky and relatively low cost product. This is especially true for round wood or chips. Transport therefore is a technical, economical and ecological challenge. Dealing with wood procurement from forest to mills, “proximity” transport (regional and/or national flows) is often the first thing considered. Even if international trade is important for some FWCs (Forest Wood Chains), in this document, we focus on this relatively short distance service in order to identify the existing dominant transport systems and possible future ones. Based on the experience of some European countries (France, Germany, Sweden and UK) this report describes the transport in the “forest-wood chain” (i.e. for M3), deliveries of wooden raw materials to wood mills. It establishes the main characteristics such as the dominant transport modes, distances, organisation, etc. It is considered that the above four country experiences are representative of the European diversity. We have concentrated on the Eurostat databases in order to identify the interest and limits of this source of data as well as to test solutions proposed in the “first round” of the transport protocol written in February 2007.

1.2 Some words on data

Depending on the market openness[1] of a country for wood (as raw material) and the local availability of wood in quantity and quality, the transport modal share is different. Taking into account imports and exports enhances the share of long distance trips, i.e. maritime and railways.

In Eurostat, the total transport definition includes: national transport, international transport - goods loaded in the reporting Member State, international transport - goods unloaded in the reporting Member State, cross-trade and cabotage tra
nsport. That means that cumulative flows are integrated and double counting possible. Eurostat data are available at NST/R[2] 24 levels (cf. annex 7.1). The last available data are from 2005, but the last consolidated data are for 2004. For comparisons over time, only data for EU15 (except Greece) and Norway can be included (for road transport). Information on national, intra EU, international and extra-EU information by groups of goods is not published. If more precise information is not available (at national level), we will consider that group 4 “wood and cork” of NST/R is representative of goods that we are supposed to be studying in WP 3.3. The main drawback is that we include in the analysis not only roundwood but also processed wood products and by this leave the context of M3 (forest to industry).

Table 1 – NST/R classification: composition of group 4 “wood and cork”

Level	Code	Description	EFORWOOD modules
2	05	Wood and cork	**M3/M4**
3	051	Paper pulp wood	**M3**
3	052	Pit props	**M3**
3	055	Other wood in the round	**M3**
3	056	Railway or tramway sleepers of wood and other wood roughly squared, half squared or sawn	**M4**
3	057	Fuel wood, wood charcoal, wood waste, cork unworked, waste cork	**M3/M4**

[1] Import and export levels relative to domestic production.
[2] Standard Goods Nomenclature for Transport Statistics / Revised of 24 goods groups.

In line with the Eurostat data at level 24 of the NST/R, the term wood used in this document covers timber - roundwood and cut-to-length logs including "long logs" - and chips. Waterways means maritime transport and inland waterways (river, lakes)[3].

2 Existing transport methods

2.1 Transport modes

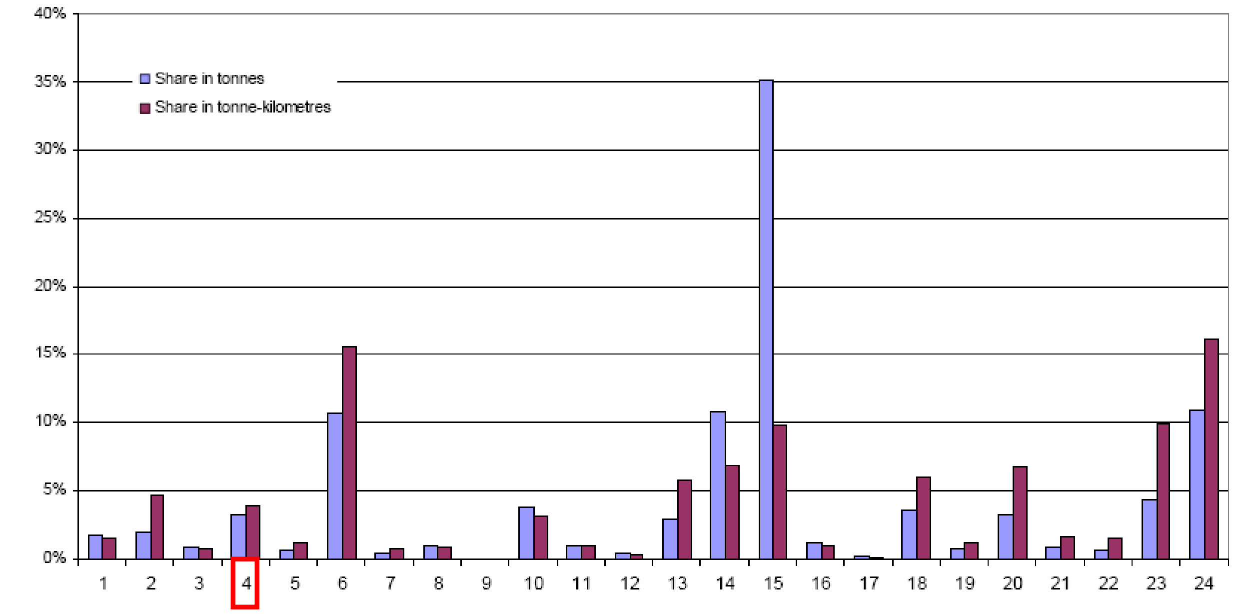
Information related to the share of modes is divided in two parts: the first one gives general information on transport mainly from Eurostat databases. The limits of the latter are such that in the second part we focus on information on "wood as raw material" from a wood procurement point of view. This second part is the most appropriate for the WP 3.3 working area.

2.1.1 Share of modes: general information mainly from Eurostat[4]

"Wood and cork"[5] (group 4) transport represents less than 5% of total goods transported in Europe in 2004

The share of modes depends on the unit (t or tkm). In Figure 1 for group 4 "wood and cork", the share of them is higher than the tonne share that means that wood tends to be carried over at least a medium distance (Eurostat, 2006a). In spite of this low share of total goods in Europe, there are variations between countries. In Sweden for example timber accounts for about 10% of the national land transport and together with forest products accounts for about 25% (Anon, 2006).

Figure 1 - Share by group of goods in total transport including international transport, 2004 – tonnes and tonne-kilometres



Source: Eurostat (2006a)[6]

[3] Cf. annex 7.2
[4] For information on the data available on Eurostat Web site (ec.europa.eu/eurostat), cf. annex 7.3.
[5] Incl. processed wood products and not only wood as raw material.
[6]. In annex 7.1, a figure based on total road + total railways + total inlandways is proposed for 2005 (some data are missing in the Eurostat databasis, cf. also annex 7.2).

All transport modes for goods[7] in 2005: road and maritime

If intra-EU maritime transport (total was estimated to be around 1525 billion tkm in 2005) and intra-EU air transport (2.5 billion tkm) are added to the land modes, then the share of road transport mode is 44.5%, while rail accounts for 9.6%, inland waterways contribute 3.3% and pipelines add another 3.2%. Maritime transport then accounts for 39.3% and air for 0.1% of the total transport of all goods.

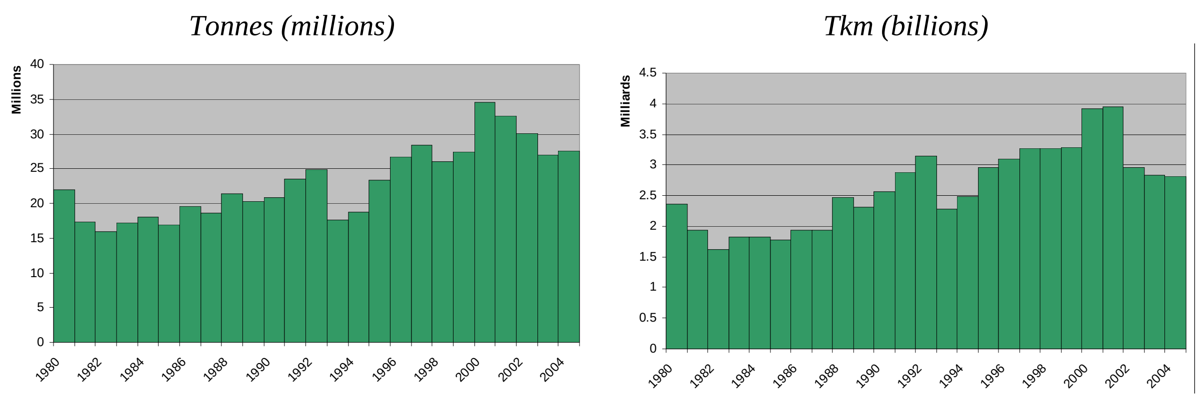
Transport land for goods: road for 75%

The demand for the four land transport modes (road, rail, inland waterways and pipelines) in the EU-25 added up to 2351 billion tkm in 2005. Road accounted for 73.3% of this total amount, rail for 15.8%, inland waterways for 5.5% and pipelines for the remaining 5.3%[8].

All transport modes: transport is growing and intra-Europe flows represent the majority

The growth of goods transport is 2.7% per year (1995-2005) in EU. This trend is also recorded for roundwood in France (see figure below) and in Sweden. Internal transport by lorries and railways in Sweden has increased by 8.5% between 1995 to 2004 in spite of reduced volumes being transported (minus 6%) and the share distribution between road and railways is unchanged (Anon, 2006).

Figure 2 – Transport is also growing for roundwood, even for internal flows: French example



Source: SITRAM[9] - AFOCEL (2006)

Note: Roundwood = 051 (Paper pulp wood) + 052 (Pit props) + 055 (Other wood in the round) in NST/R ; not accounted are 056 (Railway or tramway sleepers of wood and other wood roughly squared, half squared or sawn) cause the amount is tiny and quality or data is questionable; chips = 057 in NST/R even if other products as cork is included (057 = Fuel wood, wood charcoal, wood waste, cork unworked, waste cork).

The tonnage carried on international outside EU transport is 6% of the total international transport and forms only 0.3% of total tonnage in 2004 (Eurostat, 2006a). However, transport by non-EU haulers (other than Norway) is not considered and they may have had a large share of extra-EU road freight.

[7] Everything being transported including wood.

[8] Excluding pipelines, the shares of modes are: 77% for road, 17% for railways and 6% for inland waterways.

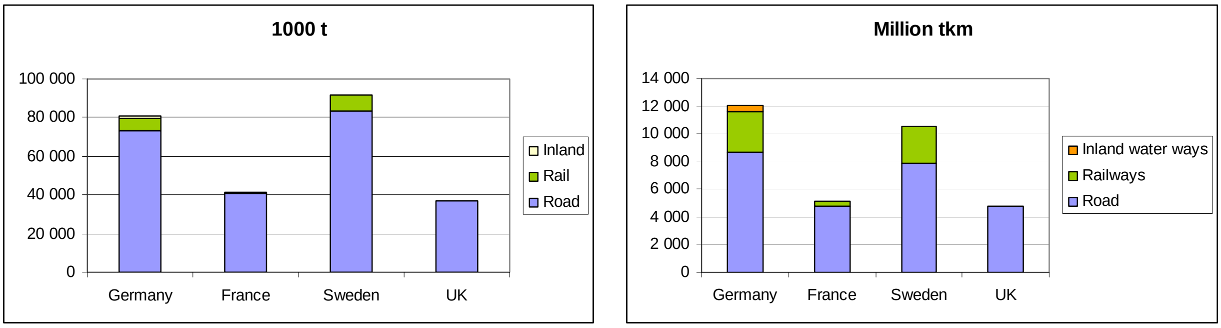
[9] Database is SITRAM (Système d'Information sur les Transports des Marchandises). Data represent regional matrix on origin/destination of internal flows (transit and international are excluded) by mode (road, rail and inland waterways) and products.

Comparison between "wood and cork" and general freight data (see annex 7.3 and 7.4)
Excluding maritime transport due to the lack of data availability on the Eurostat website (see figure in annex 7.3), a comparison has been done between the NST group 4 and the total of all commodity groups (24 groups or hereafter called NST25) for the main transport modes (road, railways and inland water ways).

For the EU25 in 2005, the share of respective modes is very similar for group 4 and for the total groups in tonnes and tkm (road represents about 90% in tonnes and 80% tkm, while the share of railways is more important in tkm, 20% vs. 11% in tonnes, due to its advantage over longer distances). This result is singular because wood has the reputation to use more road mode than other goods do. This general information at EU25 level nevertheless hides differences between countries as well as particular differences of groups within group 4, which is concentrated on flows over short-medium distances (between 75 and 150 km) as shown in the bellow distribution figure (Figure 4).

Country profiles
The following figure shows total "wood and cork" tonnages and tkm for different countries. Some additional figures are presented in annex.

Figure 3 – Wood and cork tonnage and tkm for different countries



Source: from Eurostat (2007)

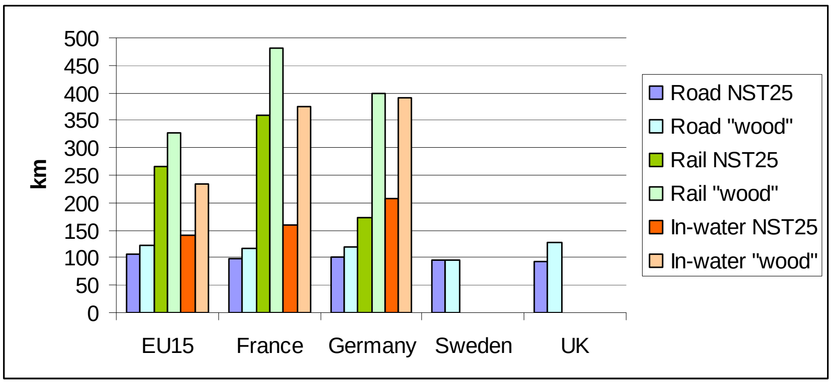
- Compared with the EU profile, France is characterised by a higher share of road transport in tonnes and tkm in general. This figure is particularly important for wood and cork, where the road records 98% of tonnes and 92% of tkm. The rational for these findings was its origin in structural problems faced in this freight market by rail.
- Germany is less road oriented in comparison with the EU25 data: the importance of inland waterways has to be noticed (it carries on 7% of tonnes and 14% of tkm for total groups data). The share of railways for group 4 is particularly important in tkm (24%).
- In Sweden, data on inland waterways are not available on Eurostat. Direct information from national data will overcome this problem in the next section. The most oriented "road mode" of group 4 can be underline in tkm in particular. Here also the weight, particularly in tkm, of the road for group 4 can be underlined (88% of wood and cork vs. 75% of NST25).
- In the UK, road is the most important mode for all commodities carriage. This trend is stressed by the fact that it is the unique mode registered in Eurostat statistics, concerning group 4 wood and cork. More details are presented later in the report.

"Wood and cork" transport profile is focused on short-medium distance: +/- 100 km:
The average distance by classes (Figure 4) indicates that average distance is more important for "wood and cork" compared with all groups (NST25). For instance in EU15, the average

distance for "wood and cork" is highest by 17 km for road, 60 for rail and 94 for inland water ways. A segmentation of the market is also represented: longer distances are covered by road alternatives modes.

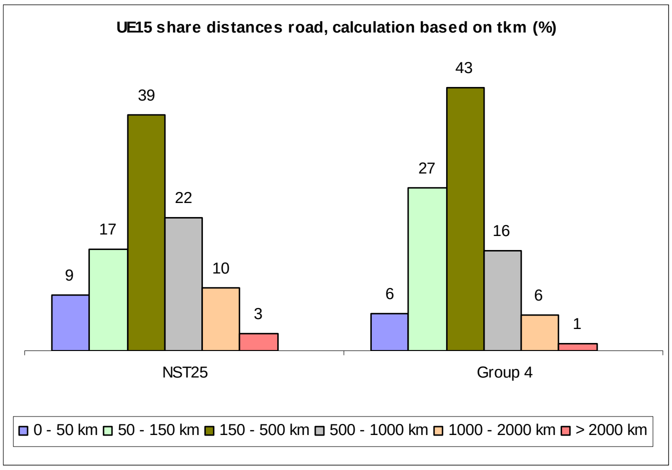
This specificity comes from the distance distribution for wood and cork in medium classes i.e. 50 to 150 km and 150 to 500 km in majority (cf. Figure 5). Therefore, road is the main mode whereas railways and inland waterways are used for long distances: 400 km for railways (250 km for NST25 in EU15) and 400 km for inland waterways (150 km for NST25 in EU15).

Figure 4 – Average distance in 2005 for road, railways and inland waterways



Source: from Eurostat (2007), wood = "wood and cork", group 4 of the NST/R.

Figure 5 – Share by distance classes for road transport in EU15



Source: from Eurostat (2007)

2.1.2 Share of modes of wood as raw material: road and proximity

Wood procurement of mills

Wood procurement not only depends on the spatial distribution of the wood industry and the forest but also on the possible modes of deliveries. Transport (tonnes, tkm) depends on the harvesting level and on the consumption needs of mills. Roads are also used in combination with other stages of transport: from/to ports and railway stations: "a continuous transport to customer is possible (no discharge or loading), truck transports are fast, it is easy to combine truck transport with other modes of transport (the whole truck or only the trailer can be put on board a ship)"[10].

[10] Department of Forest Economics, University of Helsinki (2002), page 1.

France
Since the beginning of 80s the amount of transported roundwood is increasing. Except the exceptional level of 2000 and 2001 due to the impacts of the severe storms in December 1999, the transport of roundwood represents about 25 millions tonnes per annum. The amount of transport of wood by-products for energy generation increases from 5 to 9 million tonnes, since 1980.

About 34 million cubic meters over bark are transported from the forest to:

- 16 various processing pulp mills (7 millions cubic meters over bark),
- 25 fibreboards and panel mills (3.5 millions cubic meters over bark),
- close to 2500 sawmills (20 millions cubic meters over bark), most of sawmills plants are small firms (90% of them have less than 20 employees; 10% of them produce 50% of sawnwood).

Germany
Not available

Sweden
98.3 millions of m^3 sub[11] were harvested in 2005. From the harvested total deliveries are 56.6 millions $m^3$to sawmills, 35.3 million sto pulp mills and the remainder as firewood and miscellaneous. Sweden also imports wood for its pulp industry: 8.3 million tonnes of roundwood and 2.9 million tonnes of wood chips. At the turn of the century there were almost 50 sawmills with a production over 100 000 m^3 a year. They are fairly equally distributed over the country with a majority situated to the eastern coast and southern Sweden. The pulp mills are about 30, all of them situated along the coast or the great lakes in southern Sweden. Paper mills are in similar numbers and more southerly situated. This structure has importance for the wood flow. There is a first transport from forests to sawmill; from there chips are shipped to pulp mills. There is also a direct flow of pulpwood from forests to mills.

UK
Timber is transported quasi exclusively as roundwood. There is no direct access to information on the volume of timber annually transported, because the DfT (Department for Transport) statistics uses the NST classification “wood, timber and cork”.
However, there is some information about the total volume of timber grown and delivered in the UK every year. For 2004 8.8 million green tonnes were delivered:.

- 5.05 million tonnes to sawmills
- 0.71 million tonnes to pulp mills
- 1.50 million tonnes to wood panels mills
- 1.54 million tonnes to other users or export

Additionally, for 2005 21.8 million tonnes of wood were imported to the UK (as well as 7.8 million tonnes of pulp, 8.4 million tonnes of pulp and 19.1 million tonnes of paper), which give a rough figure of approximately 30 million tonnes being transported annually.
(Forestry Statistics 2006, Forestry Commission UK)

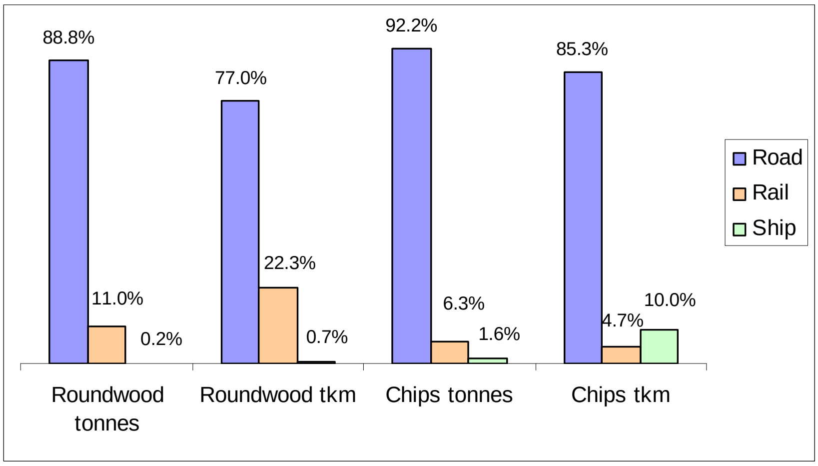
Road is the main transport mode for wood deliveries
Road transport is the main mode for wood and related products, in tonnes as well as in t-km,. The road network (flexibility of vehicles to easily joint various destinations) and geographical

[11] Solid volume under bark.

dispersion of forests make road transport the most convenient mode to use. The greatest amount of roundwood,.

Road transport is the most important mode used for wood transport and represents more than 95 % of the total tonnage of timber transported annually in the UK and in France. For Germany[12] (Scheer D. *et al.*, 2002) and Sweden[13], the share is about 90%. Road transport represents 80% for Finland. Longer transport distances by rail and on waterways gives a higher share for those modes as shown in the figure for Sweden.

Figure 6 – Roundwood and chips transport in 2005 in Sweden



Source: Anon, 2006

In Sweden road transport represents about (2004) 42 million tonnes of roundwood and 17 million tonnes of chips and waste wood. The average transportation distances for these assortments are 93 and 85 km respectively. About 5.2 million tonnes are transported by rail; with average distance 217 km (2004). chips and waste wood are also transported by rail, but little more than 1 million tonnes and for shorter distances, 78 km in average. Most of the imported volumes (about 8 million tonnes of roundwood and 2 million tonnes of chips) are delivered to Sweden by ships from Russia or other Baltic countries. The average distance is about 250 to 300 nautical miles (nm[14]); there is an important variation from 200 to 700 nm. Smaller volumes, about 0.3 million tonnes, are transported on national waterways. There the distances are longer (Anon, 2006).The Swedish case illustrates the importance of maritime transport in the FWC and enlarges the traditional "internal" country approach of wood deliveries.

Due to the larger catchments area of pulpwood industries (higher volumes and longer distances to find wood), the road share can be less important, due to the greater competitiveness of other modes, railways in particular.

Other modes for wood deliveries: infrastructures, habits and organisation

Railways and inland water ways require regular and ideally large and steady flows of wood. This is difficult to achieve: both wood lots and mills can be very of small sized and geographically dispersed.

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[12] A survey on how the trucks influence the overall transportation of wood by asking the wood processing factories found out that "88 percent of the transports of wood and wood products are done by the trucks".
[13] For roundwood (89%) and chips (92%).
[14] 1 nm = 1.852 km.

Maritime:

France

Maritime transport is based on long distance flows. Concerning imports, there are tropical timbers from Africa (2/3 of the volume) and South America. Some imports are coming also from Northern Europe (coniferous). The long-term trends of maritime flows on 1975-1995 are flat: decrease of exotic timber (-44%) balanced by an increase of pulpwood (+73%) and sawnwood (+47%) (Cariou P., Terrassier N., 1998). Due to the storms of December 1999, some exports of raw wood material occurred. Example: beeches towards China by ships. The main French maritime ports for wood products are La Rochelle (1st one for tropical timber) and Nantes (1st one for sleepers, other roughly squared woods and sawnwood).

Germany

As a result from the hurricane Lothar and the necessity to transport wood to foreign countries, Baden-Wurttenberg started to use ships as a transportation medium. But this proved to be cost effective only if the transportation distance is more than 500 km (average costs for solid cubic meter is 19€/m^3).

Sweden

The Baltic is a great area for nautical communications and connect Sweden with other shore states. It is important for wood import from East European raw material sources and also for export to the continent and UK. The ships for roundwood or chips are bulk carriers or LO/LO[15] carriers of 2000 to 10,000 tonnes deadweight. This is different from the ships for semi-manufactured or manufactured forest products, where roll on/roll off? ships are used many times. The exports are coming from ports in Baltic Russia and the Baltic states and are transported to ports in central and northern area of Sweden. The same ports are used for foreign traffic and domestic. The port operators can be various bodies, communes, the competent state authority or enterprises, or the (forest) industry. The ports are equipped for the loading and unloading stage, depending on the actual ship type.

UK

Not available

Inland waterways: a marginal mode

France

French wood inland waterways transport is clearly taking a marginal share. Nevertheless, it provides in some case a credible alternative to road transport. The French navigable network routes represent 8,500 km including 2,000 km open to large ships. After the severe storms of 1999, 2001 can is the year when ‘other than road’ modes reached a maximum: 96% of tonnage? was transported by road, 3.9% by rail and the remaining 0.4% by inland waterway. Some calculation has been done to assess the potential share of railways and inland ways for mills’ deliveries: the maximum potential share of those alternative modes is 10% (Ginet C., Monnet J-M., 2007[16].

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[15] Lo-Lo (Lift-on Lift-off) = loading/unloading by the vessel’s own derricks/cranes or by shore based cranes.

[16] The calculations are based on timber potential around wood railways station as well as wood ports and existing flows between regions.

Germany
The figures for water transport of forestry goods are aggregated with those of agricultural goods in the national statistics for Germany. The total transport tonnage was 13,706,000 t, and the traffic with harbours within Germany transported 8,368,000 t. Traffic with harbours outside Germany transported 263,501,000 t, within Europe 166,289,000 t and within EU25 115,377,000 t.

Sweden
Inland waterways transport takes place on the great lakes Vänern and Mälaren, in many cases in conjunction with imports and can be considered as a part of the same flow.

UK
In the UK, inland water ways are used mainly for processed and finished products, and the use for timber is marginal to inexistent. However even if not 'inland' strictly speaking, there is quite intense coastwise (UK to UK or UK to Ireland) traffic in costal areas, especially in Scotland[17], where the most extensive studies have taken place so far

Railways: structural constraints, rigidity

France
Some changes are occurring in the wood flows (cf. annex 7.5). The location of important mills (mainly pulp and panels) direct the flows. The change to a new main operator for freight, Fret SNCF – 2003 to 2006 plan - has led to the dramatic decrease of this transport mode (minus 9.8% between 2004 and 2005 in tkm). However, France is the third country in Europe after Germany and Poland with 40 billions of tkm in 2005.

Regarding wood, some changes occurred since the beginning of the 1980s and a reduction of the interregional flows higher than 15,000 tonnes[18].

Germany
Rail transport is important in Germany (first country in Europe in tkm) with 95 billions of tkm in 2005 for total freight. This mode is growing +3.8% between 2004 and 2005. The figures for transport of forestry goods are reported together with those of agricultural goods in the national statistics of Germany. For 2004, the total rail transport of these goods summed up to 6516000 t, whereof 2070000 t were transported within Germany, 3207000 t were exported, 898000 t imported and 340 000 t passing through on the railway.

Sweden
The railways of Sweden comprise about 12,000 km and 9,400 km are electrified. The almost main owner of the network is the state authority Banverket[19]. The network is sparse in northern Sweden, lines usually longitudinal; in Southern Sweden on the contrary, it is a grid which enables transport in all directions. The wood flow follows the same pattern, where roundwood is transported both north and south. In southern Sweden there are crosswise transports of roundwood and chips between timber terminals and industries. The gauge is as

[17] Opportunities for the Marine Transport of Timber in Scotland, Deltix IBI Business, March 2006
[18] General data are available (as proposed in the paragraph above) for 2005, but not for specific wood products since 2002.
[19] www.banverket.se

European standard 1435 mm, but this complicates cargo operations with Finland and Russia, where the gauge is 1524 mm.

Consequently railways are important in wood flows in particular for roundwood with an average distance of 217 km. Concerning chips, the fairly low distance in average (70 km) reflects the design of forest industry cluster where sawmills and pulp mills are fairly closely situated (with direct railway connections) in relation to the distance forest-industries.

UK

In the UK, there is only one line regularly handling timber by rail, for an approximate 150,000 t per annum. It runs from east Scotland to northeast Wales (Chirk), to one of the few mills with its own rail sidings. The catchments area covers up to 40 miles radius (~65 km).

In the recent years there has been another line in operation, from Kinbrace to Inverness (North Scotland) for onward road delivery, based on night-time line side loading of timber (i.e. without the need for any dedicated rail sidings). This relatively short-haul flow operated by rail rather than road in part due to planning restrictions on timber lorries over local roads It handled an annual volume of approx 15000 tonnes per annum, from a catchments area up to some 10-15 miles radius (15-25 km). This route ceased to be used for economical reasons.

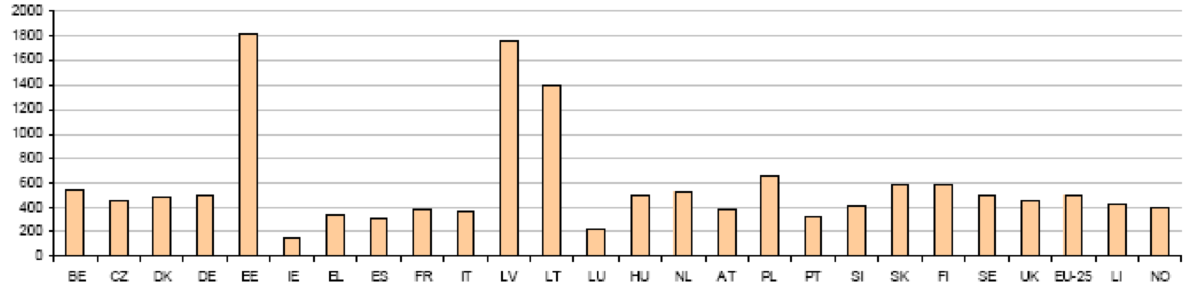
Other country

This mode is traditional in Poland (second rank with ~50 billions tkm for all commodities) where railways have higher market share: 50% for pulpwood (Gour N, 1998).

Average weight on train

The average weight of goods loaded onto trains in tonnes in 2005 (Eurostat, 2007) is a good indicator of the scale to reach in order to balance the high fixed costs linked to railway transport. In average for Europe, the weight of goods on train is 500 tonnes but in Baltic States this average is around three times as much (due to heavier payloads for fuel transportation and historic inheritance).

Figure 7 – Average weight of goods loaded onto trains, in tonnes, 2005



Source: Eurostat (2007)

Average distances are relatively short for wood if imports are excluded

In average, the procurement distance is about 100 km. Pulp mills have generally longer radius (up to 300 km), as they need large quantities of wood and a certain quality of fibres. Around 67% of roundwood transported in 2004 was intra-regional. The major part of volumes is transported by road within the same region. The inter-regional share is higher for railways. Since the beginning of the 80's, the average distances of roundwood transport has remained relatively stable both for road and railways. Regarding pulpwood, the radius seems to be more important in France (200 km) than in Austria or Sweden (about 100 km) and Germany (150 km) (Gour N., 1998). For timber in general in Germany, 150-200 km seems more accurate. In this country, the choice between road mode and rail mode occurs for distance of 80 km and more (Smaltschinski - unpublished, 2005).

The following table compile different sources and makes a synthesis:

Tableau 1 –Average distance for roundwood and chips in different countries

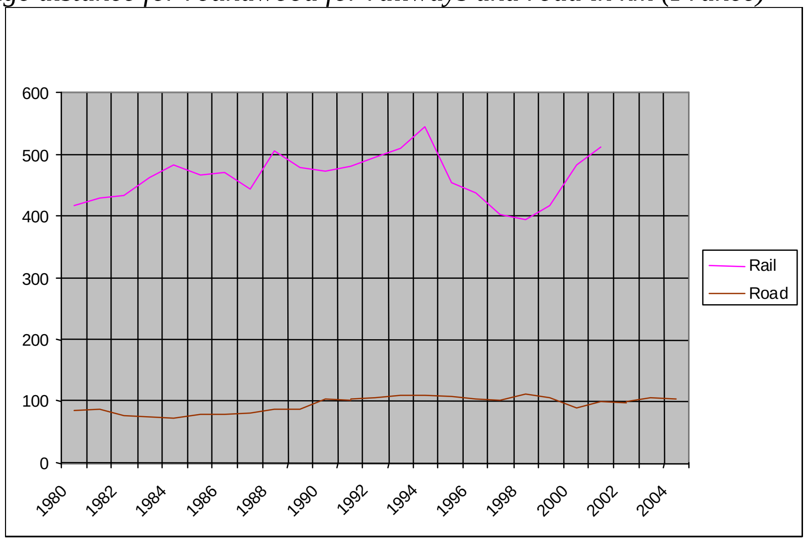
	Roundwood	**Chips**
Road (km)		
France	100 (80 for logs)	110 from data (SITRAM) 150 from pulp and panels mills
Germany	80	15
Sweden[20]	95	85
UK	~80*	unknown
Railways (km)		
France[21]	440	610
Germany	275	na
Sweden	217	70
UK	260 and 420**	unknown
Waterways (km)		
France (rivers)	330-900[22]	na
Sweden (foreign traffic)	325	215
Sweden (between Swedish ports)	470	590

Notes:
** from discussion with professionals – no hard data available on this aspect*
*** only one line currently working with two destinations*

Increasing distances for wood transport as well?

The growth rate of transport is higher than the economic one. To reduce this differential trend, public policies have focused on transport demand. This increasing distance is probably also found for wood flows. This factor is found in France: the long trend presents minor but steady increase of road transport for internal flows.

Figure 8 – Average distance for roundwood for railways and road in km (France)



Source: from SITRAM (2006)

[20] Anon, 2006.
[21] Average from SITRAM on 1995-2001.
[22] From SITRAM: in 1980, the average is 300 km and the post-storms years (2000, 2001 and 2002) indicate longer distance (up to 900). This is probably the range of availability for this transport mode.

The contributing factors could be:

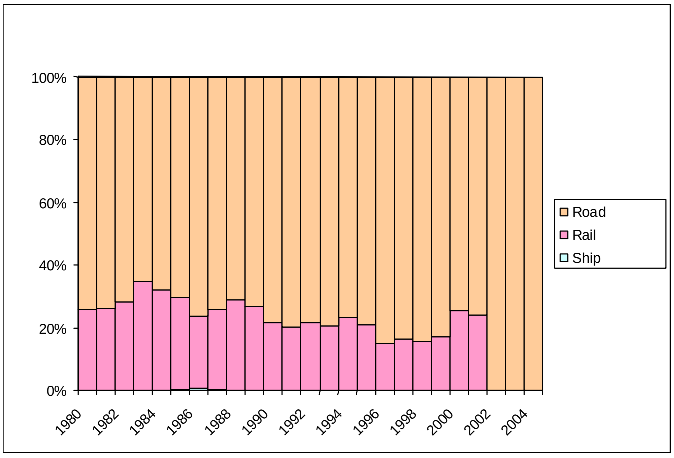
- the inadequacy of local forest resource with the mills requirements in quantity or quality ,
- the competitiveness of other transport modes (cf. French experience),
- the development of alternative uses for wood, e.g. bioenergy consumption,
- fewer and bigger mills requiring larger procurement areas of timber. This is found in Sweden where the size of the mills has been rising significantly. Average size for sawmills with more than 1000 m^3 yearly production increased from about 20,000 m^3 to more than 50,000m3 (Anon, 2006). The same phenomenon happened for pulp mills, were several have increased their production capacity to more than 400,000 tonnes/annum[23].

Concerning domestic flows, the longest distances are found in France and Germany.

Share of road transport is increasing

Road is taking the main share in the UK and in France, where it was specially in the last 2-3 years due to organisational changes in railways' operators.

Figure 9 - Modal substitution for internal roundwood flows in France in tkm



Source: from SITRAM (2006); inland waterways are so tiny that could not be showed in the figure; railways data are not available since 2002.

In Germany, the use of trucks for longer distances is observed (Scheer D. *et al.*, 2002).Transport distances are very market dependent and thus closely related to wood prices and wood availability. This two factors (quantity at "reasonable prices") tended to increase transport distances especially during the last 1-2 years in order to keep the mills running.

Transport for wood processing enterprises

The share of transport in the total cost of wood supply for the mill depends on:

- the value of the wood transported,
- the cost of the transport service itself

In France, transport represents from 20% (for good hardwood logs quality) to 40% (for pulpwood) of the cost of deliveries to the mills. In this context, the reasons for this dominant road system are economical (competitiveness of the other transport modes compared to road), geographical (proximity of timber sources/sawmills to railheads/rail network, ports, etc) and technical (need for adaptation of transport, loading/unloading techniques, etc. to the specific needs of timber transport).

[23] Pers comm. Katrin Heinsoo, Skogsindustrierna 15/3 2007.

2.1.3 *Wood transport equipment: specific, but too specific?*

Compared with general freight, wood transport is specific due not only to the larger share of road haulage but also to the equipment required. This has an incidence on the cost of wood transport .

Road equipment for wood

Roundwood

The road conveyors ensure the link between forest and production sites. A number of structural constraints relative to the forest areas require that the transporters are equipped with robust machines, specific to wood transport. These conveyors are often specialized in the wood transport and transport it in a nearly exclusive way. It is different for haulers who organise backhaulage with non timber products on non-specialised flatbeds. It is important to distinguish between in-forest (specific requirements) and out-forest (specialised or non specialised vehicles) haulage.

Products have an impact on the required equipment. Special equipment adapted to long logs is found in Germany and France (incl. "long logs" products of +/-20m) but not in Sweden and UK (short roundwood).

One distinguishes 3 main categories of means used for the road transport:

- Road train (road motor vehicle coupled to one or more trailers (timber length from 3 to 22 m in Germany and France;
- Articulated vehicle (road tractor coupled to a semi trailer) (for from 3 to 7 m) which is the dominant system in the UK, 6 axles vehicles with or without crane carrying roundwood
- Timber lorry made of one tractor and a dolly (logs up to 22 m in Germany and France[24])

According to a survey carried out by AFOCEL in 2005, focusing on transport from forest to pulp mills in France:

- 70% of cases transporters are using tractors and semi-trailers;
- Truck-trailers are used in 18% of cases;
- Timber lorries carry the remaining part (12%).

The fleet composition in France and Germany is close (5 axles in majority[25] but 6 axles are developing), whereas Nordic countries have road-train with 7 to 8 axles for short-timber. A common vehicle combination for roundwood transportation in especially northern of Sweden (70%) is 3 axles truck + 4 axles trailer with removable crane. There are also systems with an independent loader and trucks with no crane. The tare weight for trucks with crane is approximately 21 tonnes and 17 tonnes for trucks with no crane. This gives a payload on the Swedish roundwood trucks on approximately 39 – 43 tonnes. The dominant system in the UK is an articulated vehicle with 6 axles, with or without crane, carrying a maximum gross weight of 44 t i.e. payloads of approximately 25 tonnes.

Hauling wood directly from the forest may ask for special sturdy trucks with all terrain capabilities (4x4 or 6x6).

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[24] Specific conditions: road-train on a specific road network (cf. regulation section); otherwise it is included in "special transport" i.e. restricted to the traffic of "outsize goods, machinery or vehicle that exceed legal limits of length, width or weight" (Road Code. 433-1-l).

[25] About 80% in France.

Non-specific trucks are sometimes used. It is possible when the departure point is not in forest and increasingly used by long-haul companies to allow backhaulage of different products.

Trucks for bulk materials can also be used for short roundwood (ex. South of France by Spanish transporters that reduces the fix costs and unable backhaulage).

Chips

For chips transport, bulk equipments are more suitable. In Germany, the classic unrolling system DIN 30722 is normally used to transport loose, material like wood pellets and forest chips. Using the casters, the container can be put down on the floor.

Figure 10: The unrolling system DIN 30722

Trucks with a changing platform system DIN 284 are another type of transport. The advantages of this system compared to the unrolling system are that the purchase prices are much lower because there is no need for an additional crane, which cost is estimated (Kubitschke 2002) around 23,000€. The construction of a frame for the changing platform system to a classic truck would only cost 2,600€, according to Daimler-Chrysler (2002). This system is mostly used for combined road-rail transports For safety reasons, scrapper floor systems are also used (it is an alternative to tippers). In the UK, the system is not well known, and the 32 t standard tipper was only used as a reference for the costing approach. Different options (5 axles in general) are used in France: open box with cover or flat, tipper (70 to 90 m^3, load capacity of about 23 tonnes). Some equipments have "scrapper floor" (Figure 11). 3 axles truck with 2 axles trailer with loading capacity of 2 x 35m^3 containers are used. In Sweden, 3 axles truck + 4 axles trailers with loading capacity of 3 x 35m^3 containers are used; this system is also used for the transportation of lop and top.

Figure 11 – Scrapping floor for chips unloading

European differences: weight and/or length
The total payload carried is an important criterion for competitiveness of the transport enterprises. Weight per axle is related to the impact of transport on road.
To summarize, Northern Europe has higher average/allowed payloads (50 to 60 tonnes), whereas Southern part has 40 to 44 tonnes payloads (cf. annex 7.6).

Regulation for wood transport
The general transport regulation can be accompanied with specific regulation for wood.

France
In France, the government established a regulation specific to roundwood transport by road. taking in account its specificities and aiming to improve the competitiveness of the forest-wood chain (law n°2001-602 of July 9, 2001 - Law of Orientation on the Forest). It introduced the possibility for the trucks to carry greater payloads than those usually authorized (up to 50 – 52 – 57 t – 65 t –72 t depending on axles number). At the moment, for freight in general, there is a lack of haulers.

For all goods, possibility of allowing a maximum load capacity up to 44 t instead of 40 t is under consideration. Due to possible negative impacts of such a measure on the infrastructures and the fear of an upsurge of road transit, this adoption of this measure is uncertain.

In Portugal and Spain, professionals considering specific regulation are looking at the French experience.

Germany
The maximum gross weight for of trucks is 40 t, which corresponds to a load of ca. 25-23 t. In cases of national emergency (storms) the authorities can allow higher tonnage (up to 44 tons) for a limited time for wood transports. According to § 22 (2) of the “Straßenverkehrsordnung” (German road traffic regulation) the the maximum width for vehicles is 2.55 m, in the case of loading agricultural or forest goods (wood logs, forest wood chips and similar) the maximum width is 3 m at a maximum height of 4 m including load and vehicle The maximum length allowed including trailers is 20.75 m (§ 22 (4)). Overhang of load at the rear end may take up to 1.5 m, 3m for transport distances exceeding 100 km. However, any rear load overhang of 1 m and more has to be marked according to the rules or road traffic regulation.

Sweden
Lorries are allowed a total gross weight of 60 t, which enables a timber weight per vehicle of a little more than 40 tonnes. On some routes driving large vehicles is restricted by axle load and to suitable weather conditions, e.g. during thaw and heavy frost heaving.

UK
There is no system or regulation specific to timber transport in the UK; the current legislation allows a maximum gross weight of 44t for articulated vehicle or a drawbar-trailer combination, with 6 axles, road-friendly suspension, a 10.5 tonne weight limit on the drive axle and a low emission (Euro II) engine.

Average age
In France, on average roundwood tractors and trailers are 4 years old, while trailers and semi-trailers overpass 9 years. From an environmental point of view, the average age of a vehicle

matters. In the UK, the average life a tractor is 3 years and 5 years for a trailer (if relevant ? not really age but shows that the turnover is – has to be, very testing conditions- fairly important). Engine characteristics as well as their EURO classification have consequences for emissions.

Crane or not and load capacity
To handle timber, some trucks are equipped with cranes, reducing their load capacity. Depending on the type of wood transported, the weight of crane ranges between 2 and 4 tonnes, with heavier ones dedicated to long logs handling. In France, less than 50% of roundwood vehicles have a crane.

Equipment trend for wood transport
The recent evolutions in road transport vehicles are towards: an increasing number of axles (5 axles and introduction of 6 axles for France), a significant share of actually bought trailers are equipped with the auto-turning gear system[26], and an increasing number of vehicles without crane. Everywhere the objective is to have a vehicle as light as possible.

Dominant systems
The dominant systems in the 4 countries are presented in the section on transport costs.

Railways equipment: a need for specific adjustments

Roundwood transport requires adjustment of traditional infrastructure and equipments, and the connection with the rail network and logistics also require thorough consideration.

France
Fret SNCF proposes specific wagons for wood.

Table 2 – Wood wagons by Fret SNCF

Wood	Requirements		Length of load		
	Protected	Non-protected	>20m	<20m	Suggestions of wagons
Logs					L42
					R54 / R56 / R59[27]
Pulp wood or semi-final products (sawnwood…)					R59

Source: http://fret.sncf.com/fr/offtrans/offwagon/sec-apc.asp

[26] Auto-turning gear system can reduce the impact on road but demand an highest investment to transport enterprises (about 2-3 000 euros).
[27] There are in the Roos category presented in the next paragraph.

Germany
In Germany, there are different types of railway wagons[28]

- Type Snps:
  Especially constructed for logs and trimmed timber. It is a levelled wagon with 8 fixations on every side. This wagon is suitable for logs up to 19 m long. The maximum length of the logs is 19.60 m and the maximum load is 63 tonnes. The requirement is to close the linking facilities after loading.
- Type Roos:
  Especially constructed for logs and small logs. It is a levelled wagon with 16 fixations on every side. This wagon can be loaded without linking facilities when there are no surmount on the fixations at the side of the wagon. The maximum length of the logs is 18.4 m and the maximum 59 tonnes.
- Types Ealos-t, Eaos (Eas), Eanos:
  Especially constructed to transport piece and bulk goods. These wagons are open box wagons and suitable to transport industrial wood with lengths up to 4m. The length of the wagon for the Ealos-t type is 12.80m and the maximum charge 54 tonnes. The length of the wagon for the Eaos type is 12.80m and the maximum charge 58 tonnes. The Eanos wagon has a length of 14.49m and a maximum charge of 65.5 tonnes.

  Before loading the timber in the wagon, it is necessary to check for any metal pieces left from the previous transport likely to damage the wood and cause loss in value.

Sweden
Railway characteristics are designed according to the standard of the tracks, bearing capacity, differences of altitude, possible length of the train and electrification. On electrified railways the traction engine is the RC (different variations) locomotive. Its weight is close to 80 tonnes. The engine capacity is 3600 kW. For wood transport sets of one or two are used, which enables the locomotive to pull 22 or 44 wagons. The diesel electric traction engine T44 has an engine capacity of roughly 1200kW and tows, depending on conditions, 15 -22 wagons. Another similar diesel electric engine is TMX or TMY with comparable engine capacity (Anon, 2007; Green Cargo, 2007).

There is a wide range of wagons used, all according to European classification as Littera E, and K and Roos. Typical Wagons for Green Cargo are wagons of Littera K a new model Littera Laaps will be introduced. Performance of wagons is usually wagon weight roughly more than 10 tonnes that carries about 35 tonnes of cargo. The length of the train set can vary, can be 200 m or as long as 600 m. The roundwood and chips are loaded at timber terminals ports, or industry (chips) and are delivered directly to the timber yard of the mill.

Table 3 - Specifications of wagons for roundwood at Green Cargo

Type	**Length. m**	**Tare weight, ton**	**Loading space**
Kbps-x	14	12	2,8 *12,6 m
Lnbs 871,891,931	13-14	1-11	8 m^2, two or three spaces for 3 m short wood

Source: Wetterwik, 2007.

[28] www.stinnes-freight-logistics.de

UK
Very few major mills have their own private rail sidings which enable direct access for trainloads of timber, however a number of them are either located close to a railhead, or have currently non-operational sidings that could potentially be brought back into use, or are close enough to the existing network to consider non-intrusive rail crossover.

Waterway equipments: some adjustments

Import ports
The ports are generally public ports with ability to deal with Ro-Ro ships and bulk carriers. Many industries have their own ports or are situated very near a public port.

Inner ports
Due to the dependency on other transport modes, the inland ports are mostly multimode platforms equipped for storage, loading and unloading of commodities. The waterway transport and related investments are often depending on the surrounding transport network and on a logistic organization of containers. In this case, the question of the railway junctions is of primary importance, followed by the quality of road connections.

Materials for rivers
The materials are adapted to river networks size. The most suitable and traditional goods for this transport are bulk equipments. Therefore, wood chips can be transported like any other good in bulk.

Some examples:

- For a small capacity (250 to 400 tonnes) Freycinet ships are available. The interest is that transport is available all over the European network.
- Larger material exists with loading capacity up to 1000 tonnes or more.
- Tracked convoy has a capacity of several thousands of tonnes.

Roundwood requires a particular attention. In this case several technical constraints apply: the port must be able to store along the quay, over long time period, allowing the loading of whole boat (about 1000 tonnes); the crane needs to be adapted to the infrastructures (height of the quay in particular); it is better to choose an adapted carrier (boat with a capacity neighbouring 1,000 tonnes without subdivisions and the crane) then an expensive conditioning (container) which is more appropriate for the wood of high value; similarly the quantity of waste generated by handling of wood is not trivial and must be taken into account.

Mix equipment: maritime and rivers
Some equipment can both be used for rivers and maritime. This is of great interest for reducing breakings of load, which are often costing.

Maritime
The ships in the Baltic and for Swedish inner (national) waterways are the size of 3000-10000 tonnes dead weight and are able to carry 2000-6000 tonnes of load. A typical 4000 dead weight tonnes has length over all (loa) of about 100 m and have two open cargo spaces, smaller ships[29] roughly 2000 dead weight tonnes, loa 70 m and only one stowage space. Practical speed is in the vicinity of 10 knots.

[29] http://www.nordship.se/images/Nordcarrier_04.jpg

2.2 Transport sector: structural aspects

Transport systems depend on the relationship between forest resource, transport companies and wood processing industries. The local context is particularly important for identifying the characteristics of this relationship. Through country profiles (France, Germany, UK, Sweden) the diversity but also convergences of wood transport systems are presented.

2.2.1 Transport operators for wood

Road transport

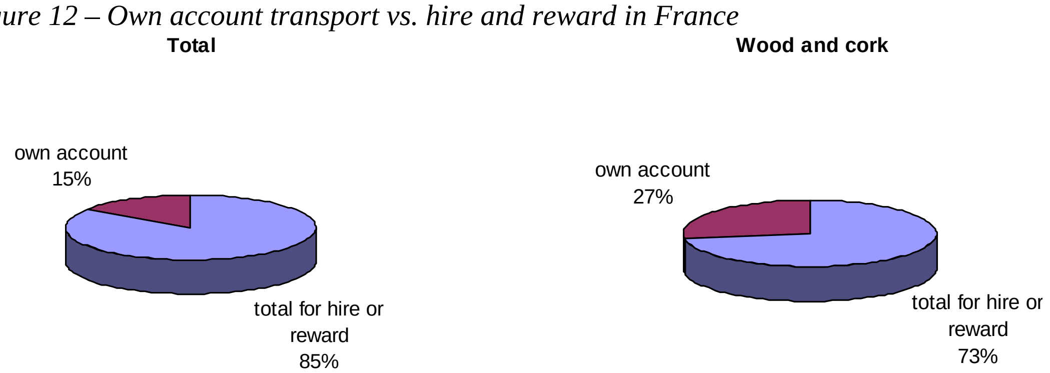
France

According to the French regulative framework, three different types of organisations are allowed to transport wood. Firstly, there are "public transporters" providing services for carriage of goods and products, including wood among others commodities. In France, the transport for *hire or reward* is mainly provided by small operators acting on a local scale (cf. here under). Secondly, the manufacturer on its own-account can do the road transport, where a transport permit is not required. In this case transport, as secondary operation, takes part among its productive activities. Finally, a particular derogation allows, only, transport of saw logs by any other transporters within 100 km. The latter does not need a specific transport permit. This case makes it difficult to precisely characterise and quantify material flows.

In road transport, due to the specificities of materials (cf. here above) enterprises are mostly specialised in wood transport only. In France these enterprises are rather small in size (number of trucks, capacities, etc.). Bemer *et al.* (2002), indicated that in forested areas or less forested areas, independent entrepreneurs do 60% to 90% of roundwood flows. During the late 1990's, it was considered that there were 600 wood transport enterprises. Some are individuals. Most of those enterprises are small ones: 80% have less than 4-5 trucks. Most of them (80%) work in a specific area (regional level).

Own account transport is developed in particular in sawmills[30]: they get some equipments on their own, transport wood for their process and can transport for other enterprises (as hauler) in a 100 km radius around the harvesting plot (Order enacted in 1999). Official data illustrates this phenomenon (cf. figure bellow), as well as direct enquiries: for instance, in Limousin - centre part of France - sawmills transport 40% of their logs by their own trucks. Such structure is a barrier to the development of potential integrated logistics solutions.

Figure 12 – Own account transport vs. hire and reward in France



Source: Ministère des Transports (2006)

[30] Many sawmills have several activities: sawing, harvesting and transporting.

The atomisation of wood road transport enterprises gives information on the dependency of transport enterprises vis-à-vis wood mills. Even if new systems, and arrangement between haulers and transport enterprises are changing (long term contracts), it was traditional that invoice was the only document existing. Traditional relationship is based on confidence, interpersonal relationship and faithfulness. Contrary to some Nordic examples (collaborative work for optimisation), one to one relationship is the rule. The atomisation of the transport activity is even more important that wood transport enterprises have specific equipments and most of them are specialised in hardwoods (logs are barely more than 14 m) or softwoods (16 to 18m logs are common).

For payment, pulp and panels mills use tonnes but sawmills cubic meters. Depending on the size of sawmills, the tradition and interpersonal relationships is more or less important. In general, enterprises integrated in their tariffs: distance, volume, loading/unloading time and not the working time or the value of the commodities (Bemer D. *et al.*, 2002).

In parallel, the foreign road transporters can offer, under conditions, a service of cabotage. The latter consists of a transport of goods between two locations (a gate of loading/embarkment and a gate of unloading/ disembarkment) located in the same country by a vehicle registered in an other country of the EU. Nevertheless, the operator has to respect conditions in order to operate: not more than 30 successive days of transport on the territory; not more than 45 days over a 12 months period; the French social system applies as of the 8th day. In France, it is possible to hire foreign vehicles but without driver.

Germany
Not available yet

Sweden
Companies for timber haulage are medium or small sized companies that are operating a few or many vehicles. They are usually specialised for timber or chips transport. The kind of company varies. The smaller companies are operating in cooperatives in a regional cooperation. Some companies are owned or controlled by forest industry. There is almost no integration backward that is to logging. However due to denationalising of regulations of railways in Sweden there are freight companies that operates both transports with road vehicles and railways.

Optimisation is on its way in Nordic countries. Transportation planning is an important part of the wood flow chain in forestry. Wood bartering (or timber exchange) between forest companies in order to reduce transport cost is fairly common in Sweden. The models and methods used in the system FlowOpt (Forsberg et al., 2005) can be used to find the actual saving if all participants co-operate as compared to no coordination. The potential savings are large, often in the range 5-15%. M. Frisk et al. (2006) deal with the key question: how savings should be distributed among the participants.

UK
Road transport enterprises are mainly haulage companies, specialised or not in the haulage of timber. A recent survey carried out in Scotland tends to show there is no relationship between the size of the company and the fact that the haulage is specialised or not, nor with the distance travelled. However there is a very clear link between the distances travelled and the fact that the business covers both timber and other products, allowing back journeys with different type of loads without which the operations wouldn't be economically viable.

Rail freight transport

German experience is interesting concerning the development of this mode for wood. Organisation conditions have been developed for making this mode interesting: regularity, massive and long flows and/or frequency combining raw material and semi-final products. On the contrary, in the current situation, the French case is the “bad” example.

France

The strategy of the State owned Railway company is not favourable to wood transportation (during the last 2 years, dramatic reduction of the number of wood railway stations from 200 to 40 and a 30% increase of the fees in average – more is planned; poor quality services and delays). The monopolistic situation of this historic railways operator is such that the wood market is declining sharply for this transportation mode.

Currently in France, there are eight operators that could providing till now or in the near future rail freight services: Europorte2 (Eurotunel), Veolia Cargo France (Velio Transport), VFLI (SNCF), Euro Cargo Rail (EWSI from UK), CFL (Luxembourg enterprises and Arcelor), SNCB (Belgium) and Rail4Chem (BASF and other German chemistry enterprises). The Fret SNCF competitors represent less than 10% of railways freight in France, but could increase their market shares due to lower tariffs (up to 30%). Two operators are interested in wood as raw materials (for export in particular), but wood flows are difficult to develop due to inner structural organisation (frequency).

The trend in their activities is to focus on the local actors, able to ensure large quantities of freight and on a regular basis.

Germany

Nieten Fracht Logistics, a 100% subsidiary of the Deutsche Bahn, is one of the biggest railway transport companies. They are specialised in the transport of wood (timber, trimmed timber and wood fibreboards) in single wagons or whole trains. Since a certain time now they have also specialized themselves in transporting firewood, wood pellets and wood chips. Nieten Fracht says that the business with the fuels out of the wood is not yet well organised in equipments and logistics. They say that until now they have had only big orders because the flexibility for smaller orders is not possible at the moment because they would not be profitable.
The most efficient and the largest products offered by the railway companies are the “Woodliner“ and the “Nordhafenzug“:

The *Woodliner* consists of block trains rather than wagonload transports. The cooperation of Rail Cargo Austria and the Stinnes AG (former DB-Cargo) brings along a very efficient possibility of wood transport. The aim is to transport German logs to sawmills in Austria, where the wood is produced into trimmed timbers and other forms of wood products. There are 130 loading stations in Germany to load timber, which should be transported to Austria. At the beginning of the program in 2003 (June 2003) the *Woodliner* transported 140.000 tonnes, in 2004 840.000 tonnes, in 2005 nearly 900000 tonnes and in the first half of the year 2006 the transport volume was already at 770.000 tonnes of timber which should go up to the intended 1.2 Mio tonnes of timber for the year 2006.

Starting from Freilassing in Germany the *Nordhafenzug* transports the final products from sawmills from Austria and Germany all the way through Germany to the seaports in the north of the country from where the products will be shipped to the whole world. In Freilassing all the different wagons from the whole Austria are assembled to one big train. The train only needs one whole day from the Alps to the seacoast.

Sweden
Several independent companies are operating cargo transport on the Swedish network. The dominant actor is the state owned Green Cargo AB, which also has ¾ of wood transports on railways. The total amount of cargo 2004 was close to 60 million tonnes, of which timber and chips was almost 10% (Official Statistics of Sweden, 2006 ; SIKA, 2006). Due to a deregulation of State railways by separating a track owning company, Banverket, and the state owned operator (Green Cargo), the field has been upended for private freight operators. They are active in wood transport as well. New constellations are under ways, e.g. a transport company for road transport acquires railway operations.

UK
Not available

Inland waterway transport

France
Looking at the ownership structure, it is necessary to distinguish the owner of the port (often the State) and the manager (usually the local Chamber of Trade), who can be the owner of superstructures (crane, rocks…). In such case the Board of directors is composed of local actors (local authorities, enterprises, etc.).
The inland waterway transport is largely depending on technical environment (infrastructures, materials, etc.) and on organisation among actors (between clients, the port management and transporters). The large quantities on a regular basis here also can facilitate connexions.

Three different types of public transporters are operating. Firstly, the craft bargemen are generally equipped with small motorized barges (the Freycinet type for example). Thanks to the size of their equipment, they can sail through the whole European network.

Secondly, small fleets are mainly gathering several bargemen owing several boats with few employees. One also finds in this category, the craftsmen organised in professional associations “co-operatives”. Thirdly, the navigation companies are generally equipped with material with a deep load profile. Their operating range is thus limited to a river basin because of the size of material and because of the lack of connections with waters open to the deep load profiles. These companies are therefore privileged for large loadings.

Finally, the inland waterways freight brokers are bringing together clients and conveyors. On behalf of the client they can take care of a whole or of a part of logistics.

All in all, working with craftsmen or small structures provides more flexibility, and their personnel is present during the loading and unloading operations. For the large companies, the programming of convoys is more rigid.

Germany[31]

The German waterway network has a length of 7300 km, comprising approximately 17800 km of inland waterways. From these about 6500 km are inland stream and river waterways and approximately 750 km lake waterways. Seaward limit is not taken into account. 35% are freely streaming rivers, 41% barraged rivers and 24 % artificial waterways. According to the principles of the European waterway classification 70% of the German waterways are considered internationally important, 17% are nationally important and 13% are not classified.

Sweden

Not relevant (cf. maritime)

UK

Not relevant

2.2.2 *Wood procurement organisation*

The logistics are more related to the qualitative aspects of the supply chain. It integrates the flows of raw materials from their origin to the incoming gate of the transformation site. Above the transport itself, logistics include the management of stocks, conditions of storage, flows of materials, etc.

The organisation of the supply chain is depending on the wood processing manufacturers, who are clients of transport service companies. The manufacturer can chose between internalising the supply chain, that gives him the advantage of control over material flows (time, quantities, locations,), or externalising it to the specialised logistic companies. The latter, gathering several material flows, can increase quantities of transported goods more easily, and thus diminish the average costs per tonne. The logistics service companies in some cases became genuine “manufacturers of transports”. In consequence however, the wood-processing manufacturer to some extent loses the control over material flows.

The transport efficiency is highly determined by the optimisation level of rounds of deliveries and by the amount of empty backhaulage of vehicles. The volume of goods available to the logistic companies gives them, an opportunity to optimise the transport operations, and thus a competitive advantage.

For instance, it is possible to leave trailers in the forest which can immediately be loaded by the forwarder meanwhile the truck will transport a loaded trailer to the factory. Such a system is only worthwhile with a collecting volume above 500-1.000 m^3 sub because three full forwarder loadings are needed in order to load such a platform, while the truck has to wait during that time. In addition to the organisational gain, this material used is cheaper than a normal log stacker. The gain could be up to 2-6 €/m^3 sub (Reiter 2003 in: www.timber-online.net, 18.12.2003).

In any case, from the client’s point of view the fluidity and speed of material flows are increasingly required for both mono and multimode transports.

[31] Wasser und Schifffahrtverwaltung des Bundes; www.wsv.de

At best, 75% of the equipment time can be done in charge (Bemer D. *et al.*, 2002 on French conditions).

Last but not least, till now we have considered that modes could be analysed independently. The following figure represents the necessary combination of those “other transport modes” (railways inland and maritime transports) with road mode. Indeed, truck transport is necessary from the forest to the train station / harbour and from the train station / harbour to the mill (if the mill has no direct access to rail / harbour).

Figure 13 – Transport mode systems: example from Baden-Wuerttemberg

Transportation Systems	Long logs	Short Logs/ pulpwood	Chips
None	Tractor+long-load dolly	Road-train, cr Tractor+semi-trailer,cr Tractor + semi-trailer	Solid bulk 5 axles
One	Tr+l-l dolly – Train	R-t – Train Tr+s-t,cr – Barge Tr+S	
Two	Tr+lld – Train – Tr+l-ld	R-t – Train – R-t Tr+s-t – Barge – Tr+s-t Tr+S – Tr+S	

Tractor + long-load dolly 5 axles with crane
Road - Train 5 axles with crane
Tractor + semi-trailer 5 axles with crane
Tractor + semi-trailer 5 axles without crane

Source: FVA (personal communication)

2.2.3 Wood transport image for the community

Till now, wood transport has been presented in quantitative and technical ways. Qualitative dimension is also important (see indicators set #5). Generally speaking, wood transport image for the community is negative.

It is not easy to rigorously determine the image reflected by the wood transport in related communities. While in some cases, wood processing manufacturers are directly involved in maintenance and in extension of road network (Scandinavian countries) in others they are often perceived as burdensome (noise, gas emissions, impact on the infrastructures, etc.).

France

In France the wood transport is perceived as generating negative impacts, on the road infrastructures in particular. This negative image has been illustrated with the implementation of roundwood regulation authorized under certain conditions higher weight.

Its implementation depends on the regional agreements between the responsible authorities of the road infrastructure (local authorities) and the professionals came off to a very diversified picture across the country. In some cases conditions of traffic became more restrictive (only some roads are open for the use) while in others situation got more favourable (large road network open to the load charges up to 57 t). After the few years of implementation the results of the law are ambivalent: many barriers were difficult to overcome between actors, and in areas with a strong forest character the importance of the chain was not necessarily reflected in the definition of favourable conditions for the professionals.

Other element reflects the bad perception of the road transport in general. Recently Germany has introduced an additional road toll on transport of goods by road on motorways. This resulted in a diversion of traffic towards some neighbouring French regions (Alsace), which registered an up surge of heavy loaded transit. Consequently, there is a proposal to apply also in this area a road toll on all heavy loaded vehicles.

Germany
Not available

Sweden
In Sweden there is a concern that road traffic causes environmental disturbance by emissions and that transport benefits many times are not balancing the burden it causes. There is general attitude that railways are more efficient also due to environmental impact. This is probably true since the use of electricity with a high content of hydropower is dominant energy use. In fact, Greene Cargo has a business concept to certify that. This means that road transportation is accepted as an alternative only if there are no railways available. Large vehicle means less energy use and few vehicles for a given quantity. In the sparsely populated areas, where forest usually are, timber vehicles are not seen a s burden, rather as a sign of economic activity. This is in northern Sweden. In the south the lorries with timber are regarded as a factor in the traffic system that has a negative impact according to general public discussion, but timber vehicles are not singled out as a "problem". Over all there is a general concern to move transports to railways where it is possible and to avoid unnecessary transport.

UK
The timber transport has a negative image mainly in the rural areas, where conflicts in terms of road use, maintenance and the nuisance perceived (traffic, noise) generate tensions. The use of forest roads, which are more often than not private roads, is not as problematic as the use of public roads, where the co-habitation of different users and the question of the maintenance are critical. The problems are exacerbated in areas where the design and or maintenance of the network do not answer to the requirements of an ever-increasing timber transport flow.

To try to address this problem, regional timber transport groups have developed a draft agreed routes map, based on forecasts of timber flows and local consultation. They are classified as:
- **agreed routes**, which can be used for timber haulage without restriction
- **consultation routes,** which are recognized as being key to timber extraction but are not up to Agreed Route standard. Consultation with the Local Authority is required and it may be necessary to agree restrictions on timing, allowable tonnage, etc. before the route can be used.
- **excluded routes**, which should not be used for timber transport in their present condition.

To summarize:

On data:
Eurostat data can provide general information through group 4 “wood and cork”, but are not enough to get all detailed information on wood procurement and its specificities.
For WP 3.3, we have to rely on national data, national/regional studies, professionals information and expert knowledge.

On wood transport
Wood as a raw material (logs, chips) is mostly transported in short to medium (50-100km) distances. Road transport is therefore dominating. Railways and water are by far less important. Trains and ships only become more important in long distance wood supply, often between countries.
Decentralized localization of forests and mills do not encourage alternative carriers and transport modes. For most wood transports specific technical equipment is necessary. This limits the possibility to adopt existing general rules / functions about transport to the peculiarities of wood transport.
It demands specific equipments for all modes, road in particular for timber.
Economic aspect is the most important one, even if environmental aspect is becoming more important (but not yet internalised in most of FWC enterprises, excepting large groups such as Stora Enso, IKEA….).

On country profiles
France, Germany, UK and Sweden are probably sufficiently representatives to illustrate in many cases wood transport in Europe.

On limits of the exercise
Maritime transport is not well known, except for Sweden. A specific effort has to be done.

3 Alternative methods and new concepts for wood transport

3.1 Containerisation of roundwood

One of the major difficulties in the forestry-wood transport chain comes from the heterogeneity of wood characteristics. For instance differences in the roundwood (freshness, dimensions, etc.) makes it impossible for operators to benefit from a strong capacity of transhipment, which limits the time of the breaking bulks and allows the transfer of one mode to another. In order to standardise the product transporters are starting to use containers (or mobile boxes). It gives an advantage to carry on standard objects and thus it increases the efficiency and performance. Indeed the backhaulage can be used to transport other products, transhipments between vehicles / modes are quicker and easier, etc.

France
Some tests of mobile boxes also exist. A sawmill has developed a prototype. The lengths of wood are 2 or 2.4 m. The weight of the box is 330 kg and unable to get a load of 7,5 tonnes (i.e. 4 boxes can be used per truck).

Germany
Other interesting examples are found in Germany to reduce the specificity of equipments and diminish the empty backhaulage rate.

- EUROFLAT is a system[32], which aims to combine classic unrolling system and changing platform system for logs.
- In 2002 a further development called Kombi-Euroflat has been proposed: With the help of the blanket you can transport forest chips from the industry to the customer to minimize the light running of the trucks. The new version of the Euroflat has a weight of 2.460 kg without volume, which is 500 kg above the older weight for this truck but the advantage of the new one is that you gain one tonne when you are transporting forest chips compared to a normal container carrying forest chips.

Figure 14 -- Euroflat-Kombi transporting logs

Figure 15 - Euroflat-Kombi transporting forest chips with the help of a blanket

[32] Constructed by the company of Georg Kraemer KG with the help of the forest company 3H-Forst Dickel GmbH & Co KG

Sweden
Swedish forestry has since many years worked towards increased payloads and decreased tare weights. Discussions with authorities on possibilities to increase legal gross vehicle weight are ongoing and within industry there is always an ongoing struggle to decrease vehicle payloads.

UK
The possibility of using containers for roundwood was studied in the Intermodal Rail Timber Demonstrator Project, the Spaven McCrossan Partnership for Scottish Enterprise, 2001. It was looking at technical solutions using containerisation to reduce handling time and cost - the study showed that a saving of 25-35 minutes per forest-railhead-forest cycle would be achievable through containerisation, which would involve a single timber loading stage for a whole cycle. This system could also improve flexibility for back loading, and would allow keeping the integrity of each load in storage areas.
However, wider use of containers would require adaptation of the machinery used (forwarder units would require load weighing equipment), forest roads (maintenance, lay-bys/platforms), and appropriate training of the operators involved.

Development of new solutions
However many barriers still prevent from the use of this tool. For example, on one hand there are technical problems related to the design of containers (robustness, weight, stacking, standardization, etc), and on the other hand there are problems of organization (integration within the supply chain, involvement of actors, etc.).

3.2 Logistic platforms for wood

A logistic platform is a geographical concentration of organizations and companies dealing with the carriage of goods (conveyors, commission agents, shippers, customs, etc) and with auxiliary services such as maintenance, storage and repair. The platform is compounded of all or of a part of five elements: buildings (offices and buildings), conditioning, transit (grouping, braking of loads), warehouse, and technical buildings.

In theory, logistic platforms enable an increase in competitiveness and an improvement in management of material flows. In practice, their management is often externalised to specialised enterprises.

The <u>expected benefits</u> from such infrastructure are related to:

- Strategic advantages:
  - To concentrate on the core of business
  - To profit from savings in competences
- Organisational advantages:
  - To focus material flows on poles of logistic excellence;
  - To substitute the spaces devoted to logistics with productive activities
  - To transfer a part of its personnel
- - Financial advantages:

To reduce the total logistic cost
  - To profit from the economies of scale released by the service provider who consolidates (increase quantities of) flows
  - To limit the investments (warehouses, transport material, etc) and the associated risks

There are also some disadvantages, which slow down this externalisation:

- The loss of confidentiality of information
- The selection of the subcontractors;
- The control of the logistic chain in its entirety, the coordination of flows
- The risk of over cost

In other words, breaking of load (the moment when a loading or an unloading takes place) is increasingly related to the creation of value added. Indeed, the interruption in the chain of transport, which usually represents a cost in time or in operations, can offer an opportunity to the company providing the service (increase in quantities of flows, assortment according to qualities, frequency, load charge, time for unloading – loading, switch of transport mode, optimisation of deliveries, etc.). Sorting woods could generate value added and overcome the platform cost.

The geographical location of platforms is crucial. In France in practice the priority is given to the quality of the surrounding road network. Even if the horizon of rail freight is not favourable, the investors take care that the platforms have a railway junction. In some branches, the tri-modal platforms (road/rail/water) are increasingly developing. Tax advantages are often granted to the financers.

3.3 ICT

The Information and Communication Technologies are numerical technologies gathering different hardware (computers, GPS, RFID, modems, etc.), software (SIG, technical applications, solutions for management of total logistic chain, etc.), and standards of communication (GPRS, Internet Protocol, etc.). They support exchange, sharing and exploitation of information. The NTIC allow collection of data from the sources, to spread them and to make them easy to exploit by all involved actors. For example they avoid errors of transcriptions, make possible to trace wood flows, etc.

The wood supply chain includes several steps from prospecting, forestry work, to transport and reception at the transformation site. Along the chain several actors are involved, exercising different activities (management of stocks, forwarding, etc.). For each of them the NTIC give opportunity to possess information in real time in order to better plan, control and manage the total logistic chain. Wood procurement depends at first on stock management. It is important that manager can rely on information in real time directly.

In the UK, the adaptation of GPS navigation system to the needs of haulers on forest roads (FC Wales) is under development. This development exists also in France, Germany, where the managing of transport are done with the aid of GPS positioning of wood and the running of the vehicles are done according to this information.

In practice for instance the large industrial groups are reorganising their supply structures by centralising within the same group but supplying different transformation sites. This requires a cooperation network, where the NTIC make possible to facilitate exchanges and to answer efficiently one particular site needs. Similarly, the traceability of highly valued products is possible, as the optimisation of transport flows (quantities, capacities, routes of delivery, etc.). The NTIC contribute to a better knowledge and to a better use of resources, thus maintaining the competitiveness of transformation sites.

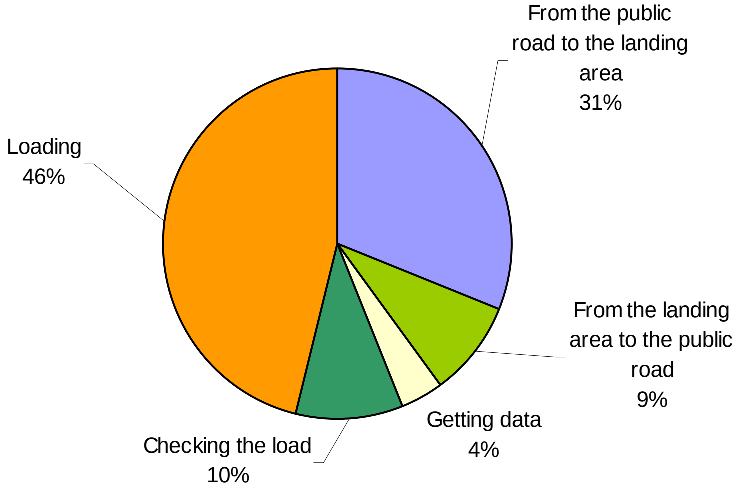
However, according to level of the information systems in the logistic chain some conditions needs to be satisfied:

- To have a regular cover with a communication network over the working area;
- To have cartographic numerical data in particular for forest roads; this request an organisation at wood chain level to organise the collect of information all over the territory,
- To define a standard for information coding and exchange;
- To have qualified personnel and trained users, because of the fact that all system depends on data quality;
- To have an efficient cooperation between actors.

But for some wood working enterprises the NTIC are quite difficult to implement. The main rational relates to the lack of adequate system of information within some enterprises, to the incompatibility between existing information systems, and to the lack of active involvement of some actors.

The German experience can illustrate the general needs for wood flows optimisation. More than improving planning for flow optimisation, technologies can directly help hauler for navigating. This has been experiment in Germany. In 1999, KWF has analysed (time analysis) the different activities of a driver going to forest to load timber.

Figure 16 – Time spending in forest by a driver in Germany



Source: KWF (1999)

This study showed that 31% of a driver time is spent in forest, whereas “only” 9% is on public road. This comes from the time needed to find the landing area. Tools like GPS with precise maps of forest roads and obstacles could reduce the non-productive time.

Different systems have been elaborated in Germany for improving planning (cf. annex 7.9).
In 2005 a general agreement between Forest owners and the wood industry has been settled to facilitate transport, driving and navigating on the private forest road network. It includes digitising of forest road maps and standard protocols for data exchange (Navlog).

3.4 Intermodality approaches

The connexion between different transport modes and intermodality approach of transport are largely depending on the infrastructure system. Indeed, adequate infrastructure equipments make possible (or not) the transfer of commodities between modes, in a rapid and efficient way. The key connections are located between:

- Maritime and inland waterways transport:
- Maritime / inland with road and rail network;
- Rail and road accessibility.

For the enterprises, such as the specialised transport companies or wood processing mills, the crucial point is to ensure reliable, rapid and inexpensive flows.

The population perceives the road transport mainly as harmful and polluting activities.

Containerisation is a major theme for the intermodal approaches
The ACTS (Abroll-Container-Transport-System) combines the classic unrolling system with the transport possibilities of the freight trains. The ACTS-train wagons are constructed with a special, pivoting frame for a better loading of the containers. There are two different systems how to place the container onto the train wagons. The first possibility is having a truck with a hook crane, which can carry the container to the train wagon platform or the truck, has a guide rail where a chain system helps to place the container onto the train wagon platform.

Another possibility to transport changing platforms are the so called "side-loader". A crane system is constructed on the truck, one in the front of the platform and one at the back. A chain system is added at the two cranes to lift the containers and place them either on a railway wagon or on the floor. Putting the changing platforms in the forests between the trees could resolve the space problems in the forests because the "side-loader" could easily load the changing platform or the container and transport it to the factory. Hammar (2002) says that it takes only 4 minutes to load a container on the truck.

Connecting networks
Improving possibilities of connection to the network is also a solution.

NCIS in UK[33]
This concept developed by Scott-Track and First Engineering in Scotland allow the connection of an existing main line track onto a planned freight siding, by raising temporary rails connecting to the separate siding above the main network rails level.

Once installed the system can be relatively quickly switched 'off' to allow the circulation of normal trains on the main network, and back 'on' to operating position.

This system offers the advantage of a relatively low cost, a high flexibility, and a relatively simple technique. It would be especially interesting in the cases of:

- flows not important or regular enough to justify the costs of classical connections,
- flows to become operational with a notice shorter than what conventional connection would allow.

[33] For more details refer to the study Potential Timber Transport Applications of the Non Intrusive Rail Crossover (NICS), Scottish Enterprise, DELTIX IBI Group – January 2006.

However the system has only been trialed to date and is not in use on a regular basis. The development of NICS depends on the capacity of the existing network; discussions in the UK showed that very few lines indeed would not be able to accommodate this type of traffic. Further detailed investigation on precise sites will be necessary to assess the potential of NICS for new catchment areas.

Floating piers in UK
A concept of experimental floating piers, temporary system allowing an intermodal road-sea-road haulage of timber is currently under examination in Scotland, aiming at studying the opportunity of such installations allowing the transfer of timber to vessels without the heavy investment needed for more lasting infrastructure.

The implementation
Amount of investments necessary to establish an adequate infrastructure is also demanding a financial involvement of public authorities.

3.5 Code of practice

Beside technical approach, wood chain stakeholder can engage voluntary agreements towards authorities and population. This approach has been developed in UK and France. There is a general cooperation between companies, authorities and communes which might be good or not satisfactory. A concern is when roads are destroyed during frost heaving etc. Accidents happen and problems arise, e.g. after heavy raining during autumn 2006.

France (Le Net E. *et al.* 2005)
In tools such as Codes of Practice, the responsibilities and duties of each actor of the wood extraction and transportation are identified: forest owners, loggers, haulers, mills and local Councils. Out of 4 codes of practice identified, two are regional (Centre, Burgundy) and two have been elaborated at the departmental level (Corrèze and Landes)

In Burgundy, the Code of Practice has been made in relationship with the “strategic roads” work. In this region, the forest-wood sector is traditionally important and it explains the long collaborative process engaged. In the Centre Region and in the Landes department, the elaboration of the code is connected to roundwood specific regulation. It is a proof of the professionals’ goodwill towards bodies in charge of road operation. In Corrèze (Limousin), the code has been promulgated in 1996 but is more oriented as a code of practice for wood storage.

The Code of Practice of Landes published in 2004 is of particular interest. As other codes, it has been elaborated in a collaborative way. Moreover, a working group has been set-up with representatives of the stakeholders to control its implementation. Regularly, the group points out the different available statistics: number of traffic controls and fines in comparison, quantities of wood deliveries at mills… In this department, the Code of Practice was a prerequisite for the “roundwood network” of the APR. Even if this APR is limited to 5 axles lorries of 44 tonnes and 6 axles lorries of 48 tonnes, professionals find it satisfying due to the favourable local haulage conditions (short procurement radius, flat terrain…). Moreover, the APR network is very large: it is possible to join it from any point after having notified this journey to the local Council and/or Department Council.

Germany
Not relevant

Sweden
Not relevant

UK
Road Haulage of Round Timber Code of Practice exists. The development of agreed routes, see section 2.2.2, is an other experience in this field.

To summarize:

On country profiles
Almost all the solutions presented (containerisation, plateforms, ICT, intermodality) are found in the four countries analysed. The mix of solutions and the level of implementation are different: for instance, collaborative solutions are developed in Sweden whereas standards are at the beginning stage in France.

On limits of the exercise
In order to feed the scenarios which will be developed in EFORWOOD, data (existing or estimations) on potential savings and improvements should be presented and represent the next phase of the work to be done.

4 Some assessments on wood transport: cost, labour and energy

Providing data is an other aspect of the WP3.3 work. Distance and load information have been already presented in the first chapter. This chapter focuses on important impacts of transport: cost, labour input and energy consumption. Cost assessments have been focused on road mode due to the importance of this mode in wood transportation.

4.1.1 Transport costs (€)

Some definitions
Definitions are coming from UN *et al.* glossary (2004):

- Cost is "the amount of available resources spent by the [inland water ways/road/railway] enterprise in connection with an operation or service, or with a series of operations and services.
- The main categories of costs being considered are:
  - Labour costs
  - Material and service costs
  - Energy consumption costs
  - Taxes
  - Financial charges
  - Other costs

No official definition is available for prices or tariffs. We will consider that price or tariff corresponds to the service paid by a shipper (included margin normally to hauler). This concept integrates the commercial relationship between shipper and hauler.

We will not integrate in the present document the concept of “total transport cost” that introduces an other dimension: the externalities of transport.

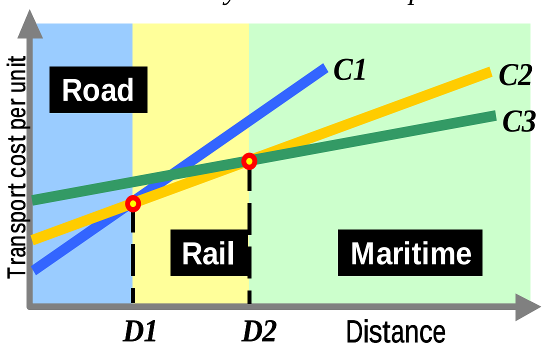
Method for transport cost calculation (theory)

- Distance of transport: it covers in km the mileage over which the goods are carried and also the empty backhaulage of vehicles;
- Time in service: driving time and also time spent on loading and unloading of the freight;
- Use of vehicle per day expressed in hours.

The cost function thus integrates fixed and capital costs (equipments, material, etc.) as well as variable operating costs (distance, maintenance, labour, etc.).

In order to establish the transport costs supported by mills in their everyday business, the cost function has to be applied on the different modes. In theory, the road transport is considered as more advantageous then the two other modes over short distances, while the situation reverse with longer distance of journeys (“truck transport bears the highest unit costs per kilometre. Its use is worthwhile on shorter distances”[34]). However, it could be possible that maritime transport could be cheaper per unit even for short or medium distances.

Figure 17 - Transport cost per unit: a hierarchy between transport modes based on distance



Source: Leinbach T. (2005)

In practice, railways and maritime/waterways are based on road cost and integrate much more contextual variables than technical ones. Studying international trade (and not longer proximity transport from forest to mills in particular), the determinants of cost are (Clark *et al.* 2004):

- Type of Product (Value/volume on insurance premium, other features)
- Trade Imbalance (backhaulage)
- Geography (distance and landlocked)
- Infrastructure (seaport, handling, road, etc.)
- Transport Technology
- Competition and Regulation

There is very little information available on sea and rail transport, and not enough expertise in the area to feed in the definition of a cost function. Data from case studies should be taken as elements applying to a given case. However they provide an indication in an area where little hard data is available.

[34] Department of Forest Economics, 2002.

Therefore, cost function method is proposed only for road mode. This approach has been developed within the cross-module transport group in order to have the same approach all over the EFORWOOD project.

Road transport

The calculation is based on three key indexes: cost per kilometre, cost per hour and cost per day ("trinomial method"). The application of the cost function on road transport requires determining goods to be carried, as well as materials/vehicles to be used and the conditions of their use. This is the situation where national regulatory conditions play a determining role, for example on maximum authorised load capacity, gas oil price, toll and taxes.

This can be transposed as follows:

- As a "benchmarking" case the situation of all commodities (A), transported under "normal" or "difficult" conditions, with or without a "toll" tax.
- The roundwood is approached through 4 normal conditions depending on the type of equipment (tractor, semi-trailer, number of axles, crane), and 2 difficult case representing mountain conditions. For this product no toll tax is considered.
- For chips two different conditions ("normal" and "difficult") are under scope, with or without a toll payment.
- Finally, the two same conditions are applied for long logs, with no toll charge.

For comparison purpose, the same calculation method is used for the four countries.

Due to different configurations of authorised equipments (weight and length[35]) Europe has been divided in two parts:

- "Scandinavian": 60 tonnes for 25.25 m of length
  - Swedish data are be integrated in the calculation method[36].
- "Southern Europe": 40 tonnes (to 44) for 16.75 m (articulated vehicle) or 18.5 m (road train) of lengths
  - In the UK, there is no existing cost function at the national level, but some detailed case studies have been carried out (see references). Using this existing work and with the help and advice of experts (Timber Transport Forum), an attempt was made at approaching a cost function using the trinomial method.
  - Combining different sources has also been the solution for France and Germany.

This approach is based mainly on operating cost. Data are based on official rules or expert knowledge and do not incorporate some 'marginal' practices (overweighing in particular).
Warning: this approach of a cost function is very dependant on the hypotheses made. Because they result from assumptions this cost function should be considered mainly as a tool providing trends for different ranges of these assumptions.

[35] Cf. annex 7.6 and 7.7.
[36] For "pine test chain", the data come from Transam (Skogforsk model).

The dominant wood transport systems by road

Country	Type of product	Transport conditions	Transport system Code	Transport systems
France	All commodities	Normal	A-F	Tractor + semi-trailer 5 axles (no crane)
France	Roundwood	Normal	R1-F	Tractor + semi-trailer 5 axles without crane
France	Roundwood	Normal	R2-F	Tractor + semi-trailer 5 axles with crane
France	Roundwood	Normal	R3-F	Tractor + semi-trailer 6 axles with crane
France	Roundwood	Normal	R4-F	Road-train 6 axles with crane
France	Chips	Normal	C-F	Solid bulk 5 axles
France	Roundwood	Difficult	Rd5-F	Road-train 5 axles with crane
France	Roundwood	Difficult	Rd6-F	Road-train 6 axles with crane
France	Logs	Normal	L-F	Tractor + long-load dolly 6 axles with crane
France	Logs	Difficult	Ld-F	Tractor + long-load dolly 6 axles with crane
Sweden	Roundwood	Normal	R-S	Truck 3 axles + trailer 4 axles with removable crane
Sweden	Lop & top	Normal	L&T-S	Truck 3 axles + trailer 4 axles 3 containers
Germany	Roundwood	Normal	R-G	Tractor + semi-trailer 5 axles with crane
Germany	Chips	Normal	C-G	Solid bulk 5 axles
Germany	Logs	Normal	L-G	Tractor + long-load dolly 5 axles with crane
UK	All commodities	Normal	C-UK	Standard tipper 32t
UK	Roundwood	Normal	R-UK	Tractor + semi-trailer 6 axles with crane

Note 1: difficult means mountainous conditions

Note 2: the number of French transport systems is important. The aim was to represent most of the existing systems in "Southern" Europe and use, if necessary French information as default by changing data for important parameters. The parameters are: gas oil price (€/l), toll (€/km), wages (€/day), load capacity (legal basis)(t).

Comparison of the three terms of the cost

Country	Type of product	Transport conditions	Transport system Code	Transport systems	Kilometric cost (Kilometric cost+toll) €/km	Hourly cost €/hour	Daily cost €/day
France	All commodities	Normal	A-F	Tractor + semi-trailer 5 axles (no crane)	0.39	21.29	154.60
France	Roundwood	Normal	R1-F	Tractor + semi-trailer 5 axles without crane	0.46	21.54	183.46
France	Roundwood	Normal	R2-F	Tractor + semi-trailer 5 axles with crane	0.49	21.54	202.26
France	Roundwood	Normal	R3-F	Tractor + semi-trailer 6 axles with crane	0.53	21.54	215.19
France	Roundwood	Normal	R4-F	Road-train 6 axles with crane	0.53	21.54	182.14
France	Chips	Normal	C-F	Solid bulk 5 axles	0.39	21.29	154.60
France	Roundwood	Difficult	Rd5-F	Road-train 5 axles with crane	0.62	21.54	156.61
France	Roundwood	Difficult	Rd6-F	Road-train 6 axles with crane	0.65	21.54	182.14
France	Logs	Normal	L-F	Tractor + long-load dolly 6 axles with crane	0.56	21.54	240.02
France	Logs	Difficult	Ld-F	Tractor + long-load dolly 6 axles with crane	0.72	21.54	240.02
Sweden	Roundwood	Normal	R-S	Truck 3 axles + trailer 4 axles with removable crane	0.74	23.97	297.78
Sweden	Lop & top	Normal	L&T-S	Truck 3 axles + trailer 4 axles 3 containers	0.71	20.13	265.88
Germany	Roundwood	Normal	R-G	Tractor + semi-trailer 5 axles with crane	0.51	18.24	149.04
Germany	Chips	Normal	C-G	Solid bulk 5 axles	0.51	17.93	173.11
Germany	Logs	Normal	L-G	Tractor + long-load dolly 5 axles with crane	0.51	18.24	149.04
UK	All commodities	Normal	C-UK	Standard tipper 32t	0.55	10.16	141.22
UK	Roundwood	Normal	R-UK	Tractor + semi-trailer 6 axles with crane	0.78	14.08	258.55

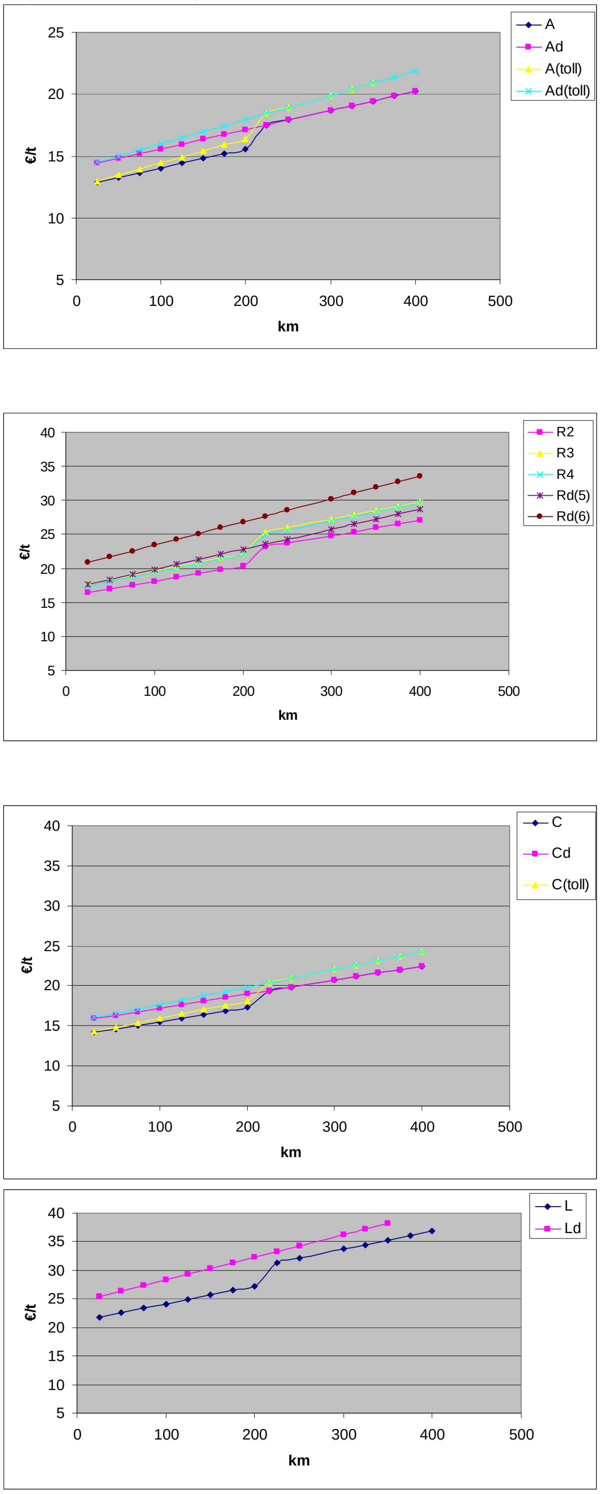
The range of results obtained for the UK, even based on assumptions, is globally consistent with the results of recent work (ConFor, pers. comm.) showing that the transport cost is between 1.71 £/km (approx 2.56 €/km) on forestry roads and 0.93 £/km (1.4 €/km) on public roads.

The comparison with “all goods” transport shows that timber transport is more expensive – this is partly due to the part of circulation on forestry roads, where the fuel consumption and cost of maintenance are greater, and the general life-span of the tires, truck, trailer etc. are reduced.

Different cost functions and the cost variability: example from France
Based on a publicly available database, considering hypothesis established here above, the French road transport conditions result in the following cost functions presented in the following figures where X axis = distance (km); Y axis = cost (€ / t)

For France, loading weight is based on general rules (i.e. 40 tonnes) of the Road Code.

*Figure 18- Cost functions (€/t * km) in France (2005)*



All commodities

For a short journey of 25 km, the cost is about 13 €/t (from 12.9 to 14.5 depending on the context condition, difficult or not). Toll parameter has also an impact on short distance.

For 150 km, cost varies from 14.8 to 16.7 €/t and for 18.7 to 19.3 €/t for a long journey of 300 km. Longer is the journey, higher the toll parameter has an influence on the cost.

Roundwood

For roundwood transport, the gas oil consumption is more important than for a reference equipment (all commodities): from 42 to 48 l/100km for wood 34 l/100km in general. Due to rather short average distance of wood flows, wood transport enterprise can have a higher share of own tank procurement than reference enterprise. This reduces the cost. Moreover other fees (hotel, restaurant) and overheads are less important (familial enterprises, few employees).

The forest context demands adaptation to equipment. This result of highest costs for:

- Tires (+25 to +200%)
- Maintenance (+35 to 50%)
- Investment

Chips

This activity is the closest to the reference case (All commodities).
Excepting for forest chips produced on the plot or at the forest roadside, this transport does not demand travelling on forest road. We consider here only public road transportation.
The cost varies from 14 to 22.5 €/t.

Logs

This case is the most specific one. The fuel consumption varies from 50 to 60 l/100km.
Tires are submitted to tough conditions and must be change quite often (retreading are not often use because of security reasons).
Systematically, there is a powerful crane (24tm)
Necessity to get strong tractors
Cost varies between 21 to 37 €/t

Source: Comité National Routier (www.cnr.Fr) for all commodities ; AFOCEL

How to account for empty backhaulage?

Empty backhaulage is rather important for wood transport:

- For roundwood (about 40%[37] in Germany and France, 48% in Sweden)
- For logs (about 45% in Germany and France)
- Even for chips (50% in Sweden)

For each of these cases, the use of hypotheses relative for the transport distances (from 0 to more than 200 km) and corresponding backhaulage indirectly paid by mills is necessary. Some assumptions have been done concerning the share of backhaulage paid by mills to carriers (expert knowledge from practices). For long logs requiring very specific equipment, we could have considered that shippers pay the total backhaul. For chips, we consider that there is not such practice.

Table 4 – assumptions of % of backhaulage paid by shippers to carriers from expert knowledge for roundwood

Forest to enterprises in km	France	Germany*	Sweden[38 39]	UK
0-25	100%	100%	100%	100%
26-50	100%	100%	100%	100%
51-100	75 %	75 %	80 %	50%
101-150	50 %	50 %	80 %	50%
151-200	25 %	25 %	80 %	10%
More than 200	0 %	0 %	80 %	0%

*Note: * = mills do not pay backhaulage. However there is a "hidden" payment of backhaulage as transport companies are paid on basis of fare zones, wherein pendular transport is somewhat considered. We made the hypothesis for the theoretical assessment that French and German conditions are the same.*

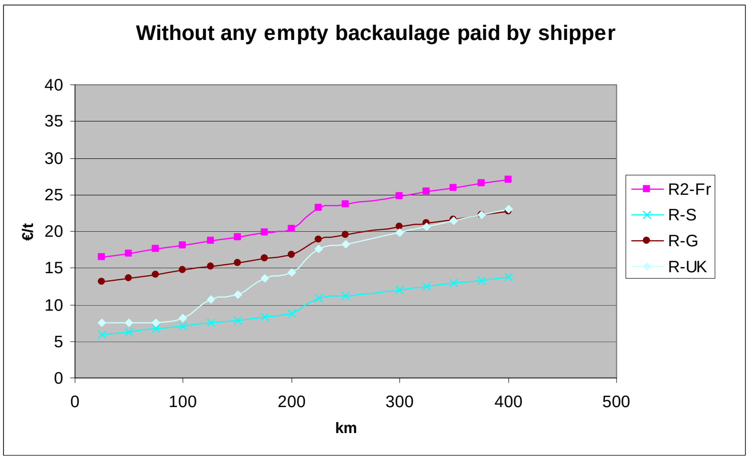
Two comparisons between countries are proposed:

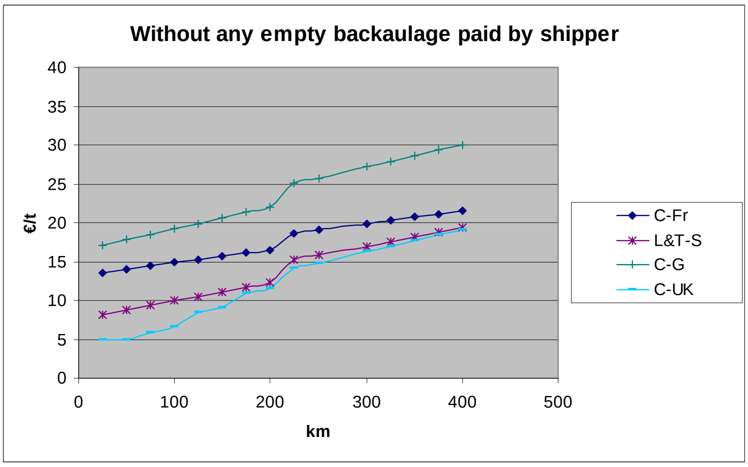
- The first one does not take into account the payment of empty backhaulage by shippers.
- The second one includes this payment (expert knowledge).

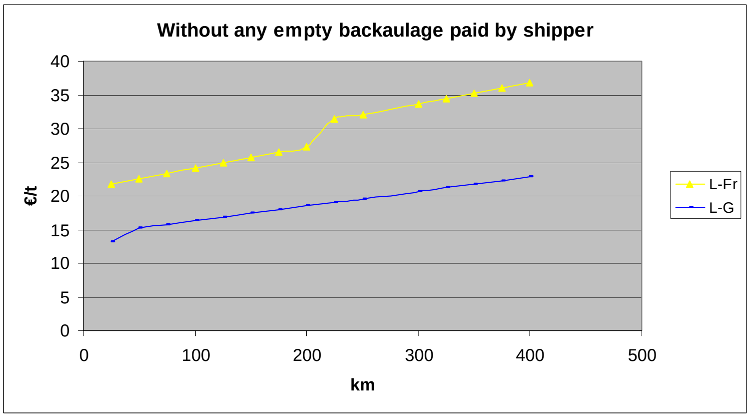
The most representative systems are proposed in the following figures.

[37] Share of km done unloaded.
[38] General share empty driving for all Sweden all branches is 24 % (table 270, Anon, 2004).
[39] As the Swedish vehicles are specially designed for transports of timber, occasions for backhaul seldom. The philosophy is rather to improve the routes than to find return cargo. When such is found it is usually higher probability to find it when distances are longer (cf. "transport systems" section).

€/tonnes * distance (km)

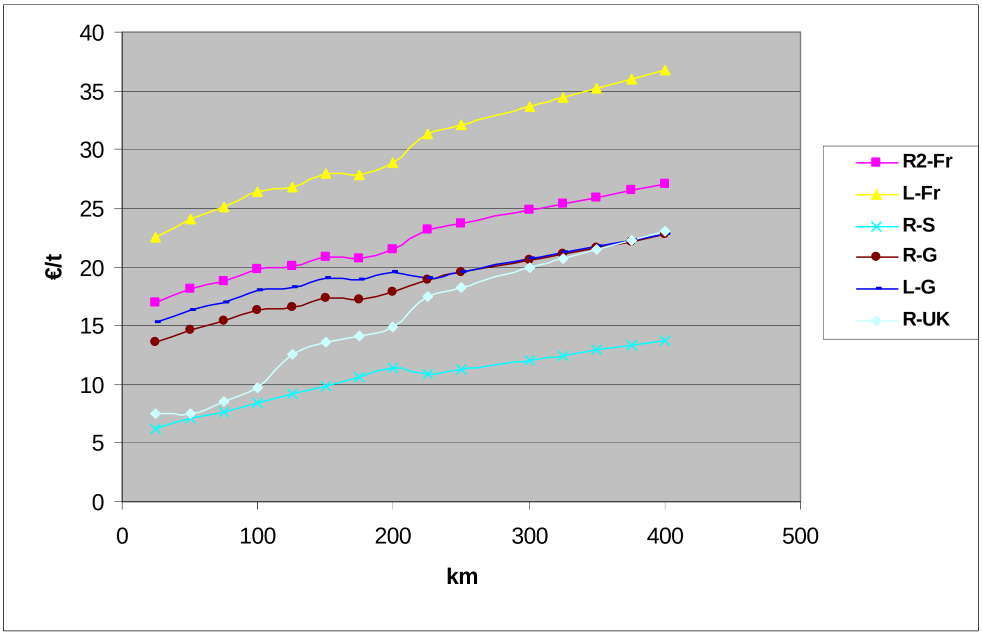






Those figures show a coherence of information obtained by calculation. In short distance, UK seems to have a comparative advantage, but this result is probably an artefact. Swedish costs integrate the impacts of the tare weight (60 tonnes vs. 40 tonnes).

€/tonnes * distance (km)
including the payment of a share of empty backhaulage by shippers



The main impact is on short distances up to 200 km (we suppose that over 200 km there is no backhaulage payment). The principle is that the % of backhaulage is higher when the distance is shorter.

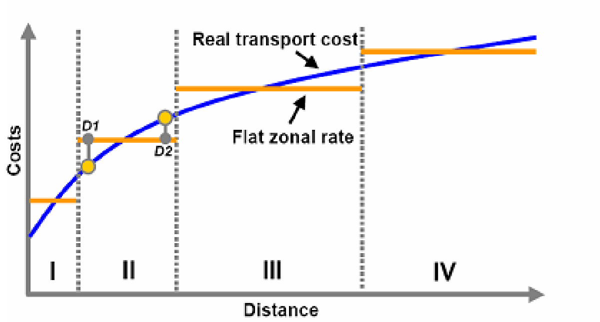
Paying a share of backhaulage increases the transport cost. The following table gives information of the over cost for the main transport systems.

Table 5 – Over cost due to the payment of a share of empty backhaulage by shippers (€/t)based on assumptions in Table 4

	25 km	**50 km**	**75 km**	**100 km**	**125 km**	**150 km**	**175 km**	**200 km**
R2-Fr	0.55	1.11	1.24	1.66	1.38	1.66	0.97	1.11
L-Fr	0.78	1.56	1.75	2.34	1.95	2.34	1.36	1.56
R-S	0.41	0.83	0.99	1.32	1.65	1.99	2.32	2.65
R-G	0.54	1.08	1.21	1.62	1.35	1.62	0.94	1.08
L-G	2.13	1.08	1.22	1.63	1.35	1.63	0.95	1.08
R-UK	0.00	0.00	1.12	1.49	1.86	2.24	0.52	0.60

To our knowledge no data on transport costs of alternatives modes (inland waterway and rail) are publicly available. In general, it is considered that the distance is important for freight rail transport: the longer distance, the lower marginal cost of additional kilometre, considering that there are no unloading/loading operations. Instead of having a cost function, zonal freight rates are studied.

Figure 19- Zonal freight rates



Source: Leinbach T. (2005)

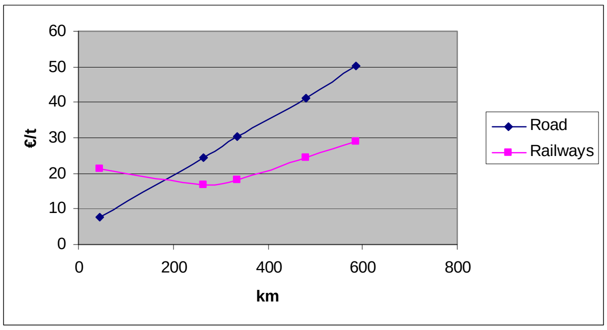
Compiling different information and sources is required to estimate the zonal freight rate. Concerning wood, it has not been possible to identify such zonal freight rate. However, it is important to have these principles in mind.

France

There is no direct information allowing the estimation of zonal freight for other modes than road. Generally, road transport is the reference on which other modes elaborate their tariffs . The general idea is that railways is competitive for long distance (more than 350-400 km).

It is possible however to have an estimation for logs for 2000. In the following figure, the comparative advantage of railways is about 200 km. This result is probably due to the intrinsic value of timber hauled in this example.

Figure 20 – Comparing cost for oak logs in France



Source: Bemer et al. (2002)

VNF (Voie Navigables de France)[40] estimates that for bulk transport, inland waterways are competitive on prices (€/tonne) for about 110 km for large navigable canal, 240 km for small canal[41].

[40] Voies navigables de France is responsible for managing, operating, modernising and developing the largest network of navigable waterways in Europe, comprising 6,700 km of canals and developed rivers, over 2,000 permanent structures and 40,000 hectares of waterside public land.

The main point is that is it very difficult to get hard data, especially in the actual situation where many changes occur in railways in particular.

Germany
Railway transports are based on specific contracts by considering every step of the transport separately, like the kind of commodity, which should be transported, the type of the wagon, the distance and/or the weight. Because the companies have to discuss the price of the transport with a lot of offers, especially when the products should be exported or imported, it is very difficult to find out a general rule concerning tariff practices. The companies propose the prices to their customers with a margin for their company. In the annex 7.10, the prices of log[42] and industrial wood for the inland traffic of Germany for the year 2007 are presented.

For a transportation distance of approximately 250 to 350 kilometres the cheapest and environment friendly option would be the train. This is of course only the case if both forest and the destination mill are within reasonable distance of a station/railhead. Setting amount in solid cubic meter = average of assortment length x setting width x setting high x 70%[43]. These values can be seen as an approximation for the calculation of transport costs. They can vary according to contractor or assortment.

In Germany, sea shipping combined with inland navigation is not used very often. In years with regular fellings, the inland navigation vessel is not the common medium of transport. On the other hand, as a result from the hurricane Lothar and the necessity to transport logs to foreign countries, Baden-Wurttemberg started to increasingly use this transportation medium. It is only cost effective if the transportation distance exceeds 500 km (average costs for solid cubic meter is 19 €/m^3).

Even the fact that transporting wood products can be very cheap; there are some disadvantages for the customers. Using sea transport gets interesting only for a transportation distance over 500 km. Nowadays most customers want their commodities “just in time” and by considering this marketing possibility, the sea transport does not seems to be very efficient. On the other hand, for Germany, the sea transport forms usually the main part in the export transports of forest industry products to the world.

Sweden
The expenses for railway and sea shipping are according to prices reached in negotiations. They are reached according to certain periods and terms that are on the conditions for a certain market. The contractor expects to receive compensation for the service, his/her investments and costs, and its risks. Long-term agreements will therefore likely reach a lower level for the buyer because the risks in fact are shared between parties. For railways a benchmark will be the costs for transport with road vehicles according to the philosophy demonstrated in the above figure. For sea transport the level of agreements will be depending on the operation of the ships and several other costs that are included. Such are e.g. costs for pilot, loading and port costs at the receiving party. Is the buyer also an owner of a port there are interesting options for both parties. The cost level for road transport is not so obvious as a benchmark as it in many cases is no reasonable alternative for transports from the eastern shores of the Baltic to the Gulf of Botnia. The terms are rather depending on the conditions on

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[41] Cf. annex 7.8 (www.vnf.fr)
[42] Cost data are not available but only prices.
[43] E.g: Snps: 16m x 2.70 x 2.00 x 70% => 61 Fm; Eanos: 3 x 4.50m (3 logs piles) x 2.70 x 2.10 x 70% => 51 cm.

the international freight market, not the market for inland wood transport in Sweden. The design of costs in the above figure per transported unit for forest industries may still be very true, likely be higher than long distance road transport, but still rational considering the distance.

UK

- Regarding sea transport, the report Opportunities for the Marine Transport of Timber in Scotland, Deltix IBI Business, March 2006, quotes '*a typical £4-£8 range for short[er] hauls in the UK in 2002'*, however a case study on a given route comparing 'all-road' and 'combined road-sea' solutions shows that under the current circumstances, maritime transport could not economically compete with road haulage prices around £ 10-13 / tonne (15-19.5 €/tonne)
- Several case studies in the report Potential Timber Transport Applications of the Non-Intrusive Rail Crossover (NICS), Scottish Enterprise, DELTIX IBI Group – January 2006, indicate costs of rail haulage per train mile from £ 10 to £ 20 (15-29 €) with payloads between 500 and 600t.

4.1.2 Labour input (number of full time equivalent, FTE)

Country calculation

Having no direct information on labour input for wood transport, some calculations are necessary. These evaluations are compared with direct information from Eurostat through the share of wood transport (NST/R 24) in tkm (cf. transport protocol).

France

- Using the consumption of mills (sawmills, pulp mills and panels mills) and the share of roundwood and by-products, having information on the share of road and on average load per truck (22 tonnes for roundwood and 25 tonnes for chips), average speed of wood trucks (50 km/h) and working hours per year (2200), it is possible to estimate that 850 FTE are delivered roundwood in France, and 100 FTE delivered sawmills by-products to panels and pulp mills.
- Relying on information on the number of wood transport enterprises by road, the range is between 700 and 1000 FTE.
- Some consider that 1 forwarder = 1 truck, that means that there were 3000 trucks. The hypothesis of 1 truck = 1 driver is also used, that is to say that by this way, the wood transport employment for road is about 3000 persons.
- Other assessment based on potential productivity of trucks and hypothesis of transport rotation (1,5 rotation per day, load from 25 to 35 tonnes) indicates that in average the annual wood load is about 9000 tonnes per annum, i.e. 3600 persons.

The range is large and not satisfying.

Germany

Not available

Sweden

This calculation is done in two ways. Based on calculation program for wood transportation we will find that transport with roundwood vehicles on road on average distance and average load, provided with normal crew, 4800 work hours/year, gives 0.4 FTE (2 200 hours) per 10000 tonnes. This gives the lowest possible level. On the other hand, looking in national statistics (Anon, 2004) we find that the total amount of transported goods in Sweden on roads is 281812 million tkm at an average distance 107 km. This gives about 270 million tonnes of total goods. The amount of persons working with transport was 189 000. If we assume they are on fulltime this gives about 7 FTE per 10000 tonnes. As a general figure this is a clear overestimate for wood transports as it also includes labour intensive transport on short distances. A fair estimation is that FTE for transport of roundwood on road vehicles is more than 0.38 bust most probably in the lower regions of the internal 0.38 – 7 FTE per 10000 tonnes.

Table 6 – Labour input for wood transport: evaluation

	FTE
France	1000-3000 (road)
Germany	**na**
Sweden	See above
UK	1200 (road) - 1380*

*Note: * last elements known 2002*

UK

There is no direct recent information about the equivalent full time corresponding to timber transport. However, two approaches are possible: relying on the assumption in 2.1.1 that approx 8.8 million green tonnes of timber are hauled annually in the UK, it is possible to use:

- the results of the 1998/1999 Forestry Employment Survey. For the year 1999 it accounted for 1061 EFT for timber haulage. The deliveries of roundwood in the UK for this year were 7.9 million green tonnes so one could assume that the FTE for 2005 must be in the range of 1200 EFT.
- Extrapolating on a 2002 basis:

total goods lifted	1,627 million tonnes in 2002, DfT (2004)
FTE	282,575 in 2002, Eurostat
Timber delivered	8.021 million tonnes

giving a range of 1380 FTE.

These two methods tend to show that the FTE for timber haulage in the UK must be in the range 1200 to 1400, giving an equivalent of 1.36 to 1.6 FTE per 10,000 tonnes.

Calculation from Eurostat

There is no direct data on the level of employment involved in the wood transport. Nevertheless, employment is one of the key indicators identified in the Transport data protocol draft in February 2007. The method suggests extrapolating the level of employment by mode and by countries from data on total employment in transport, provided by Eurostat non regarding the sector of activity. No more detailed data have been found on the Eurostat web site.

It is applied for 2004 (the last available year for employment) for:

- Transport modes: road, railways, inland, all;
- EU25, EU15, Germany, France, Sweden and UK.

The calculation method is based on the following principle:

Employment in transport in Eurostat * share of wood and cork among all goods (NST/R4 in NSTR/25) in t and in tkm gives estimations of employment level by mode.

In other words, it means that we are estimating the level of employment through the relative share, in t and tkm, of “wood and cork” among the transport of all goods.

Figure 21 – Rough estimation of employment for group 4 "wood and cork" from Eurostat (2004)

Road freight		Railway		Inland waterways		Total (road + rail + inland waterways)		
based on t	**based on tkm**	**based on t**	**based on tkm**	**based on t**	**based on tkm**	**based on t**	**based on tkm**	
86 000	102 000	42 000	42 000	90	150	120 000	145 000	**EU25**
67 000	79 000	29 000	29 000	80	130	90 000	100 000	**EU15**
7 000	8 000	1 000	2 000	40	50	8 000	10 000	**Germany**
6 000	7 000	1 000	1 000	0	0	8 000	9 000	**France**
15 000	15 000	1 000	1 000	na	na	16 000	16 000	**Sweden**
6 000	8 000	0	0	na	na	6 000	8 000	**UK**

Source: from Eurostat (2007), na = not available.

If we estimate level ratios - t/FTE and tkm/FTE[44] - from Eurostat at NSTR/24 level, we can identify that the transport employment productivity is generally increasing from railways towards inland waterways. Road mode is in-between. We can also identify some particularities in German (for road mode[45]) and Sweden (for railways) profiles comparing to EU 25 profile.

Figure 22– Transport employment productivity: t/FTE and tkm/FTE

Road freight		Railway		Inland waterways		Total (road + rail + inland waterways)		
based on t	**based on tkm**	**based on t**	**based on tkm**	**based on t**	**based on tkm**	**based on t**	**based on tkm**	
6 118	659 878	1 600	412 857	12 759	3 494 067	4 634	590 464	**EU25**
6 474	685 884	1 640	444 670	14 085	3 898 089	5 021	625 059	**EU15**
10 368	1 060 504	3 840	1 154 840	26 896	7 281 268	9 219	1 112 478	**Germany**
5 952	593 229	611	231 256	19 709	25 677 624	5 120	529 787	**France**
5 342	514 851	7 386	2 533 310	na	na	5 485	645 413	**Sweden**
6 124	563 005	0	0	na	na	6 124	563 005	**UK**

Source: from Eurostat (2007), na = not available.

The method from Eurostat embodies an over estimation of employment

The estimation seems to be excessive due to:

1- the incorporation of processed woods in the analysis (covering all group 4; in France for example alternative calculations presented much lower levels but only related to roundwood);

2- the implicit hypothesis in the calculation method that the logistics, handling, storage and other services offer in general with transport is the same for raw materials as wood as for end-consumers ones.

Therefore we can consider that the wood transport is less labour intensive than transport of "all commodities" in general.

4.1.3 Energy consumption

Country calculation

France

[44] T and tkm are for 2005 and FTE for 2004.

[45] We do not have reasonable explanation for the German singularity for road mode.

In average by road, the consumption is 0.45 l/km for pulpwood, 0.55 l/km for logs and 0.35 l/km for chips.

Germany
By road, for short log transport the average consumption of diesel fuel is 0.45 l/km, and for lubricants is 0.0005 l/km.

Sweden
Based on the assumption that a loaded vehicle uses 0.58 l/km and an unloaded for return 0.54 l/km, no backhaul anticipated, the average energy use per tkm is 0.9 MJ. The payload is assumed to be 25 tonnes. In practice the energy use is somewhat higher roughly 1.1 MJ/tkm[46].

Transport with diesel electric locomitives[21] may cost energy in the vicinity of 0.4- 0.7MJ per tonne km, with long train and electric operated locomotives[21] low as roughly 0.25MJ. Ships[21] consider several options depending on size an interval is 0.2 –0.6MJ/tkm.

UK
Elements regarding the energy consumption for road transport can be found:

- from the Road haulage association for the 'all commodities' modality, indicating 8 miles per gallon, i.e. approximately 12.775 MJ/km[47],
- for timber transport, the case studies carried out as part of the Review of Timber Haulage and Forest Roads showed a consumption around 6 miles per gallon, i.e. approximately 18.98MJ/km.

Calculation from Eurostat
There is no direct data available in Eurostat on the energy consumption by the wood transport. The energy consumption is among the key indicators identified in the Transport data protocol draft in February 2007. Its estimation is based on the method similar to the one used for the employment level (here above). The method is applied by mode of transport for 2004 (the last available year).

The method is based on:
final energy consumption in toe[48] (road, rail, inland, total) provided by Eurostat * share of wood and cork among all goods (NST/R4 in NSTR/25) in t and in tkm gives estimations of final energy consumption in toe by mode (road, railways, inland, total).

The results are available based on "t" or on "tkm" for EU25, EU15, Germany, France, Sweden and UK.

[46] Skogforsk database SimaPro.
[47] On the basis of 36,500 MJ/m3 for oil.
[48] Tonne of oil equivalent. 1 toe can be traduced in "equivalent in barrels" (*7.33) and in litres of gas oil (*159).

Table 7 - Rough estimation of level of final energy consumption in 1000 toe, 2004

Road freight		Railway		Inland waterways		Total (road + rail + inland waterways)		
based on t	**based on tkm**	**based on t**	**based on tkm**	**based on t**	**based on tkm**	**based on t**	**based on tkm**	
9600	11400	400	400	10	20	10000	11800	**EU25**
8300	9700	300	300	10	20	8000	10000	**EU15**
1300	1500	30	50	1	1	1000	1500	**Germany**
800	900	0	10	0.1	0.2	800	900	**France**
1600	1500	30	30	na	na	1600	1500	**Sweden**
700	1100	0	0	na	na	700	1100	**UK**

Source: from Eurostat (2007)

To summarize:

The method elaborated for road cost is probably sufficient. The *method* itself is clear and reliable – what is not, at least in the UK case, is the *data and assumptions* we feed in, and further research in this direction is necessary if we want to build a reasonably reliable data. More consistent work are also necessary for other modes.
Full time equivalent assessments are in the first stage and need to be consolidated.

5 Conclusion

From the four coutry profiles (France, Germany, Sweden, United Kingdom), **some general information on wood transport in Europe** can be proposed :

- Road is the main transport mode for wood deliveries to the mills (roundwood, logs, chips), and its share cannot decrease drastically lest some important investments take place.
- Roundwood and logs demand specific equipments for all modes, but this could be considerably reduced if containerisation or similar techniques could be developed
- Logistics depends on the structure of the FWC.
- Own account transport can be found in some sawmills.
- Compare with other commodities, there are additional cost on wood transport.
- Road haulers are often specialised on wood.
- Wood transport enterprises by road are for small size and/or individual enterprises.
- Difference between transport enterprises can be found depending on products transported: logs/pulpwood, hardwood/softwood (wood product specialisation of road haulers).
- Wood transport is specific but tends to be less and less specific for intermodality, cost reduction, through experimentations such as containerisation
- Cost reduction of transport is important for the FWC: “light” equipments, timesavings, new organisation, information systems… are key developments.
- Increased gross vehicle weights are maybe the most efficient way to reduce emissions and cost for forest transports.
- new IT-supported developments like “virtual platforms” with common data protocols as industry standards may contribute to overcome the disadvantage of specialisation and fragmentation of the forest-wood-transport today.
- Social acceptability of wood transport is delicate.

- Wood transport Code of Practice have been elaborated in some countries/regions (UK, France).

SWOT

France / Germany

Wood transport is one of the main important topics for the competitiveness of FWC enterprises in France. Even if social and environmental aspects are becoming more and more significant, economic costs of road transport represent the daily stakes of enterprises. The implementation of wood regulation allowing higher load capacity for wood trucks is the key subject at the moment. This specific regulation has led also to discussion and explanation with local communities. However, at the same time, new solutions, alternative modes such as railways (but also river ways) and new technologies (Intelligent Transportation Systems) are tested to overcome existing barriers. Organisation of flows is becoming more and more important inside large companies. That means that wood are no longer separate from other flows (input/output). Wood transport is probably in the threshold for elaborating new solutions combining commodities and transport modes. The next step will be to organise networks between stakeholders and go ahead individual interest of enterprises in order to generate more value throughout the whole supply chain. Industry specific IT solutions and standard data protocols may contribute to overcome the existing disadvantages of fragmentation.

Sweden

Due to difficulties to find return load efforts have been to reduce the tara weight of the vehicles in order to increase payload. Removable crane on the vehicle or special loaders is a solution directed to the same direction. Environmental concern has driven the development to use new vehicles with small emissions. Depreciation times are therefore short, e.g. three years. In order to increase profitability the issue has been to optimise the flow and transport routes rather than finding back loads. Here the use of GPS and operations analysis is an important element of timber transports. Sweden is according to European standards a large country with a small population. Few people are living in the forested countryside. Timber transport vehicles are not a large burden for traffic compared to Central Europe. There is no strong political opposition against the use of large vehicles outside urban areas. The issue is rather for environmental reasons to transport as much as possible with railways; this is also an advantage when timber is to pass urban areas. Transport by ships is especially necessary for export/import. Here are strong incentives to use less environmentally harmful fuels than the traditional marine diesels. Such a shift will however take some time, as it has to do with the technical properties of the ships and the general situation on the European or global freight markets.

UK

Timber transport is a major link of the wood supply chain, and in the UK takes place quasi exclusively by road.

The timber haulage industry is under considerable economical strain (timber market, increase of costs linked to haulage: fuel, insurance, wages) and suffers from a negative perception from the community.

However, the progressive development of consultation and agreed solutions, and the growing opportunities offered by the development of the timber market as a source of fuel, building material should open the filed to new possibilities in the future.

To materialise these new opportunities, a collective approach by the whole wood supply chain will be necessary, supported by a commitment of local and national authorities and communities, and will require the development or upgrading of the infrastructure network and logistics facilities to allow the alternative transport mode share to grow.

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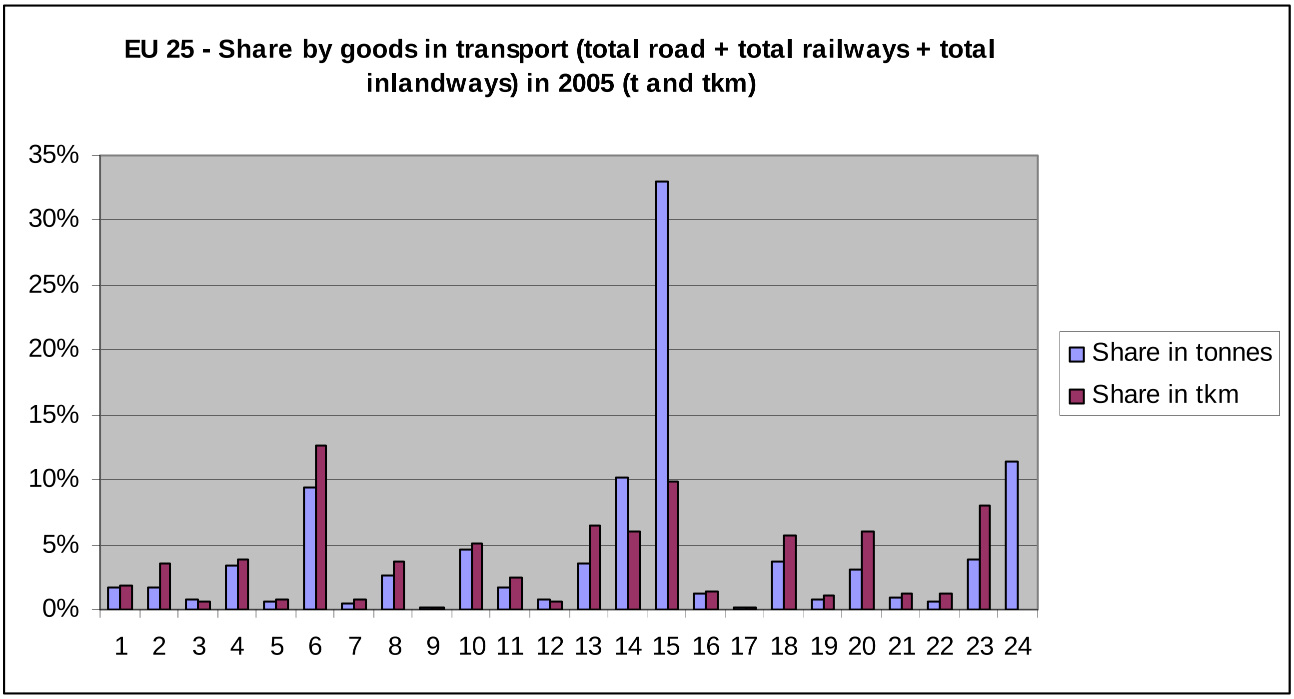
7 Annex

7.1 Transport classification: NST/R 24

Groups of goods	NST/R Chapter	NST/R groups	Description
1	0	1	Cereals
2		02, 03	Potatoes, other fresh or frozen fruit and vegetables
3		00, 06	Live animals, sugar beet
4		5	**Wood and cork**
5		04, 09	Textiles, textile articles and man-made fibres, other raw animal and vegetable materials
6	1	11, 12, 13, 14, 16, 17	Foodstuffs and animal fodder
7		18	Oil seeds and oleaginous fruits and fats
8	2	21, 22, 23	Solid mineral fuels
9	3	31	Crude petroleum
10		32, 33, 34	Petroleum products
11	4	41, 46	Iron ore, iron and steel waste and blast furnace dust
12		45	Non-ferrous ores and waste
13	5	51, 52, 53,54, 55, 56	Metal products
14	6	64, 69	Cement, lime, manufactured building materials
15		61, 62, 63,65	Crude and manufactured minerals
16	7	71, 72	Natural and chemical fertilizers
17	8	83	Coal chemicals, tar
18		81, 82, 89	Chemicals other than coal chemicals and tar
19		84	**Paper pulp and waste paper**
20	9	91, 92, 93	Transport equipment, machinery, apparatus, engines, whether or not assembled, and parts thereof
21		94	Manufactures of metal
22		95	Glass, glassware, ceramic products
23		96, 97	Leather, textile, clothing, other manufactured articles
24		99	Miscellaneous articles



Source: from Eurostat databasis.

7.2 Inland waterways: definitions (Eurostat)

Waterway. River, canal, lake or other stretch of water which by natural or man-made features is suitable for navigation. *Waterways of a maritime character (waterways designated by the reporting country as suitable for navigation primarily by sea-going ships) are included. Waterways also include river estuaries; the boundary being that point nearest the sea where the width of the river is both less than 3 km at low water and less then 5 km at high water.*

Navigable inland waterway. A stretch of water, not part of the sea, over which vessels of a carrying capacity of not less than 50 tonnes can navigate when normally loaded. This term covers both navigable rivers and lakes and navigable canals.

Inland waterways transport (IWT). Any movement of goods using an IWT vessel on a given inland waterways network.

IWT vessel. Floating craft designed for the carriage of goods or public transport of passengers by navigable inland waterways.

7.3 Transport data availability in Eurostat

Share of transport modes:

- For EU25 and EU15, data on transport modes for all goods (NST/R1 to NST/R25) are available (in “t” and “tkm”); thereafter the share of modal importance for each good can be computed as well as the share of each good in the particular transport mode (or all modes).

- For each country (Germany, France, Sweden and UK) from the Eurostat database source can be represented: each transport mode by goods (NST/R1 to NST/R24) in “t” and “tkm”; the share of transport mode for NST/R25 and NST/R4 (graphs here under); and the share by goods in total road, railway and inland waterways transport (share in “t” and “tkm”) – on the basis of graph in Eurostat paper “road freight transport (2006)”.

- Historical evolution of freight transport by mode, by product and by country is possible;

- Data by country on maritime transport: only available by weight and by direction (inwards, outwards). Not integrated in computations in this paper.

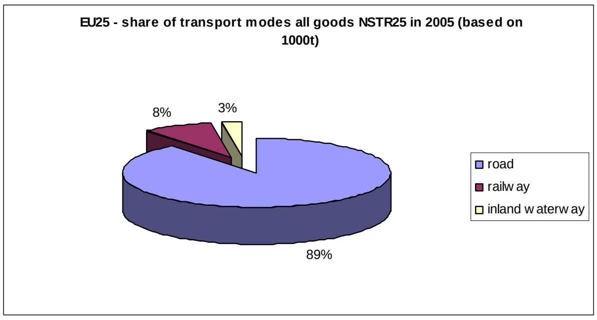
Estimation of average distances:

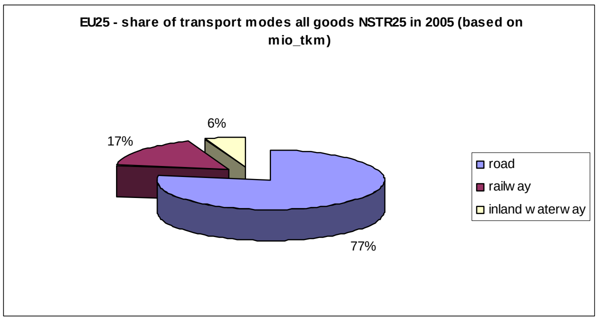
- For each mode (road, rail, inland waterways) annual transport by distance class and by group of goods (NST/R4 in NSTR/25), in “t” and “tkm” is provided for EU15 (EU25 only for inland waterways), Germany, France, Sweden and UK (no inland waterways transport data for these two last countries).

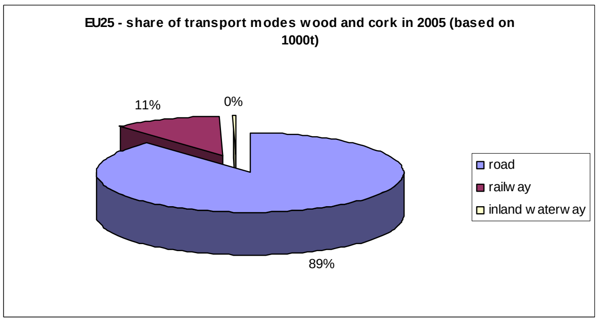
- For each country and mode, the average distance and the share of distance classes (based on “t” and “tkm” distances) by goods is estimated.

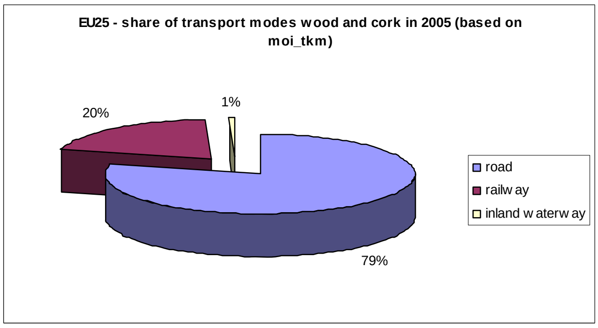
7.4 Group 4 vs. all groups ("NST25") from Eurostat (road, rail, inland) in 2005

EU25

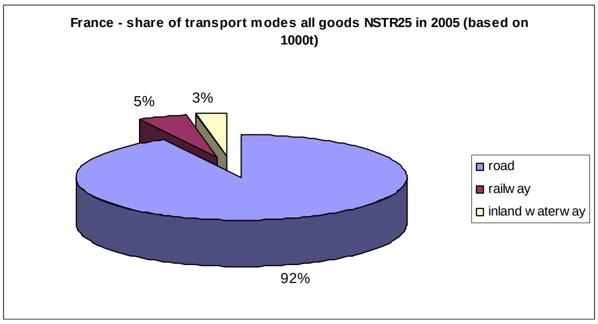


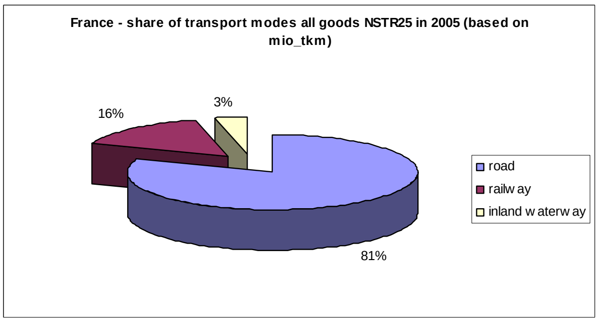


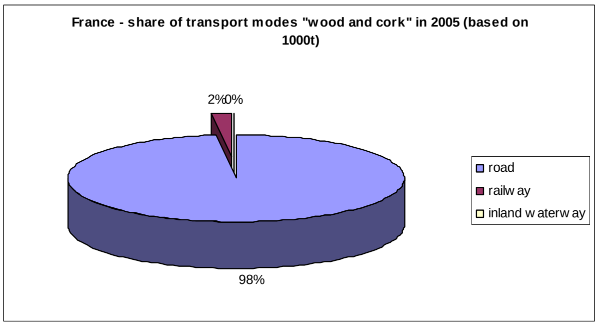


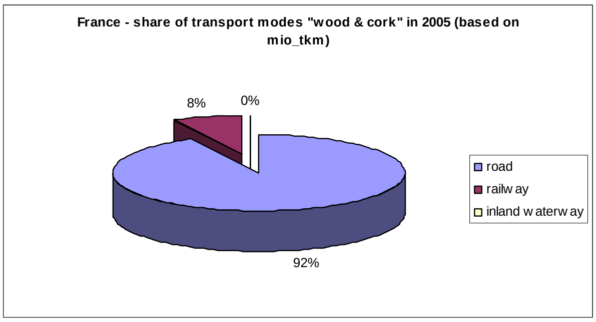


France



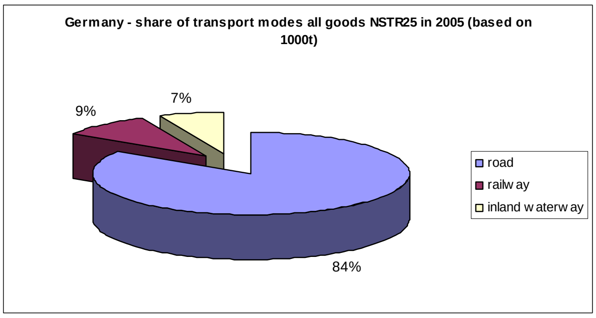


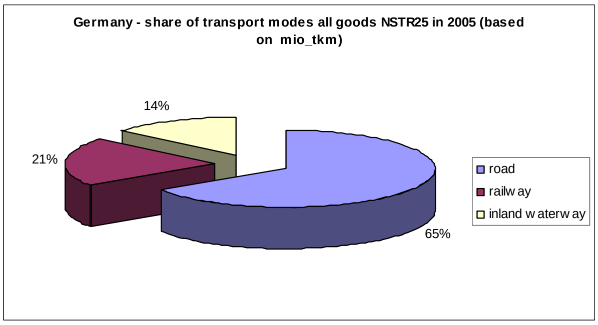


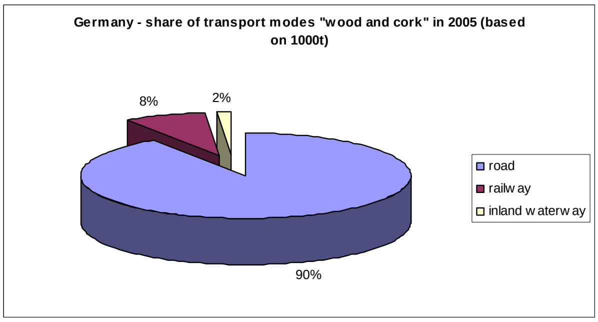


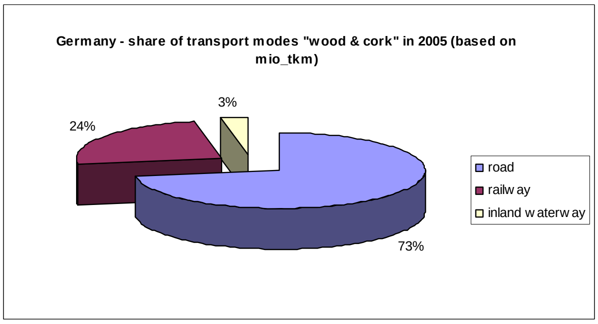
Source: from Eurostat(2007)

Germany

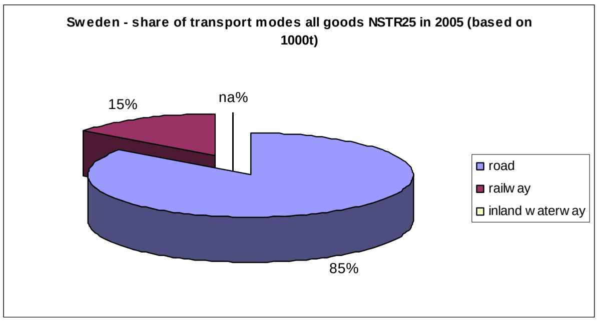


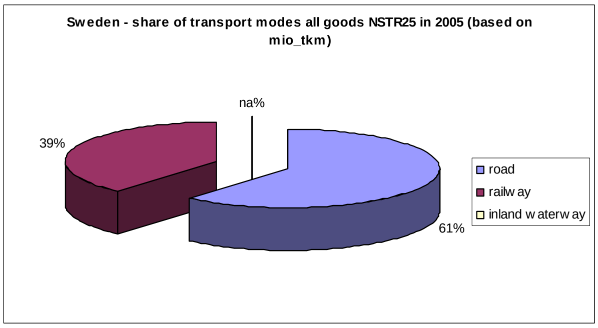


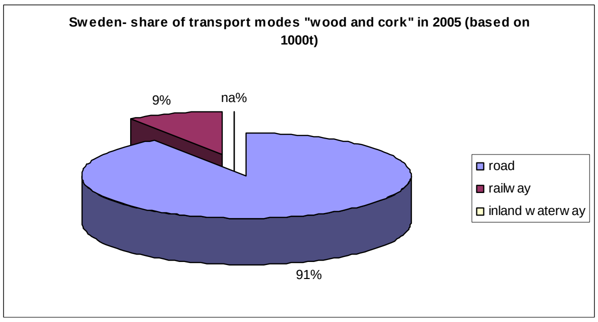


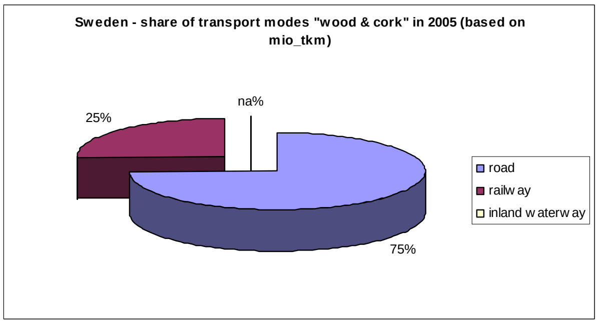


Sweden

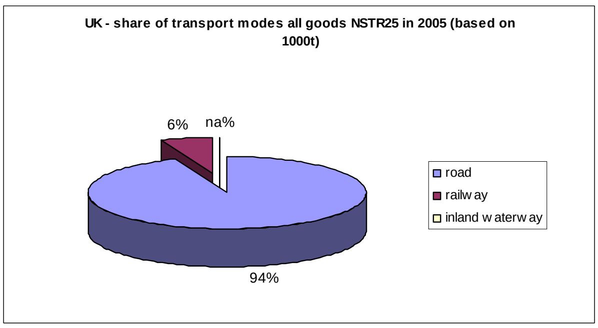


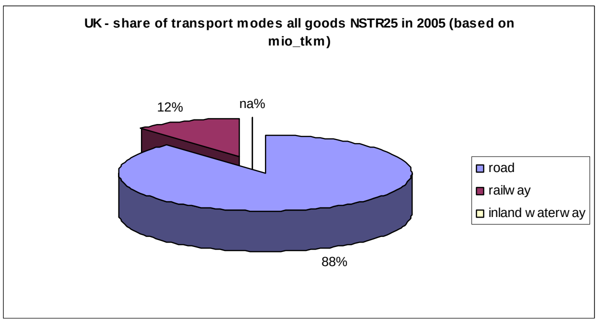






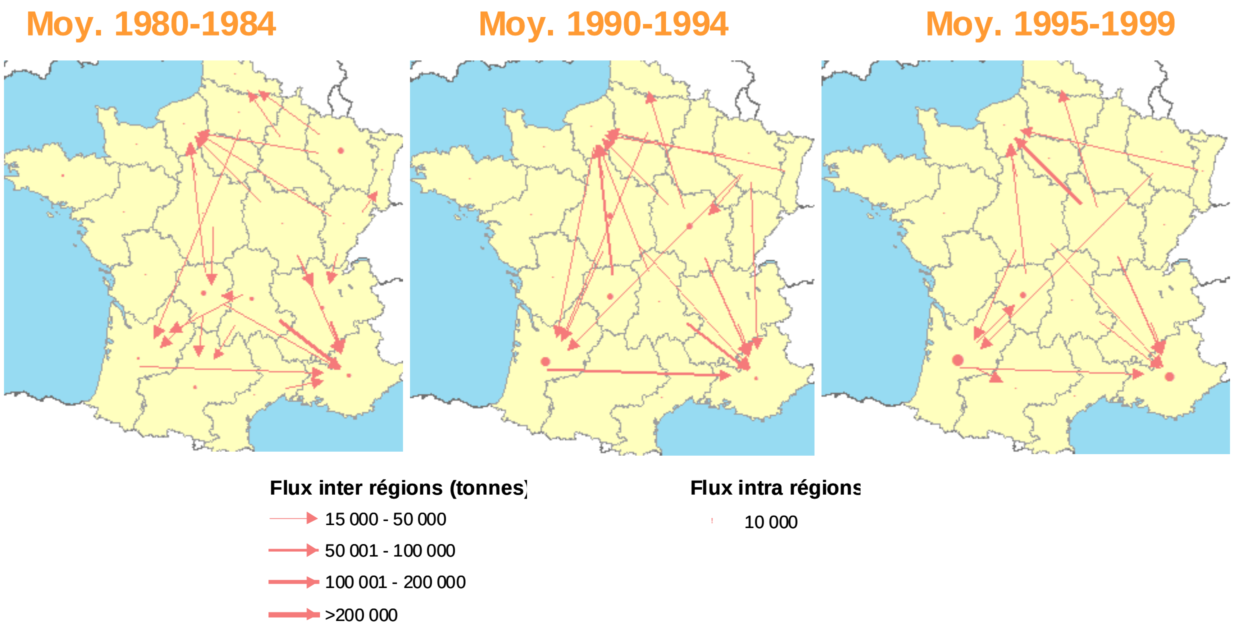
UK (for wood and cork, data are not available for inland and 0% for railways, i.e. 100% for road)





Source: from Eurostat (2007)

7.5 Internal railways flows in France



Source: from SITRAM (2006)

7.6 Permissible maximum weight for road transport

PERMISSIBLE MAXIMUM WEIGHTS IN EUROPE (in tonnes)							
Country	Weight per bearing axle	Weight per drive axle	Lorry 2 axles	Lorry 3 axles	Road Train 4 axles	Road Train 5 axles and +	Articulated Vehicle 5 axles and +
Albania	10		18	25	40	44	38
Austria	10	11.5	18	26	38 (2)	38 (2)	38 (2)
Azerbaijan	10				37	37	37
Belarus	10		18	25 (1)	36	38	38
Belgium	10	12	19	26	39	44	44
Bosnia-Herzegovina	10		20	26	40	40	40
Bulgaria	10	11.5	18	26 (1)	36	40	40
Croatia	10	11.5	18	26 (1)	36	40	40
Czech Republic	10	11.5	18	26 (1)	36	44 (1)	42 / 48
Denmark	10	11.5	18	26 (1)	38	42 / 48	42 / 48
Estonia	10	11.5	18	26 (1)	36	40	40
Finland (3)	10	11.5	18	26 (1)	36	44	42 / 48
France	13	13	19	26	38	40	40
FYR Macedonia	10		16	22	36	40	40
Georgia	10				44	44	44
Germany	10	11.5	18	26 (1)	36	40	40
Greece	10	11.5	18	26 (1)	36	40	40
Hungary	10	11	20	24	36	40	40
Ireland	10	10.5	17	26 (1)	35	40	40
Iceland	10	11.5	18	26	37	40	44
Italy (4)	12	12	18	26 (1)	40	44	44
Latvia	10	11.5	18	26 (1)	40	40	40
Liechtenstein	10	11.5	18	26	36	40	40
Lithuania	10	11.5	18	26 (1)	36	40	40
Luxembourg	10	12	19	26	44	44	44
Malta	10.8	11.5	18	25	36	40	40
Moldova	10		18	24	36	40	40
Netherlands	10	11.5	21.5	33	40	50	50
Norway	10	11.5	19.5	29.5	50	50	47
Poland	10	11.5	18	26 (1)	36	40	40
Portugal (4)	10	12	19	26	37	40	40
Romania	10	11.5	18	26 (1)	36	40	40
Russia	10		18	25	36	38	38
Serbia	10		18	24	36	40	40
Slovakia	10	11.5	18	26 (1)	40	40	40
Slovenia	10	11.5	18	25		40	40
Spain (4)	10	11.5	18	26 (1)	36	40	40
Sweden	10	11.5	18	26 (1)	60	60	60
Switzerland	10	11.5	18	26 (1)	40	40	40
Turkey	10	11.5	18	25	36	40	40
Ukraine	10				38	38	38
United Kingdom	10	11.5	18	26 (1)	36	40	40 / 44

1. With air suspension or similar
2. These values are increased by 5% for vehicles registered in an EU member country
3. For vehicles registered in an EEA member country
4. Increased values are applicable for certain types of transport (i.e. containers, motorcars, etc.)

ECMT, 25-Jan-07

7.7 *Permissible maximum dimension for road transport*

PERMISSIBLE MAXIMUM DIMENSIONS IN EUROPE					
COUNTRY	HEIGHT	WIDTH	LENGTH		
			Lorry or Trailer	Road Train	Articulated Vehicle
Albania	4 m	2.50 m	12 m	18.35m	16.50 m
Austria	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Azerbaijan	4 m	2.50m	12 m	20 m	
Belarus	4 m	2.55 m	12 m	20 m	20 m
Belgium	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Bosnia-Herzegovina	4 m	2.50m	12 m	18 m	17 m
Bulgaria	4 m	2.55 m	12 m	18.75 m	16.50 m
Croatia	4 m	2.55 m (3)	12 m	18.35 m	16.50 m
Czech Republic	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Denmark	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Estonia	4 m	2.55 m	12 m	18.75 m	16.50 m
Finland (1)	4.20 m	2.60 m	12 m	25.25 m	16.50 m
France	not defined	2.55 m (3)	12 m	18.75 m	16.50 m
FYR Macedonia	4 m	2.50m	12 m	18 m	16.50 m
Georgia	4 m	2.50 m	20 m		20 m
Germany	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Greece	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Hungary	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Iceland	4.20 m	2.55 m	12 m	22 m	18 m
Ireland	4.25 m	2.50 m (3)	12 m	18.35 m	16.50 m
Italy (2)	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Latvia	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Liechtenstein	4 m	2.55 m	12 m	18.75 m	16.50 m
Lithuania	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Luxembourg	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Malta	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Moldova	4 m	2.50 m	12 m	20 m	16.50 m
Netherlands	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Norway	not defined	2.55 m (3)	12.40 m	18.50 m	17 m
Poland	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Portugal (2)	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Romania	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Russia	4 m	2.55 m (3)	12 m	20 m	20 m
Serbia	4 m	2.50 m	12 m	18 m	16.50 m
Slovakia	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Slovenia	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Spain	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Sweden	not defined	2.60 m	24 m	24 m	25.25 m
Switzerland	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Turkey	4 m	2.55 m (3)	12 m	18.75 m	16.50 m
Ukraine	4 m	2.65 m	12 m	22 m	22 m
United Kingdom	not defined	2.55 m (3)	12 m	18.75 m	16.50 m

1. For vehicles registered in an EEA member country
2. Increased values are applicable for certain types of transport (i.e. containers, motorcars, etc.)
3. refrigerated vehicles = 2.60 m

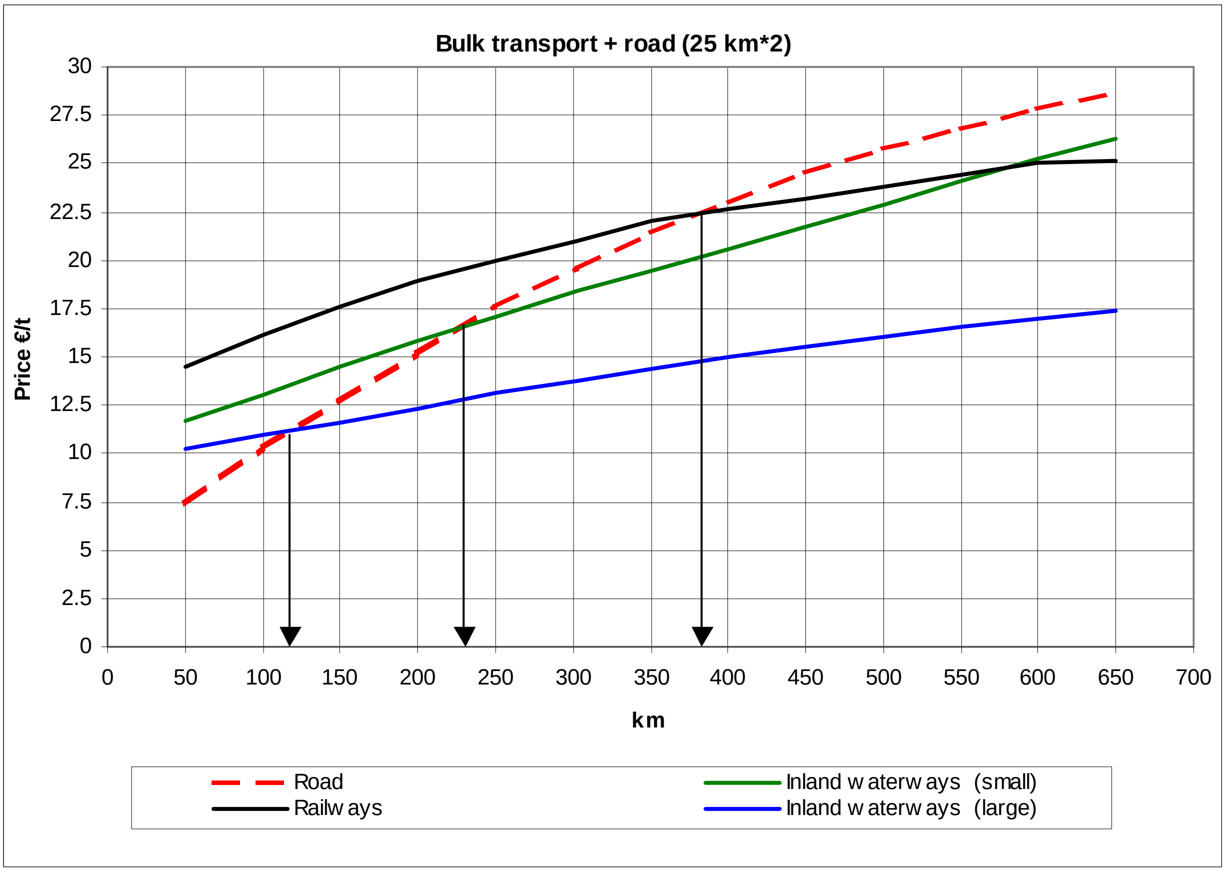
ECMT, 25-Jan-07

7.8 Comparison of transport modes in France: an example for bulk

In this estimation, the line haul from/to the port (25 km each) or to the railway station is included.

If we consider that road transport is the reference mode, the comparative advantage for bulk transport of

- waterways is about 110 km for large navigable canal, 240 km for small canal
- railways is about 390 km.



Source: VNF (2006)

7.9 Planning systems developed in Germany

NAVLOG (www.navlog.de/)
For developing the German navigation system, the German council of wood economic advisors (DHWR) and the German council of forestry (DFWR) have established the NavLog GmbH association. Therefore the forest and wood industry can keep all road data. For both organizations it has been very important to keep this data and to avoid that someone else could misuse it.

ELDAT (www.infoholz.de/html/f_start_page.phtml?p3=223)
The data flow between forestry and wood industry represents an obstacle for the supply chain. Until now all data is given in an analog form. In some regions digital data transfer is already in use and also very expensive.

Through ELDAT the information flow has been improved. Data can not only be transfer but also other information, such as for example contracts, bills, etc., can easily be made available. Therefore it has become an important tool for 'supply-chain-management'.

GEODAT (www.kwf-online.de/deutsch/arbeit/geodat/geodat_index.htm)
DFWR and DHWR want to develop a standardized geographical tool to optimize the information flow between forestry and wood industry. Following this goal, the first step is to digitalize and standardize all forest roads. By doing so it is aimed to facilitate the truck drivers the access to forests and logs.

GEOMAIL (www.geomail.biz/geomail.html)
Geomail is software which is assigned as a communication tool between all participants of the logistic chain to facilitate management und logistics. Its application is based on a client-server-system.

7.10 Prices for the national railway transport of timber in Germany

Rohholz - Binnenverkehr

Frachten in €/Wg gültig vom 01.01.2007 bis 31.12.2007

	Snps Laa (Railtrans)	Roos Laa (TWA)	Eanos Ea(n)s (83 m3)	Eao Eas (72 m3) Ealos-t 058	K
bis km		Rs, Rs-u, Res			
200	734	682	631	580	476
250	787	731	677	621	511
300	865	804	744	683	562
350	958	890	824	756	622
400	1.021	949	878	807	664
450	1.071	996	921	847	696
500	1.113	1.035	957	880	724
550	1.144	1.065	984	905	744
600	1.178	1.095	1.014	931	766
650	1.215	1.130	1.045	960	790
700	1.269	1.180	1.091	1.003	825
750	1.324	1.232	1.139	1.046	861
800	1.371	1.275	1.179	1.083	892
850	1.419	1.320	1.221	1.122	922
900	1.462	1.359	1.257	1.154	950
950	1.502	1.397	1.292	1.187	977
1000	1.550	1.441	1.333	1.224	1.007
ab 1001	1.600	1.488	1.375	1.264	1.040

P-Wagen abzüglich 15 %

Att. 1 : Prices for the national railway transport of timber. Source: Nieten Fracht Logistics