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Resumen

Durante las últimas décadas, ha habido un crecimiento muy importante en el transporte de mercancías. Debido al aumento de la demanda, debemos buscar nuevas opciones en el transporte de productos, que ayuden a solucionar problemas económicos, sociales y medioambientales.

El transporte tiende a una intensificación del tráfico y a un desequilibrio creciente en la utilización de los distintos modos de transporte, con un aumento de la parte correspondiente al transporte por carretera y una reducción de la parte correspondiente al transporte ferroviario.

La intermodalidad, definida por la Comisión Europea como una característica de un sistema de transportes en virtud de la cual se utilizan de forma integrada al menos dos modos de transporte diferentes para completar una cadena de transporte puerta a puerta, permite, mediante un planteamiento global, una utilización más racional de la capacidad de transporte disponible.

En este proyecto se ha abordado la situación actual que presenta la intermodalidad estructurándolo en tres módulos. En el primero se detalla en qué consiste el transporte intermodal y las medidas a tener en cuenta en su desarrollo, en los siguientes puntos:

1. Transporte intermodal de mercancías

El transporte intermodal es el movimiento de mercancías por medio de una única unidad de carga, que utiliza dos o más modos de transporte sin manipular las mercancías durante los procesos de intercambio modal, evitando su ruptura.

La mejora de la competitividad y sostenibilidad económica y ambiental de los sistemas de producción y consumo pasan por reducir costes y aumentar la eficiencia, mediante la gestión de la movilidad de las mercancías de forma global desde un punto de vista intermodal.

Estas tendencias requieren que los agentes del sector dominen los factores y tecnologías que inciden tanto en la organización, operación y gestión como en la planificación, diseño, financiación y explotación de las infraestructuras y operaciones asociadas a corredores y nodos que conforman la red intermodal.

2. Desarrollo del transporte intermodal y principales problemas

En los últimos años el transporte de mercancías por carretera ha sufrido un considerable incremento. De cara a un desarrollo sostenible la Comisión Europea y los distintos gobiernos nacionales y regionales, se han marcado como necesidad fomentar el uso del transporte intermodal. Representantes de los agentes del transporte coinciden en apuntar que la intermodalidad aparece como una posible solución para minimizar en lo posible las consecuencias de este aumento de demanda en el movimiento de mercancías.

Actualmente existe una falta de sensibilización y desconocimiento de esta alternativa de transporte. El mayor problema se presenta con la necesidad de una organización más eficaz entre los diferentes medios de transporte involucrados ya que se requieren soluciones "puerta a puerta" y, por ello, es necesario desarrollar soluciones que faciliten la integración y la intermodalidad de todos los medios de transporte.

Además de la estandarización o la unificación en materia legislativa en los diferentes Estados, la innovación tecnológica puede ayudar y beneficiar al transporte intermodal, ofreciendo herramientas que faciliten y potencien su uso.

3. Papel del sector público y políticas de transporte intermodal

El transporte de mercancías es necesario, pero también tiene efectos negativos. Las autoridades públicas deben que establecer las condiciones necesarias para crear un buen funcionamiento del mercado y reducir los efectos negativos del transporte.

La internalización de los costes externos

La inversión en infraestructuras de transporte es tradicionalmente una responsabilidad de las autoridades públicas, destinada a que la sociedad fomente el uso eficiente y sostenible de dichas infraestructuras. Por tanto, es responsabilidad de las autoridades públicas crear reglas transparentes e igualdad de condiciones en su uso para todos. Las autoridades públicas han de fomentar la competencia y habida cuenta de la intención de fomentar la utilización eficiente del sistema de transporte, las consecuencias y costes del uso de distintos modos de transporte deben ser internalizados. Una forma de hacerlo es mediante el uso de impuestos y tasas a que el precio del transporte en línea con sus costes marginales socio-económicos. Los costes marginales de transporte se definen como los costes sociales causados por cada vehículo adicional, tren o barco. Estos costes sociales están formados por la inversión necesaria para mantener la red de infraestructuras, los costes de la congestión y el coste social de los accidentes y los daños ambientales. El principio del coste marginal en los precios de la infraestructura asegura que todos los elementos del coste social se tengan en cuenta en las decisiones sobre transporte. Según la teoría, esto traerá consigo el óptimo uso y eficiencia de la infraestructura.

En Europa, la liberalización del transporte ha sido más radical en el sector ferroviario. El primer paso fue la separación de la infraestructura de las operaciones de transporte. Sin embargo, en algunos países siguen siendo las relaciones entre el administrador de la infraestructura y el operador ferroviario. Dentro del transporte por carretera y marítimo de corta distancia, los mercados nacionales se han abierto, incluido el de cabotaje. Las diferencias nacionales en materia de precios, sin embargo, distorsionar la competencia en el mercado del transporte internacional, por lo que es necesario crear reglas de juego iguales entre los países y entre los diferentes modos de transporte.

La legislación, ordenación y organización

La variedad de niveles de los instrumentos legislativos y reglamentarios en vigor, especialmente en Europa, para fomentar la actividad intermodal hacen que casi cada país tenga una normativa interna en el ámbito del transporte intermodal. Por ejemplo, algunos países permiten un peso máximo bruto más alto de los vehículos utilizados en el transporte intermodal. En muchos países existen reglamentos sobre el transporte de camiones, por ejemplo, restricciones en el transporte de camiones por la noche y en áreas específicas. Sin embargo, en varios países, los vehículos de transporte intermodal están exentos de este tipo de normas de circulación. Los usuarios de transporte combinado pueden también quedar exentos de otras formas de restricciones y cargos.

Gestión de las infraestructuras viarias

El aumento del número de vehículos de pasajeros y camiones de carga ha reducido la capacidad de la red de transporte por carretera. Una forma de hacer frente a la limitada capacidad es la implementación de medidas operativas tales como el desarrollo de rutas para camiones, la gestión de franjas horarias, los sistemas de reserva y la información. Estas normas ya están en funcionamiento en algunos países (por ejemplo, Alemania, Suiza). Es tarea de las autoridades públicas, administrar los recursos de manera óptima. Estas medidas operativas también pueden conducir a un cambio modal, como el ejemplo de Suiza.

Capacidad económica y financiera de apoyo

En la mayoría de los países, el sector público tiene un papel importante en la planificación y financiación de infraestructuras de transporte. Las carreteras y ferrocarriles se financian en gran parte los ingresos fiscales, aunque algunas infraestructuras se financian y explotan de manera privada. En el transporte marítimo y terminales portuarias es común que los usuarios colaboren en el desarrollo de la infraestructura. Un aumento de los fondos gubernamentales de los terminales y otras obras de infraestructura para el transporte marítimo podría ser una medida para reforzar el transporte intermodal. Hay varias razones para que los gobiernos ofrezcan financiación en el desarrollo de terminales intermodales:

• La construcción de terminales intermodales es un negocio altamente rentable;

• Los costes de inversión son altos, y por lo tanto difícil de soportar para las empresas privadas;

• La financiación del gobierno podría ser lo que se necesita para lograr que las empresas privadas interesadas en las nuevas terminales intermodales.

Los costes de operación son pagados normalmente por los usuarios. Sin embargo, en algunos países existe la posibilidad de financiación por parte del gobierno en la fase inicial de los nuevos servicios de transporte intermodal. Esto podría ser una manera de reducir el gran riesgo económico en la construcción de un nuevo servicio intermodal.

Interoperabilidad y normalización

La interoperabilidad entre la infraestructura, medios de transporte y equipo de transporte es importante en el transporte intermodal. La interoperabilidad puede lograrse mediante la estandarización, y/o normalización. Debido a que la normalización es de interés público, las autoridades públicas pueden apoyar la normalización mediante la financiación de proyectos para su desarrollo.

4. Medidas gubernamentales y desarrollo del sistema de transporte intermodal

Desde su creación (1957), la Comunidad Europea se dotó de una política común de transportes, para establecer medidas en el transporte terrestre (carretera y ferrocarril) y por mar (fluvial y marítimo).

En los años 70, la política de transportes se amplió al transporte aéreo. El Tratado de la Unión Europea de Maastrich (1992) recoge nuevos objetivos para la política de transportes: la seguridad en el transporte, la red transeuropea y la protección del entorno.

El objetivo genérico de la actual política de transportes es garantizar la movilidad de personas y mercancías en el mercado interior europeo y también desde y hacia terceros países, así como aprovechar al máximo los dispositivos técnicos y de organización para facilitar el transporte de personas y de mercancías, respetando el medio ambiente. Estos objetivos tienen que conseguirse mediante la mejora de la seguridad, la reducción del ruido y la contaminación y la promoción de la protección del medio ambiente.

La política de transportes se considera fundamental en el fortalecimiento de la cohesión económica y social de la UE. Contribuye a reducir las disparidades regionales, mejorando el acceso a las regiones insulares y periféricas. Además, tiene un efecto positivo para la creación de puestos de trabajo, ya que fomenta las inversiones en infraestructuras de transporte y favorece la movilidad de los trabajadores.

La Unión Europea tiene cinco millones de kilómetros de carreteras, 215.000 kilómetros de vías ferroviarias y 41.000 kilómetros de vías fluviales navegables. Mejor dicho, no es la UE, sino sus Estados miembros, porque lo que falta en Europa es precisamente una visión europea de las comunicaciones terrestres o fluviales. En 2006 se creó la Red de Transporte Transeuropeo (TEN-T), para reparar esa carencia y con el objetivo de que la Red jugara un papel esencial en la creación de vínculos entre los países miembros, evitara los actuales cuellos de botella en el transporte y formara una conexión intermodal por tierra, mar y aire en los transportes europeos

Del mismo modo, el programa Marco Polo II recoge los objetivos del primer programa Marco Polo: reducir la congestión y mejorar el comportamiento medioambiental del sistema de transporte intermodal, contribuyendo a la creación de un sistema de transporte eficaz y sostenible, que aporte un valor añadido a escala comunitaria, sin repercusiones nefastas para la cohesión económica, social o territorial. Ahora bien, Marco Polo II incluye disposiciones nuevas.

El objetivo de las medidas gubernamentales relacionadas con el transporte intermodal en los países de la Unión Europea busca aumentar la competitividad del transporte intermodal de mercancías armonizando los procedimientos de mantenimiento de las unidades de carga de todos los modos de transporte, en particular, los contenedores y cajas móviles, utilizados en el transporte por carretera, por ferrocarril y fluvial.

5. Buenas prácticas del transporte intermodal en Europa

Entre las buenas prácticas desarrolladas por los países de la Unión Europea destacan las impulsadas en la región de los Alpes (Alemania, Austria, Suiza y el norte de Italia) y otros países, mediante un amplio sistema de medidas políticas y legislativas para fomentar el transporte intermodal. De esta manera, el transporte por carretera se ve limitada por diversos medios, tales como las licencias de tránsito limitado para los vehículos no pertenecientes a la UE, las prohibiciones de circulación los fines de semana y las prohibiciones de circulación para los camiones pesados por la noche. El transporte intermodal goza de las exenciones de ancho de todas estas limitaciones.

6. Desarrollo de transporte intermodal: España

A través del Plan Estratégico de Infraestructura y Transporte (PEIT), el Ministerio de Fomento ha definido los principales ámbitos para la organización logístico-territorial que se quiere llevar a cabo con el desarrollo de la intermodalidad.

El desarrollo del transporte intermodal de mercancías necesita de unas infraestructuras con capacidad suficiente y requiere de plataformas específicas donde se realice el intercambio entre modos de transporte.

Por ello, dentro del Plan Estratégico de Infraestructura y Transporte (PEIT) se establece un Plan Intermodal de Mercancías que contempla simultáneamente:

- Actuaciones en infraestructuras intermodales: nodos y corredores
- Definición del marco de prestación de los servicios de transporte intermodal

Los objetivos que se pretenden con el transporte intermodal son:

- Contribuir a la redistribución gradual del reparto modal de mercancías
- Aprovechar el posicionamiento logístico global de España
- Reequilibrar la estructura logística territorial
- Integrar el conjunto del sistema de mercancías como una red

Para tener claros los datos en cuanto al transporte de mercancías en España, el transporte por carretera es con mucha diferencia el mayoritario con un 84%, el marítimo el 10,1% y el ferroviario sólo el 3%, con estos datos queda claro la importancia que tiene el transporte por carretera dentro del conjunto del sector y la mejora en la congestión del tráfico terrestre que se podría lograr incentivando el uso de otros modos de transporte.

7. Legislación europea en transporte intermodal

El recurso de la intermodalidad reviste una importancia fundamental para el desarrollo de alternativas competitivas en el transporte por carretera. Así pues, es preciso tomar medidas para integrar mejor los modos de transporte que cuentan con importantes capacidades de transporte potenciales en una cadena de transporte administrada eficazmente y en la que todas las prestaciones estén integradas. Son prioritarias las medidas de armonización técnica e interoperabilidad entre sistemas, en particular para los contenedores. Además, un nuevo programa comunitario de apoyo, "Marco Polo", centrado en iniciativas innovadoras, se propone para que la intermodalidad sea, más que un lema, una realidad competitiva viable desde un punto de vista económico.

Se pueden concretar los puntos prioritarios de la actual política de transportes de la UE:

- Libro Blanco sobre el transporte
- Redes transeuropeas
- La Europa del ferrocarril
- El transporte marítimo en la UE
- Short sea shipping
- Transporte intermodal/combinado
- Espacio único europeo
- Movilidad sostenible
- Seguridad en el transporte
- Sistemas de transporte inteligente. El proyecto Galileo
- Política de transportes y la ampliación de la UE

En este contexto, la Comisión Europea adoptó en septiembre de 2001 un nuevo Libro Blanco sobre el Transporte, bajo el título "La política europea de transportes de cara al 2010: la hora de la verdad", donde recoge las iniciativas y propuestas legislativas que prevé adoptar para desarrollar la política común de transportes durante el periodo 2000 2010 y aporta tres claves principales:

1. Es necesario un equilibrio de los diferentes modos de transporte para garantizar la movilidad en una Europa ampliada.

2. Es necesario luchar contra la congestión y los efectos medioambientales.

3. Es necesario reorientar la política de transportes hacia los ciudadanos, que exigen más seguridad, más calidad y más protección en sus desplazamientos.

El objetivo del Libro Blanco es establecer las medidas necesarias para orientar Europa hacia una movilidad sostenible, exponiendo los instrumentos políticos y legislativos para conseguirla. Está compuesto de un programa de acción con medidas escalonadas que han debido adoptarse hasta el año 2010, de un mecanismo de seguimiento y la previsión de elaborar un informe intermedio expuesto en el año 2005 para verificar si los objetivos planteados se han ido cumpliendo o no.

Una vez conocido el concepto, la normativa y el desarrollo del transporte intermodal, el objetivo es analizar los costes, beneficios e impacto del impulso que puede suponer la intermodalidad como solución a los problema de transporte, mediante un mejor uso de los modos alternativos como son los ferrocarriles, las vías navegables y el transporte marítimo de corta distancia, junto con el transporte por carretera:

8. Impacto, costos y beneficios de las medidas para el fomento de transporte intermodal

El modelo de transporte existente en la Unión Europea presenta, según la Comisión Europea, un excesivo uso de la carretera. Esto supone una sobrecarga para todo tipo de calzadas y un aumento considerable de la contaminación.

Los beneficios de la intermodalidad son muchos aunque, en el estudio Análisis, Información y Divulgación sobre la aportación del transporte por carretera a la intermodalidad [Ministerio de Fomento de España, 2004] los resume en los siguientes:

- Reduce de los plazos y costes de transporte
- Disminuye la congestión de las carreteras, con lo que aumenta la seguridad viaria
- Baja la contaminación atmosférica y acústica

- Reducción de los tiempos de carga y descarga
- Propicia nuevas oportunidades comerciales para las empresas
- Disminuye los robos y los daños de la carga
- Reducción de los controles fronterizos
- Simplificación documental en el transporte intermodal
- Seguimiento más exhaustivo de la mercancía

La intermodalidad favorece la descongestión de la carretera, reduce los costes, promociona modos de traslado más respetuosos con el medio ambiente y beneficia el incremento en la eficiencia de las operaciones, entre otras.

La intermodalidad no es sólo rentable para las grandes empresas, ya que las pequeñas y medianas empresas pueden salir muy beneficiadas, siempre que envíen contenedores completos. Así consiguen un beneficio interno, en forma de menores costes, y externo, con menos contaminación y congestión en las carreteras.

9. Conclusiones y recomendaciones

Las medidas propuestas pueden agruparse en estos temas:

- Revitalización del ferrocarril.
- Promoción del transporte marítimo (short sea shipping) y de las vías navegables interiores, creando verdaderas "autopistas del mar".
- Hacer realidad la intermodalidad.
- Mejorar la calidad del sector del transporte por carretera.
- Mejorar la seguridad del transporte por carretera.
- Revisión de la red transeuropea (Transeuropean transport network).
- Equilibrar el crecimiento del transporte aéreo y la preservación del medio ambiente.
- Decidir una política de tarificación eficaz de los transportes.
- Reconocimiento de los derechos y de las obligaciones de los usuarios.
- Poner la investigación y la tecnología al servicio de un transporte sostenible y eficaz.
- Control de los efectos de la globalización del transporte.
- Desarrollar los objetivos medioambientales a medio y largo plazo para un sistema de transporte sostenible.

El aumento de la demanda de transporte en la Unión Europea se debe entre otros al crecimiento del transporte de mercancías, motivado principalmente por los cambios vividos en la propia economía europea y su sistema de producción. Esta es una de las causas para que la UE requiera de un uso más racional y equilibrado de los distintos modos de transporte.

El objetivo de la política común de transportes de la UE es promover la movilidad sostenible, promoviendo servicios de transporte eficientes, adecuados en costos, seguros, ambientalmente limpios y socialmente aceptados. Esta política se encuentra desarrollada en el Libro Blanco sobre el transporte, el cual establece las medidas necesarias para orientar a Europa hacia una movilidad sostenible exponiendo instrumentos políticos y legislativos para conseguirla; entre las medidas encuentra “hacer realidad la intermodalidad”.

Según la UE el transporte intermodal es una cuestión de comercio y movilidad en la que el ferrocarril, las vías navegables, las vías aéreas y la carretera contribuyen a hacer óptimo el conjunto del sistema de transporte, apoyándose en servicios de información y comunicación.

La economía global del transporte intermodal depende de la voluntad de los Gobiernos para tener en consideración las ventajas externas que este transporte aporta en materia de ahorro, de energía, polución, costo social: en Europa su explotación es presenta un gran déficit, cosa que obliga a los Estados a subvencionarlos.

Ante las consideraciones de la UE sobre el crecimiento del transporte de de mercancías por carretera, se ha propuesto que se adopten medidas para que la cuotas de mercado de los diversos modos de transporte regresen a su nivel de 1998 en el 2010.

El programa Marco Polo se implementa en la UE con el objetivo de reducir la congestión del sistema de transporte por carretera, mejorar el impacto ambiental del sistema de transporte de mercancías dentro de la Comunidad y potenciar la intermodalidad, contribuyendo a un sistema de transporte eficaz y sostenible.

Se puede concluir finalmente que la Unión Europea está apostando por un transporte sostenible y por la intermodalidad, elemento importante para alcanzar este objetivo.

Abstract

During recent decades, there has been very substantial growth in the freight transport sector. Freight transport is increasing faster than the economy or passenger transport. Demand is increasing more rapidly than supply and is resulting in environmental and social problems. Increasing congestion, too, is affecting efficient and reliable freight distribution, and consequently having a deleterious effect on local economies. Intermodality is therefore needed to make better use of alternative modes that have accessible spare capacity, such as railways, inland waterways and short sea shipping.

Because of the increasing problems in road freight transport, it is important to consider intermodal alternatives that will make freight transport more sustainable and to use suitable combinations of the different modes productively. It is the role of public authorities to support intermodal transport and to provide the suitable framework conditions taking into account the public interest and the requirements of the industry.

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1. FREIGHT INTERMODAL TRANSPORT

SCOPE

To establish an effective intermodal transport network that has fewer negative environmental impacts and responds to the growing freight transportation of goods, major collaborative measures for roads and other modes of transport are necessary. This chapter focuses on measures that would lead to the removal of obstacles to intermodal transport; for example, improvement of road access to intermodal transport facilities such as seaport, inland waterway and rail/ road terminals, and governmental measures promoting intermodal transport, such as investing in improvements at freight terminals, financially supporting new intermodal solutions, efficient framework conditions and organisation.

1.1 CONTEXT AND PRESENTATION

In the period 2000-2003, studies showed that rail has declined in Europe, while road and short sea shipping are growing. In the USA and Australia, however, rail has an important role on long distances. [Eurostat, 2003]

For the future, studies focused increasingly on environmental impacts, safety standards and transport management, as well as development of new transport technologies and regulation forms. Also registered an increased willingness of countries to encourage intermodal transport solutions.

Logistic platforms could be one way to stimulate intermodal transport. This project therefore studies obstacles to intermodal transport, effects generated by logistic platforms and conditions for success in these platforms.

Considering the work, this project studies measures to overcome the obstacles to intermodal transport, focused on governmental measures in support of intermodal transport and terminals and highlighted the role of the public sector.

This project is in five main parts: sections 1 and 2 dealing with general issues, trends and key problems in the development of intermodal transport; sections 3 and 4 dealing with the role of public sector and governmental measures in support of intermodal transport; sections 5 and 6 presenting best practise in support of intermodal transport;

sections 7 dealing about European Community Transport Law and the final sections 8 and 9 drawing some conclusions and recommendations concerning governmental measures.

1.2 WHAT IS INTERMODAL TRANSPORT?

It is necessary to begin by presenting the concept of intermodal transport and to deal with the question of why there is a need for supporting this kind of freight transport. This project uses the broad and well-accepted definitions of the Terminology on Combined Transport prepared by the UNECE, the ECMT and the European Commission:

- Intermodality or intermodal transport is defined as “The movement of goods in one and the same loading unit or vehicle which uses successively two or more modes of transport without handling of the goods themselves in changing modes” [UNECE, 2001].
- A terminal is defined as: “A place equipped for the transhipment and storage of Intermodal Transport Units” [UNECE, 2001]. When speaking of intermodal terminals, transfer points are meant as well.

Modes of an intermodal transport chain are rail, barge (inland waterway), ship (short sea shipping and deep sea shipping) and road used usually for pre- and end-haulage to and from terminals. The most common intermodal chains are shown in figure 1.

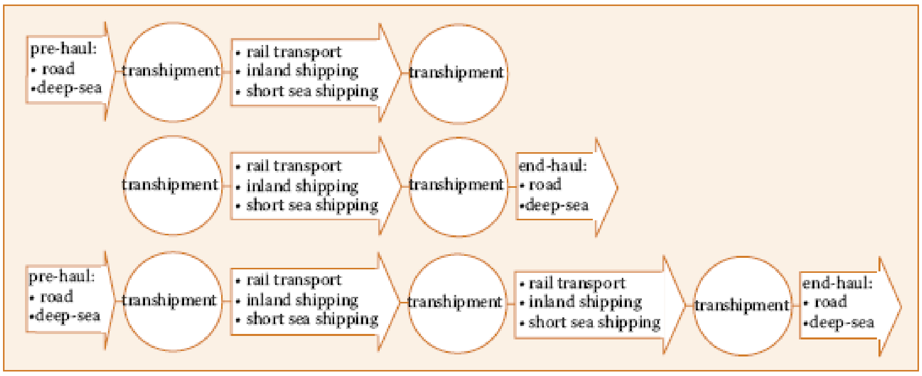


Figure 1 - Intermodal chains (TRILOG 1999)

Combined transport is a segment of intermodal transport and is defined as “Intermodal transport where the major part of the journey is by rail, inland waterways or sea and any initial and/or final legs carried out by road as short as possible” [UNECE, 2001]. This expression is often used synonymously for intermodal transport.

Haul is by rail, inland shipping or short sea shipping transport. Containers swap bodies and semi-trailers are transported as loading units in intermodal transport chains. This kind of intermodal transport is non-accompanied.

On rolling motorways, also trucks and tractors with semi-trailers can become loading units. This kind of intermodal transport is “accompanied” if the driver remains with the vehicle on the main haul.

Figure 2 - Loading units in intermodal transport (UNECE, 2001)

Roll-on-roll-off (RO-RO) intermodal transport is defined as “Loading and unloading of a road vehicle, a wagon or an ITU (Intermodal Transport Unit) on or off a ship on its own wheels or wheels attached to it for that purpose” [UNECE, 2001]. Lift-on-lift-off (LO-LO) intermodal transport is defined as “Loading and unloading of intermodal transport units using lifting equipment” [UNECE, 2001].

Figure 3 - Rolling motorways (UNECE, 2001)

This project does not deal with multimodal transport, which is defined as “Carriage of goods by two or more modes of transport” [UNECE, 2001]. Multimodal transport does not require that the goods should stay in one and the same loading unit over the whole transport chain.

In the mid-term review of the European Commission’s 2001 Transport White Paper, the Commission introduces the term “co-modality” denoting that the new transport policy enables optimal use and combination of different modes of transport.

Figure 4 - Ro-Ro and Lo-Lo (UNECE, 2001)

1.3 NEED FOR ENCOURAGING INTERMODAL TRANSPORT

Owing to the rapid growth of freight transport, nearly all continents are facing severe freight transport problems. Since the beginning of the 1990s in the most developed countries, growth in freight transport has been higher than in passenger transport, and often higher than economic growth. In the Mid-term review of the European Commission’s 2001 White Paper “Keep Europe moving” some figures of economic growth and trends in transport are presented.

In the period 1995-2004 the EU member states (EU 25) had an average economic growth on 2,3% a year, while the growth of freight transport was 2,8%. Passenger transport grew at a lower rate of 1,9%. The main reasons of the rapid growth of freight transport are globalisation, the spatial division of labour and the individualisation of demand. [Eurostat, 2003]

In the past 30 years, road freight has been steadily capturing market share from rail and inland waterway transport in Western European countries. The longer term trend shows that total tonne-kilometres in the road freight sector increased by a factor of more than 3,4 over the period 1970-2004. In 2004, rail freight stood at less than 50 percent of its modal share in 1970. Forecasts indicate that road transport will continue to grow faster than other modes of transport in the future. [European Commission’s White paper, 2004]

In the Central and Eastern European countries and the Baltic States, rail has lost the dominant position it held as late as in 1990. Road transport carried over 60% of the combined tonne-kilometres conveyed by road, rail and inland waterways (compared with 79% in Western European countries). In CIS (Commonwealth of Independent States) countries (Russia, Belarus, Ukraine, Moldova, Azerbaijan, Georgia), railway freight still has a dominant position (i.e. a market share of 87%). However, with economic growth there is certainly a risk of a rapid increase in road freight transport also in Eastern Europe in time. [European Commission's White paper, 2004]

The productivity of road transport is declining as a result of congestion, improved enforcement of regulation and social standards (training, driving times) and is leading to higher costs and loss of competitiveness of road transport. Road transport capacity will not increase in tact with growth because of the costs of new infrastructure and local objections to new roads and road extensions. New capacity is anyway taken by the massive growth in private passenger transport.

Environmental problems (noise, pollution, area space use, etc.) are increasing, especially in sensitive mountainous regions, coastal regions and urban areas.

Concerns about climate change are increasing. Road truck transport is heavily dependent on fossil fuel and high fuel prices and price instabilities have to be faced.

Economic growth involves increased traffic flows, and to cope with this the different transport modes need to combine their services to create an efficient and sustainable transport system. Intermodality is seen as one possible approach with a high potential to make freight transport more sustainable and ensure economic development. Intermodality is needed so that better use can be made of alternative modes that have accessible spare capacity. Making better use of available resources is not an expensive solution and reduces stress on over-used road networks.

1.4 FACTORS IN THE DECISION-MAKING ON TRANSPORT MODE

Mode choice decisions in freight transport are taken indirectly and long term on the strategic level and short term on the operational level.

On a strategic level, the logistics concept is essential determined as it is by production and client requirements. In developed countries, transport costs occupy a very low share of the product total costs; even in relation to logistics, transport costs are not so big.

The share of transport costs in the overall product is between 2% and 5% (for bulk goods also more) and in the logistics costs is between 20% and 40%. [PIARC, Paris, 2005] Over logistics strategies, the spatial distribution of procurement, production and distribution sites and the degree of outsourcing is defined. These are the decisive factors for distance and consignment size. The possibilities and chances of modes are already heavily determined by the characteristics of the transport modes and their various. On the operational level, mode choice is made short term under specific framework conditions (logistics strategy, infrastructure, equipment etc.) on the basis of quality and cost requirements. Different studies on decision-making processes in freight transport (including stated preference analysis) show that price, reliability, flexibility, lead times, frequency, security and added value services are the most important factors in any decision on choice of mode. Their individual importance depends on the logistics.

Decision factor	**Description**		**Developing countries**
Price	Price for transport, transhipment and further logistical services	++	+++
Reliability	Frequency and scale of delays against agreed delivery times	+++	++
Flexibility	Time span between order and delivery	++	+
Lead times	Door-to-door time between consignor and consigner	++	++
Frequency	Frequency of services in a time span	++	+
Security	Number and probability of damage or loss of goods	+	+++
Added value services	Availability of added value services (tracking and tracing, reverse logistics, etc.)	++	+
+++ very importance, ++ high importance, + importance			

Table 1A. Qualitative assessment of the importance of the decision-making factors. Source: IRE / Rapp Trans AG (2005). Bewertung von Qualitätsmerkmalen im Güterverkehr. ASTRA Auftrag 2002/011. Dezember 2005.

For developed countries, reliability plays a key role in mode choice, but there are also other quality criteria that are relevant. Price remains an important decision factor. For developing countries, price and security are important in the choice of mode, but quality criteria such as lead times or reliability are also relevant. Security, in particular, is heavily dependent on the local framework conditions within a country.

The different modes have different characteristics and do not fulfil the cost and quality requirements in the same way. Within the IQ project [IQ, 1998], the key factors as to why either intermodal or road transport is chosen by actual users have been identified. The results are valid for developed countries within Europe.

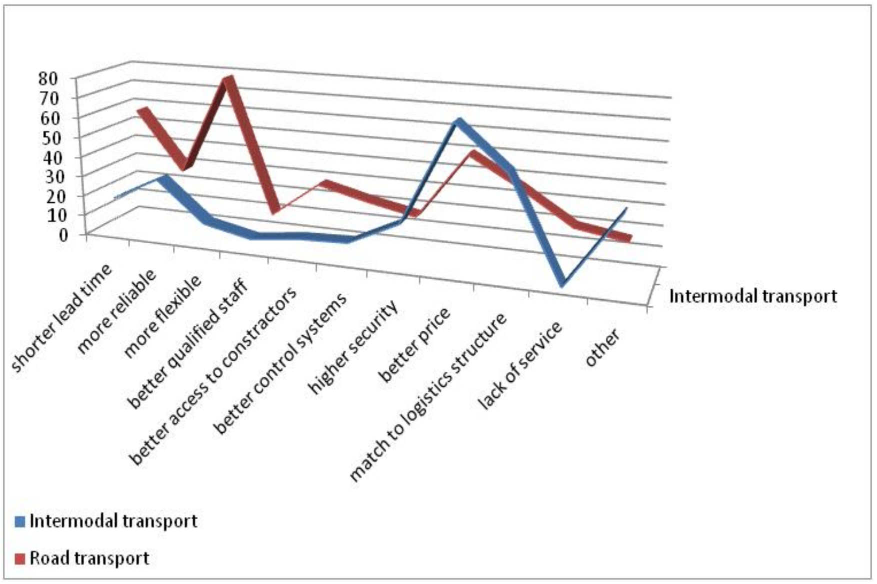


Figure 5 - Assessment of key factors for modal choice (IQ 1998)

In line with other studies [LOGIQ, 1999], the results show that cost of transport is an important criterion for intermodal transport choice [SPIN, 2000]. Companies, as expected, also choose intermodal transport to match their logistics structure. Intermodal transport is not considered to be synonymous with flexibility, and is not chosen by companies requiring shorter lead times. With an improved intermodal service network the quality requirements can better be matched in the future.

2. DEVELOPMENT OF INTERMODAL TRANSPORT AND KEY PROBLEMS

This section describes trends and discusses key problems in the development of intermodal transport.

2.1 TRENDS IN INTERMODAL TRANSPORT

The focus in this chapter is on development of intermodal transport and its share in freight transport. The data and statistics situation in intermodal transport is not as good as in pure rail, road or ship transport because today's data collection is mode related and not consignment related. It is therefore difficult to find significant and comparable data. This has to be considered when assessing the following developments in intermodal transport.

In 2002, a quantity of around 6 billion tonnes of goods was transported globally [Lemper, 2003]. Growth rate in the past 15 years has been about 2,9% per year. Intercontinental trade has increased greatly in recent years, with around 98% of it transported by deep-sea ships. The highest growth rates can be observed for container ships by 9% to 10% per year. The containerisation degree of intercontinental trade increased from 25% in 1980 to around 60% in 2003 [Lemper, 2003]. Worldwide container transport increased three times more quickly than world trade, and it is expected that growth of container transport will continue by around 7% to 10% per year.

2.1.1 Development in Europe

Freight transport within EU-25 in 2004 was estimated to about 4 billion tonne kilometres. The share of road transport was 44%, maritime transport 39%, inland waterways 3%, rail 10% and air and pipelines 4%. Sea transport and road transport are expected to continue to increase more than other modes in the future. [Eurostat, 2004]

Intermodal transport has a remarkable share in short sea shipping, inland waterway and rail transport (see Figures 6A and 6B and 7).

EU-25 Performance by mode for freight transport (1995–2004) billion tonne/kilometers

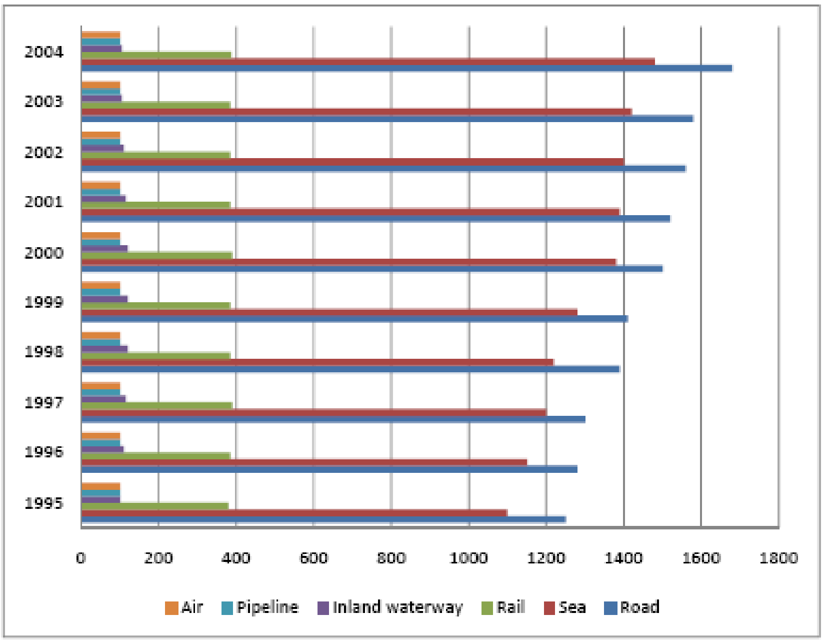


Figure 6A - The development of freight transport in EU-25, 1995 – 2004 (Eurostat)

Transport growth EU-25 Passengers, goods, GDP (1995 – 2004)

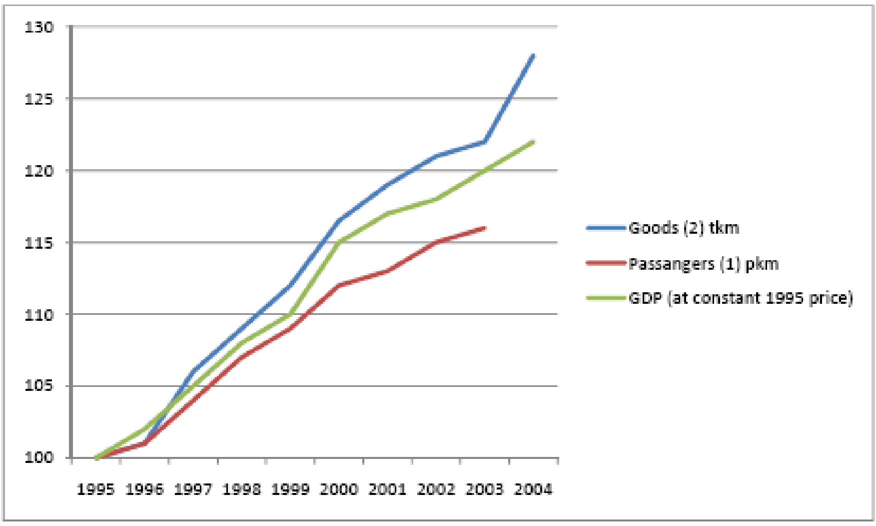


Figure 6B - The development of freight transport in EU-25 1995 – 2004 (Eurostat) (1) passenger cars, powered two-wheelers, buses & coaches, tram & metro, railways, air, sea. (2) road, sea, rail, inland waterways, pipelines, air. GDP at constant 1995 prices and exchange rates.

Table 2A: Annual growth rates EU-25. The steep increase in goods transport between 2003 and 2004 is partly due to methodological changes in the collection of freight transport statistics in some EU countries.

GDP at constant prices	1995 – 2004 p.a	2,3 %	2003 -2004	2,4 %
Passengers transport	1995 – 2003 p.a.	1,9 %	2002 - 2003	0,9 %
Reliability	1995 – 2004 p.a.	2,8 %	2003 - 2004	5,1 %

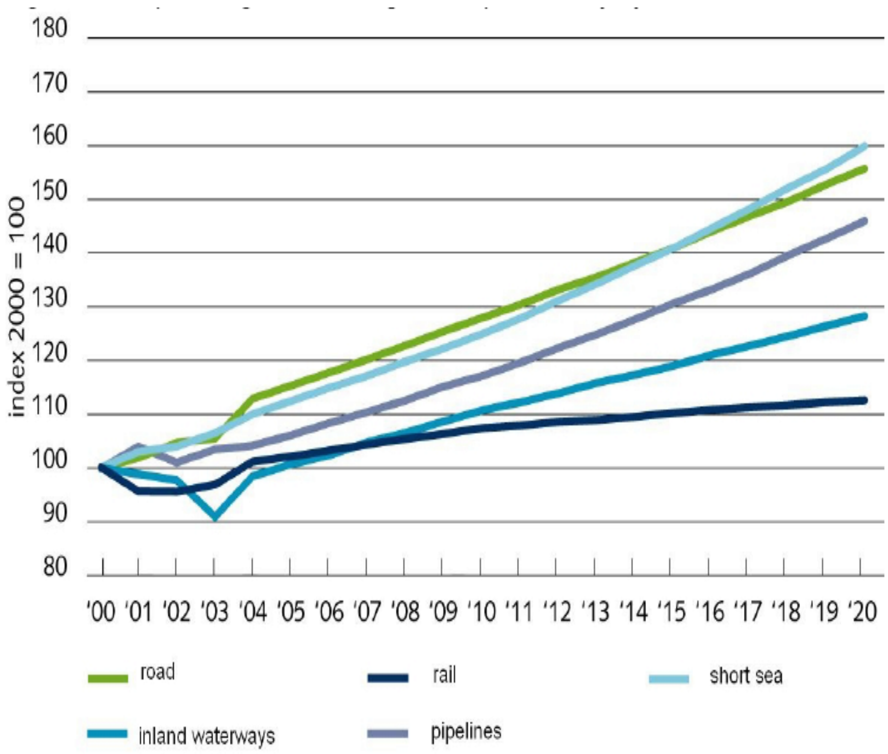


Figure 7 – Source: EC (2006). Expected growth in freight transport activity by mode in EU-25 (2000=100)

The development in intermodal transport road / rail can be seen in the following figures. Number 8 from the UIRR (International Union of Combined Rail-Road Companies) website (www.uirr.com) these represent about 50% of the intermodal rail / road transport in Europe. The growth rate is around 8% to 10% per year and therefore the same dimension as that of container shipping. And number 9 from UIC (International Union of Railways) website (www.uic.org) shows major international intermodal trade lanes involving CEE countries in 2007.

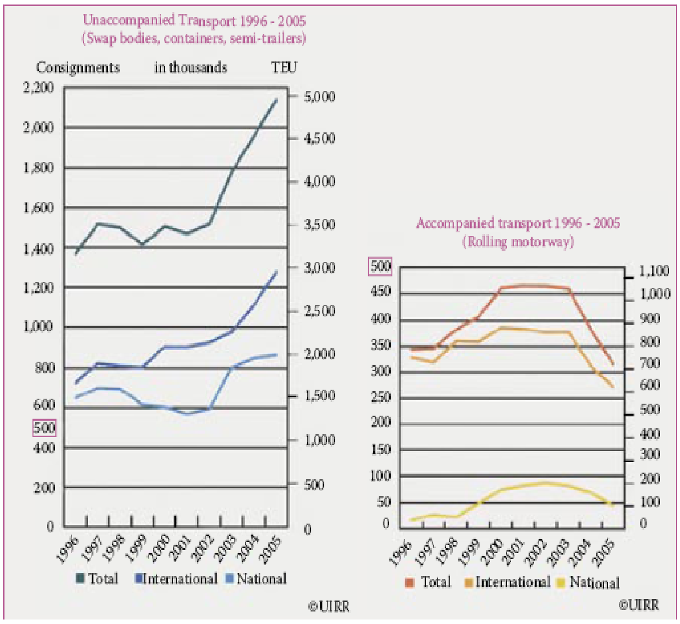


Figure 8 – Source: UIRR. Development of intermodal transport rail/road

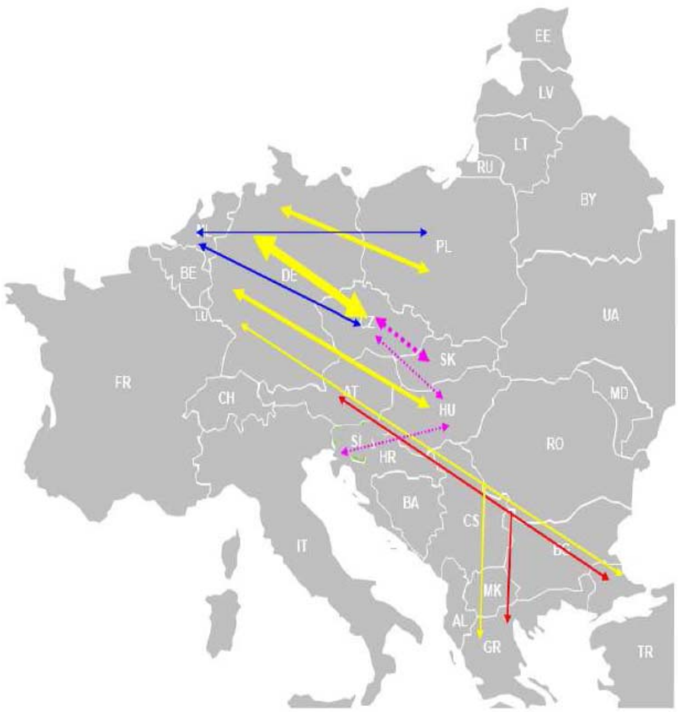


Figure 9 - Source: UIC. Report on Combined Transport in Europe 2007

The share of international traffic is about 55%, whereas national traffic accounts for around 45%. Since 2002, a strong increase in international unaccompanied transport can be observed, and since 1990 unaccompanied international transport has risen sharply, while accompanied national transport has stagnated or even decreased. The position of rolling motorway is limited because transport by this means is often politically driven and largely dependent on economic incentives from the authorities.

UIRR international traffic flows are concentrated on north-south corridors, especially transalpine corridors (UIRR, 2005). In 2005, the average distance was 796 km.

The trends in combined road-rail transport in Europe differ greatly from one country to the next, with decline today in France and Switzerland, stagnation in Austria, Spain and Belgium and growth in Germany and Italy. Italy is now the country with the second highest volume of this kind of transport in the European Union (see Figure 10).

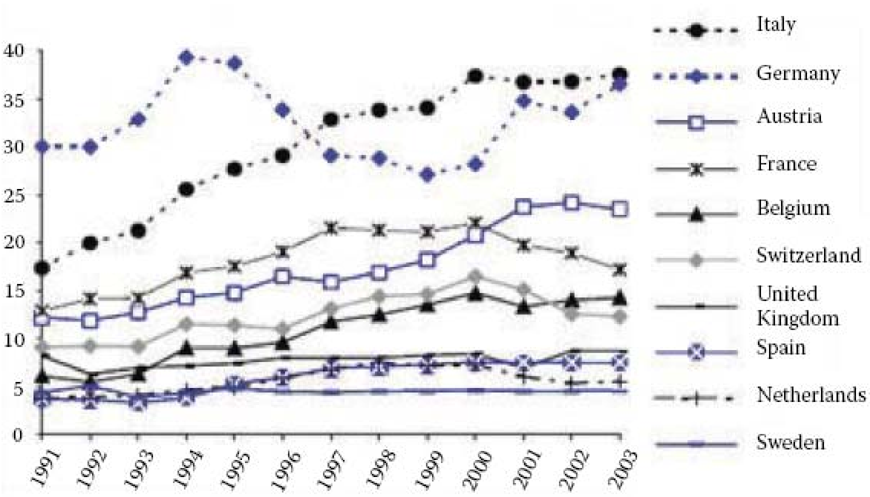


Figure 10: Combined transport traffic of major European rail networks (between 1991 and 2003) in million tonnes – UIC. Figure 10 – Source: UIC. Trends in combined rail-road transport in some European countries

Traffic volumes have increased in most countries since 2003. The most important rivers for inland waterway transport are the Rhine, rivers in north Germany, France and the Danube. The most important routes for short sea shipping are feeder transports to and from big seaports with high volumes.

2.1.2 Development in North and South America

The shares of different modes of transport in the United States (without short sea shipping) are given in Figure 11. In freight transport, rail has a much more important position in the US than in Europe.

Intermodal transport has a remarkable share in inland waterway and rail transport, especially for services to and from seaports.

In South America, mode share differs very much with country. The main mode is like that of the other continents' road with a share between 63% and 92%. The rail share is between 1% and 30%, while the inland waterway share is between 0% and 13%.

Table 2B - Share of each mode in national freight volume transported in South America (DGTPE 2005)

Country	Rail %	Road %	River %
Argentina	18	75	7
Bolivia	30	64	6
Brazil	24	63	13
Chile	3	92	Insignificant
Colombia	27	70	2
Mexico	11	85	Insignificant
Peru	1	80	8
Venezuela	1	71	Insignificant

Intermodal transport is included in the values in Table 2. The share of intermodal transport is not as high as in Europe or the United States because of the weak intermodal services and capacity. The network density of rail is lower than in the United States and Europe, but there are plans to develop intermodal hinterland connections to ports. Countries with sea access generally have a high share of short sea shipping freight transport. Because seaport traffic is increasing, it can be assumed that intermodal transport is growing faster than monomodal transport.

Figure 11 - Share of different modes in freight transport in the United States (next page. US Department of Transport, 2004)

USA Performance by mode of transport: freight
1,000 M tkm

	Road (1)	Rail	Inland waterways	Pipelines	Total
1990	1,247	1,554	516	853	4,170
1995	1,521	1,923	534	878	4,856
1996	1,564	2,011	518	904	4,997
1997	1,634	2,031	520	900	5,085
1998	1,677	2,115	521	905	5,217
1999	1,731	2,195	528	902	5,357
2000	1,756	2,258	526	842	5,383
2001	1,786	2,335	505	841	5,467
2002	1,833	2,344	507	856	5,539
2003	1,845	2,341	476	861	5,524

Source: US Department of Transport
Note: (1) intercity truck traffic only

Average annual change
% per year

	Road (1)	Rail	Inland waterways	Pipelines	Total
1990 - 95	+4.0	+4.4	+0.7	+0.6	+3.1
1995 - 00	+2.9	+3.3	-0.3	-0.8	+2.1
2001	+1.7	+3.4	-4.1	-0.2	+1.6
2002	+2.6	+0.4	+0.4	+1.7	+1.3
2003	+0.7	-0.1	-6.1	+0.7	-0.3

Modal split
%

	Road (1)	Rail	Inland waterways	Pipelines
1990	29.9	37.3	12.4	20.5
1995	31.3	39.6	11.0	18.1
1996	31.3	40.2	10.4	18.1
1997	32.1	39.9	10.2	17.7
1998	32.1	40.5	10.0	17.3
1999	32.3	41.0	9.9	16.8
2000	32.6	41.9	9.8	15.7
2001	32.7	42.7	9.2	15.4
2002	33.1	42.3	9.1	15.4
2003	33.4	42.4	8.6	15.6

2.1.3 Development in the Asia-Pacific region

The percentage modal shares of selected countries in the Asia/Pacific region are given in Table 3, but there is a lack of data for some modes.

Country	Rail %	Road %	River %	Short sea %	Air %
China	56	24	5	15	0,2
Indonesia	2	93	-	Small	4
Japan	3,9	57,5	-	38,4	0,2
Mongolia	65	35	-	-	Small
Thailand	3	93	-	-	4
Korea	18	23	59	-	-
Australia	42	28	30	-	-

Table 3 - Modal shares (in%) of selected countries in the Asia/Pacific region. Sources: DGTPE: Le développement du transport intermodal de marchandises dans les pays émergents, June 2005; OECD in figures – 2005 edition; Ministry of Land, Infrastructure and Transport, Japan.

There are big differences between modal shares resulting from quality of services and transport network and also on the degree of liberalisation in the transport sector. In developing and transition countries, the share of road transport is increasing and rail usually decreasing. In India and Bangladesh, 70% of freight transport today is by road (in Pakistan the figure reaches even 90%).

In countries with sea access, short sea shipping is important. Landlocked countries are dependent on efficient and high quality rail or inland waterway connections to sea ports. In many countries, intermodal services (except short sea) are limited.

2.1.4 Development in Africa

African rivers and lakes have always been the main means of transport, exchange, trade and development inside the continent. The best known are the Nile (and the associated lakes, the largest one being Lake Victoria), the Congo, the Zambezi, the Niger, the Senegal and the Gambia. The Congo-Oubangui-Shanga basin is used for carrying a large share of goods towards landlocked countries such as the Central African Republic or Chad. Ferries on Lake Tanganyika carry a large share of imports-exports to Burundi in a multimodal chain with rail and road transport.

Currently, the combination sea/road is used for between 75% and 90% of the freight. This model has been thriving over the past 15 years to the detriment of rail, but most of the continent’s leaders agree that this situation cannot go on and that an improvement of existing infrastructure quality, combined with a policy more balanced towards rail, is necessary for growth and sustainable development. The World Bank has also been supporting railways through financed concessioning of the main networks.

Most concessions have been included within the framework of the continent-wide NEPAD programme, either at the regional level with economic integration organisations or inside States. Over time, the programmes supported by the World Bank have covered 22 rail networks: 5 in West Africa and Nigeria, 4 in Central Africa, 5 in East Africa, 8 in Southern Africa and Madagascar.

Rail-road combined transport chains have been developed for example in the Ivory Coast for fuel transport to Mali or in Cameroon on 1,200 km by rail and 800 km by road for import-exports to Chad. The Abidjan – Ouagadougou railway, which operates the rail link of this chain, was the first African network to be concessioned in 1995.

In West Africa, too, the river-rail-road-sea intermodal concept is being developed around the Niger and Senegal basins. A global survey of navigation projects on the rivers Niger and Senegal has been carried out with the objective of extending the navigation season from 3-5 months to 10-11 months. An additional network of link canals and secondary rivers allows navigation all year long in certain sections. In the Niger basin, for instance, the central part of the river is used for navigation along 374 km from Bamako to Kouroussa, and the river Milo along 385 km from Bamako to Kankan, with connections by road and rail from both cities to the Conakry harbour. Towards the north, the Niger can be used for passenger and freight transport along 1,408 km. Three canals allow navigation throughout the year along 200 km and connections to three rivers allow navigation along an additional 275 kilometres.

2.1.5 Development in the Commonwealth of Independent States

The modal shares (in %) of selected countries in the CIS region are given in Table 4.

Country	Rail %	Road %	River %	Short sea %	Air %	Others %
Armenia	30	58	-	-	0,2	12
Kazakhstan	12	78	-	-	-	10
Russia	43	17	4	1	0,3	36
Ukraine	56	15	-	3	-	27
Uzbekistan	6	84	-	-	1	9

Table 4 - Modal shares in CIS countries. Source DGTPE: Le développement du transport intermodal de marchandises dans les pays émergents, June 2005

In many of these countries, pipeline transport (gas, oil) has an important position. Rail transport, too, can have a high share, especially in countries such as Russia and the Ukraine. In the other countries, road is the dominant mode. Intermodal transport is included in these figures.

Economic growth lies behind the increasing freight volumes in these countries. Because of increasing world trade and increasing containerisation, the freight volumes in intermodal loading units will increase too. Therefore an increasing share of intermodal transport can be expected.

2.2 KEY PROBLEMS IN INTERMODAL TRANSPORT

Although intermodal transport is growing, its share is still relatively low and the big breakthrough of intermodal transport has still to come. The main reason for this development is the inability of intermodal transport adequately to meet customer requirements in the new logistics environment that emerged during the 1990s. Road transport is often considered to be more flexible, cost effective, transparent, efficient and to provide a higher quality service. [OECD TRILOG, 2000]

The main barriers and key problems that hinder a breakthrough of intermodal transport are the following (FIAP 2003, ISIC 2005, EUTP II, PINE , PROMIT , DGTPE 2005):

- organisational barriers, i.e. too many partners involved, a lacking cooperation between involved actors, unclear responsibility and liability, etc.;
- technical barriers, i.e. missing information technologies, no door-to-door tracking and tracing, friction at transfer points, lack of standardisation (semi-trailers, certain loading units), etc.;
- infrastructural barriers, i.e. unsuitable infrastructure at terminals, different rail gauges, capacity restraints at terminals and their access roads, different rail track equipment, lack of standardisation at terminals, etc.
- operational, logistical and service-related barriers, i.e. lacking transparency in the transport chain, missing flexibility for short-term orders, priority for rail passenger transport, missing intermodal services, missing information about available services, missing awareness of possibilities of intermodal transport, problems integrating intermodal transport in logistics chains of companies, etc.;
- financial and economic barriers, i.e. high investment costs for intermodal equipment, intermodal terminals, high pre- and end-haulage costs, cost-intensive storing capacity, etc.;
- political barriers, i.e. no harmonised framework conditions for pre- and end-haulage, terminal funding, etc.

The barriers in the intermodal chain are localised and a rough assessment of their importance is indicated in Table 5.

Table 5 - Barriers for development of intermodal transport. XXX = very high importance, XX = high importance, X = low importance.

Problem areas		Main haul	Terminal	Pre- and end haulage
Organisational barriers	XXX	XX	XX	XX
Technical barriers	XX	X	XX	
Infrastructural barriers		XXX	XXX	XX
Operational, logistical and service related barriers	XXX	XX	XX	XX
Financial and economic barriers		XX	XX	XXX
Political barriers (framework condition)	X	X	XX	XX

These barriers and problems have a negative impact on the efficiency and quality of intermodal transport chains and decrease its attraction to others.

This chapter focuses on measures and alternatives that can be directly (e.g. incentives) or indirectly (e.g. measures related to road freight) influenced by public authorities. However, intermodal transport has no role to play in the general coverage of a territory especially providing the final distribution. It is a solution that is restricted to certain segments of the market and certain corridors. It has to link zones of economic activity that are sufficiently strong to generate mass transfers and sufficiently far apart that advantages of rail, river and sea transport outweigh the additional costs of terminal operations compared with door-to-door road transport.

3. ROLE OF THE PUBLIC SECTOR AND POLICIES FOR INTERMODAL TRANSPORT

This section focuses on the role of the public sector in the development of intermodal transport.

3.1 WHY SHOULD THE PUBLIC SECTOR AND ROAD AUTHORITIES PROMOTE INTERMODAL TRANSPORT?

Throughout the world, fuel prices and road congestion are increasing. Global warming, local and regional air pollution and safety problems in the road system are other strong reasons for finding alternatives to road transport. More than ever, we are in need of intelligent transport chains optimising costs, environmental impact and speediness of delivery of products in internal markets and worldwide. We are being forced to make better use of railways, canals and coastal waters for transporting freight.

Economic growth means increased traffic flows, and to cope with this the different transport modes have to be combined for an efficient and sustainable transport system to be created. In this intermodal transport, using railways, inland waterways and shipping will all take on a greater role. It is therefore important for the public sector and road authorities to promote intermodal transport. If goods can be moved from road to rail, inland waterway and sea transport, there will be better accessibility for traffic that has no alternative but to use the road.

The benefits of increased intermodal transport are considered significant and offer the promise of:

- lowering overall transportation costs by allowing each mode to be used for that portion of the trip to which it is best suited;
- increasing economic productivity and efficiency, thereby enhancing the nation’s and continent’s global competitiveness;
- reducing congestion and the burden on over-stressed infrastructure investments;
- reducing energy consumption and contributing to improved air quality and environmental conditions

3.2 POSSIBILITIES OF PUBLIC SECTOR POLICIES FOR INTERMODAL TRANSPORT

Freight transport is necessary to make the world “go around”, but it also has negative impacts. Society therefore has to establish the framework conditions needed to create a properly functioning market and reduce transport’s negative effects.

3.2.1 Internalisation of external costs

Investment in transport infrastructure is traditionally the responsibility for public authorities, while society has to encourage efficient and sustainable use of the public infrastructure. Good quality of service and reasonable costs are in the interests of economy and society. It is therefore a public responsibility to create transparent rules and equal conditions for all players in the market. Public authorities have to encourage fair competition and reduce and internalise the external costs of transport. Firms will decide for themselves the transport arrangements they make within the framework defined by society, but this presupposes consideration, in a situation of choice, not just of private cost (e.g. driving costs, driving time etc.) but also of the effects on the community as a whole. That can be achieved through economic instruments and regulatory arrangements that internalise the external effects, i.e. include the effects on others in the private cost. Given the intention of encouraging efficient utilisation of the transport system, it is the traffic volume-related external effects, i.e. the consequences of using different modes of transport, which have to be internalised. One way of doing this is by using taxes and charges to bring the price of transport into line with its socio-economic marginal costs. The marginal costs of transport are defined as the social costs caused by each additional vehicle, train or vessel. These social costs consist of the cost of maintaining the infrastructure network, congestion costs and the social cost of accidents and environmental damage. The marginal cost principle in infrastructure pricing ensures that all social cost elements are taken into account in transport decisions. According to the theory, this will bring about the optimum in efficient infrastructure use.

The heavy vehicle fee implemented in Switzerland (2001) partly internalises the external cost. The heavy vehicle fee implemented in Austria (2003) and Germany (2005) does not take into consideration external costs because the European Union regulation does not allow for this.

Earlier, a large share of the transport market was under public control. This situation has changed in many parts of the world. Liberation of the transport sector goes hand in hand with globalisation, internationalisation and harmonisation in order to avoid distortions in competition. In Europe, liberalisation reform has been more radical in the railway sector. The first step was the separation of infrastructure from transport operations. However, in some countries there are still ties between the infrastructure manager and the railway operator. Within road transport and short sea shipping, national markets have been opened up, including cabotage. National differences in pricing, however, distort competition on the international transport market. Further harmonisation is necessary to create level playing fields between countries and between different modes of transport.

3.2.2 Legislation, regulation and organisation

Most governmental transport organisations are monomodal. They therefore know a lot about rail, waterways and sea-going shipping, but are generally less knowledgeable about logistics chains, and less focused on the operational efficiency of the transport system as a whole than on modal issues. Transport administrations with established intermodal transport units, which have political authority to implement reforms, have developed more explicit and more focused intermodal transport policies than monomodal administrations, but there are very few countries with intermodal units.

Varying levels of legislative and regulatory instruments are in place, especially in Europe, to encourage intermodal activity. For example, many countries allow a higher maximum gross weight of road vehicles used in intermodal transport. In many countries there are regulations on truck transport, e.g. restrictions on truck transport at night and in specific areas. However, in several countries, vehicles in intermodal transportation are exempted from this kind of driving regulations. Users of combined transport may also be exempted from other forms of restrictions and fees.

In the Alps region in Europe (Austria, Switzerland and northern Italy) there is an extensive system of political and legislative measures to promote intermodal transport. Road transport is constrained by various means, such as limited transit licenses for non-EU vehicles, driving bans at weekends and driving bans for noisy trucks at night. Intermodal transport enjoys wide exemptions from all these limitations.

Another measure in use is the reimbursement of the Heavy Vehicle Fee for trucks used in intermodal transport.

3.2.3 Management of road infrastructure

Increased number of passenger cars and freight trucks has reduced the capacity on the road transport network. One approach dealing with limited capacity is implementation of operational measures such as truck routes, slot management and dosing, reservation and information systems. These regulations are already in operation in some countries (e.g. Germany, Switzerland). Measures such as slot management and reservation systems are still in the planning phase. It is the task of the roads authorities to manage the roads to optimal capacity. These operational measures can also lead to a modal shift, as the example of Switzerland shows.

3.2.4 Economic and financial support

In most countries, the public sector has an important role in planning and financing transport infrastructure. Roads and railways are financed primarily out of general taxation revenue, even though some roads are financed by car tolls. In shipping and seaport terminals it is common for users to pay for development of the infrastructure. An increase in governmental funds for terminals and other infrastructure for sea transport could be a measure for strengthening intermodal transport. There are several reasons for governments funding intermodal terminals:

- construction of intermodal terminals is not a highly profitable business;
- investment costs are high, and therefore difficult to bear for private companies;
- government funding could be what is needed to get private companies interested in new intermodal terminals.

Operation costs are normally paid by the users. However, in some countries there is a possibility for government funding in the starting phase of new intermodal transport services. This could be one way to reduce the great economic risk in building up a new intermodal service.

3.2.5 Interoperability and standardisation

Interoperability between the infrastructure, transport means and transport equipment is important in intermodal transport. Interoperability can be achieved by regulation and/or standardisation (private responsibility). Because standardisation is in the public interest, public authorities can support standardisation by funding standardisation projects or mandates.

3.3 INTERMODAL TRANSPORT POLICIES IN DIFFERENT CONTINENTS

Intermodal freight traffic is increasing globally. According to the World Bank, the number of intermodal containers passing through ports worldwide doubled over the last decade, with similar progressions in intermodal air traffic, intermodal rail traffic and intermodal truck traffic. Indeed, the development of intermodal transport has become a key policy priority and challenge at global level. However, policy settings and approaches differ from country to country and between the major three industrial regions EU, NAFTA (North American Free Trade Agreement) and Asia.

Although overall policy directions are similar, emphases differ:

- EU’s main concern is the environmental issue, highway congestion, and technology improvements and innovations,
- NAFTA stress global connectivity and trade, leading role of industry, market treatment of modes, and energy problem, and
- Asia’s policy aims at competitiveness, increasingly in the Asia-Pacific market, and environmental and societal needs.

In the face of growing road congestion and more stringent environmental standards, many policy makers in different countries have decided to favour modal shifts diverting trucks off the road:

- EU: move towards rail and coastal shipping (back to 1998 modal share in 2010) and move 12 billion t-km off the road every year (Marco Polo programme)
- NAFTA: funding intermodal connectors and associated facilities and developing major intermodal cargo hubs

- Asia: targeted 50 % share for rail and coastal shipping in 2010 from today’s 40% and non-road transport in city & regional logistics

In comparison, the intermodal logistics policies of the EU, NAFTA and Asia favour different policy instruments. The EU is focusing on operations and services (including subsidies) and has emphasized technology developments and innovations through its large Framework Research Programmes. NAFTA is using co-funding mechanisms to stimulate intermodal infrastructure projects, Freight Corridors, and projects of national significance with emphasis on intermodal connectors as well as tracking and security technologies including joint ITS intermodal programs. Asia’s logistics policy is a “comprehensive” package where all modes participate and contribute, setting quantitative targets and following them up.

Major logistics policy measures

EU: focusing on operations and services, incentives through subsidies and pushing technology applications and innovations.

NAFTA: infrastructure oriented, projects of national significance, co-funding approach and partnerships and technology applications.

Asia: “comprehensive, multi-modal” package within traditional modal budgets, regulatory reform measures and pushing technology applications and standardization efforts.

3.3.1 Main policies in Europe

In 2006, the European Commission presented a mid-term review of the 2001 Transport White Paper: Keep Europe moving – Sustainable mobility for our continent. The White Paper identified the main challenges: the imbalance in development of the different modes of transport, congestion on routes and in cities, as well as in airspace, and impact on the environment. Accordingly, in proposing policies for adjusting the balance between the modes, stressing the need to do away with bottlenecks in the trans-European networks (TEN) and reducing the number of road accidents, the White Paper called for an effective policy on infrastructure charging and argued that the Community should strengthen its position in international organizations. It has to be taken into account that the White Paper expected strong economic growth, which did not materialise.

Experience since 2001, as well as further studies and projections, suggests that the measures envisaged by the Commission in 2001 will not be sufficient on their own for achieving the fundamental objectives of EU policy, in particular if we have to contain the negative environmental and other effects of transport growth while facilitating mobility as the quintessential purpose of transport policy. In the enlarged EU, situated in a globalised, rapidly changing world, a broader, more flexible, transport policy toolbox is needed. Solutions may range from European regulations and their uniform application, economic instruments, soft instruments and technological integration to a geographically differentiated approach, using methods of tailor-made legislation or enhanced cooperation.

This mid-term review argues for a comprehensive, holistic approach to transport policy. Whereas future policies will continue to be based on the White Papers of 1992 and 2001, in many areas European intervention will not be sufficient. Mutually complementary action will be needed at national, regional and local levels of government as well as by citizens and industry. That is why a permanent dialogue is essential. Future actions, including the implementation of those already announced in the 2001 White Paper and not yet followed up, will be based on a broad dialogue with all the stakeholders concerned.

The overall objectives of transport policy remain the same, namely competitive, secure, safe and environmentally friendly mobility fully in line with the revised Lisbon agenda for jobs and growth and with the revised Sustainable Development Strategy. The transport policy toolbox needs to evolve to take into account the experience gained and to reflect the evolving industrial, political and international environment. Stronger international competition, but also weaker than predicted economic growth, have made the task of ensuring sustainable mobility even more challenging.

A European sustainable mobility policy therefore needs to build on a broader range of policy tools achieving shifts to more environmentally friendly modes where appropriate, especially on long distance, in urban areas and in congested corridors. At the same time, optimal use of each transport mode is paramount. All modes must become more environmentally friendly, safe and energy-efficient. Finally, co-modality, i.e. the efficient use of different modes on their own and in combination will result in optimal and sustainable utilisation of resources. This approach offers the best guarantee for achieving at one and the same time a high level of mobility and of environmental protection.

The EU will continue to support intermodal or multimodal transport, but the goal of the same modal split in 2010 as in 1998 is no longer viable. The EU expects faster growth in road and sea transport than in railway transport. However, to strengthen railway transport, the EU suggests the following actions: implementation of the rail transport acquits with the help of strong regulatory bodies in the Member States; acceleration of efforts to remove technical and operational barriers to international rail activities with the help of the rail industry and the European Railway Agency; examination of a possible programme to promote a rail freight oriented network within a broader transport logistics policy; rail market monitoring including a scoreboard.

To strengthen maritime transport, the Commission proposes the following actions: build on a broad public consultation of stakeholders to develop a comprehensive strategy for a “common European maritime space”; develop a comprehensive European ports policy; take action to reduce pollutant emissions from waterborne transport; continue to promote short sea shipping and motorways of the sea, with particular emphasis on landward connections; implement the NAIADES action plan for river transport.

The Commission draws attention to public policies enabling the optimal use and combination (“co-modality”) of different modes of transport. This may include action to remove regulatory obstacles to co-modality, to stimulate learning and the exchange of best practice throughout the EU, to promote standardisation and interoperability across modes and to invest in transhipment hubs. Adapting dimensions of containers and vehicles to meet the needs of intelligent logistics will be part of these considerations. Therefore, the Commission proposes the following actions: develop a framework strategy for freight transport logistics in Europe, followed by broad consultation and leading to an action plan.

The European Commission has given priority to the following measures to support intermodal transport:

- Marco Polo: The programme supports new intermodal services;
- Motorways of the sea: The Commission supports the development of new corridors for intermodal freight transport with sea transport at its core;

- Targeted research: EU support is targeted towards policy needs for new tools and cooperation to develop efficient intermodal transport and related logistics;
- The NAIADES programme: An action plan for promoting river transport has been set out by the Commission.

The Commission provides national governmental funds to support intermodal transport so long as the scheme is not discriminatory and does not lead to misalignment in the competition between companies.

Economic support should normally be used to cover investment costs, not operation costs. Many European countries support intermodal transport infrastructure and sometimes new intermodal services.

Trans-European Networks of Transport (TEN-T) provide the physical infrastructure for the European internal market. The full cost of the 30 TEN priority projects identified in 2004 alone is estimated at around 250 billion Euros. However, the public financing capacity of the EU member states is constrained. The available resources are limited. Therefore the EU will need to focus its co-financing from the TEN budget on the critical border crossing sections and the other main bottlenecks among the priority projects. The EU will maximise investment in trans-European infrastructure of European interest by mobilising all available sources of financing including the TEN budget, Structural and Cohesion Funds and capital market lending (including from the European Investment Bank, the European Bank for Reconstruction and Development, public-private partnerships).

The White Paper on European transport policy for 2010 emphasised the role of transport flows organisers as a developing profession **-** “freight integrators” **-** able to combine the specific strength of each mode at European and world-wide level to offer their clients the best services, in the broader sense. These organisers of international freight transport face a complex and difficult task. They must master a range of legal, technical and commercial issues in order to arrange door-to-door shipments. As announced in the White Paper, the Commission is examining ways of supporting the organizers of freight transport and intends to produce an Action Plan in the near future. The Commission has investigated the current organisation of the transport chains with all the parties concerned. Against that background, a study has been carried out aiming to research comparable concepts and develop a definition for Freight Integrators as well as indicators for their identification. The investigation revealed that more needs to be done to foster a better integration of the intermodal transport chain (ZLU et al. 2003). Based on the Freight Integrator Study, the ISIC Project (Integrated Services in the Intermodal Chain, ISIC 2005) was launched to identify measures and actions relating to liability and documentation in intermodal transport harmonisation of technical requirements relating to semi-trailers, developing indicators for benchmarking and quality label, technical standardisation, quality standards for training and certification and the potential of intermodal promotion centres.

3.3.2 Main policies in Africa

Since the middle of the 1990s, African leaders have become conscious that multimodality needs to be developed. The NEPAD initiative illustrates this awareness. Infrastructure development is placed as priority no. 3 in the global action plan, which insists on the necessity to associate the private sector with this objective. This initiative is implemented at regional level by the Regional Economic Communities (SADC , COMESA , ECOWAS , CEMAC UEMOA , SSATP , etc.). However, despite all the feasibility studies carried out and the supposed support of international financial institutions, projects are progressing only when a strong political impetus is given, especially at the national level. Kenya and Tanzania appear as examples of this determination. These countries try, as much on the national as on the regional level, to carry out and implement projects. Besides important internal management transport reforms influenced by the successful customs reform, these States are attempting to make headway on several corridors, with the support of financial backers, in a multimodal integrated approach combining rail, sea and road.

At the African continent level, the United Nations Economic Commission for Africa (UNECA) supports intermodal transport policies. NEPAD is a major stakeholder supporting intermodal transport and implementing actions and projects aimed at facing up to difficulties with Public Private Partnerships or with privatisation of services and operations.

To implement the Addis Ababa commitments concerning the United Nations international convention on multimodal transport set up in 2005, a first step was to create container dry ports in countries without coasts, first in Southern Africa, then in Western Africa. NEPAD have strongly supported these implementations despite the fact that 30 African countries out of 50 have not yet ratified this international convention.

UNECA's common objectives concerning intermodal and multimodal transport are:

- development of an integrated approach of transport taking into account all modes of transport;
- enhanced harmonisation and coordination of transport to avoid duplication
- and contradiction;
- approval and implementation of the conventions, agreements, decisions on intermodal transport approved by States;
- improvement and extension of transport networks by construction of the missing links;
- implementation of regulations allowing greater participation of the private sector;
- improvement of infrastructures and services in transit transportation corridors in countries without coasts;
- transport facilitation by removal of physical barriers;
- improvement of transportation safety and security;
- reinforcement of institutional and human resources for intermodal transport;
- development of the use of new Information and Communication Technologies
- (ICT) in transport;
- account taken of problems connected with the struggle against HIV/AIDS and STDs in transport policies.

Among numerous continental and regional initiatives that have already been taken in accordance with these UNECA intermodal transport objectives, we can quote: Transport promotion and facilitation in the different corridors by the regional economic communities and transport specialised agencies, and involvement of private partners implementing African intergovernmental decisions.

NEPAD was created in 2001 by the African Heads of State with the target of developing partnerships mobilising all the material and human wealth of the African continent. It aims at making the private sector take a major role in the development process, without removing the historical role of the State in protecting populations through an efficient economic and social progress policy. NEPAD aims at facilitating integrated development by region through commercial exchanges and important investments in the rail sector. These objectives have been implemented through four major decisions taken by NEPAD in accordance with the African “good governance” policy:

- identification of transport infrastructure needs by region;
- arbitration of investment choices in transport infrastructures (transnational,
- transregional roads and railways, funds prospecting of air and port companies at fair costs);
- support for all regional institutions on transport;
- prospecting funding to implement transport policies on infrastructure creation and modernisation.

In Western Africa, the main intergovernmental organisations are ECOWAS (15 States) and UEMOA (8 States) around a common currency, the Franc CFA, at constant parity on Euro. ECOWAS objectives concerning intermodal and multimodal transport are to create an appropriate institutional framework at the level of the Community as a whole and at the level of each Member State; to set up regulations for intermodal transport; to favour intermodal transport infrastructures and technologies such as dry ports; to support commerce facilitation and resource enhancement; to develop multimodal corridors; to set up interfaces between customs departments; to interconnect custom data-processing systems; to unify conventions, processes and documents for Inter State Transit (TIE) and Inter State Road Transport (TRIE); to harmonise construction standards. UEMOA is more focused towards road transport, but implements multimodal actions like automatic freight tracking or the creation of transport supranational companies involving several states, e.g. Transway Africa.

Similar intergovernmental organisations are leading similar intermodal policies in the other three Sub-Saharan African subregions, Central Africa, East Africa and Southern Africa.

3.3.3 Intermodal policies in Latin America

In Latin America the Initiative for Integration of Regional infrastructure of South America (IIRSA) identifies the main integration and development routes as well as their projects including intermodality. Actual achievements are however expected. The Mercosul countries have signed in 1994 an “agreement for multimodal transport promotion”. In 1996 the International agreement on South America Transport has been approved.

At the national level, intermodality is at present an active component of national transport policies in Brazil (through the four-years plan called PPA that identifies some transport projects using several transport modes). The federate states take systematically into account intermodality in their transport master plans and have a keen interest in experimentation concerning multimodal logistic terminals: establishment of terminals on suburban highways railways (still in project) in Sao Paulo, connections between the inland production areas and the ports, projects in the State of Bahia, port of Rio Grande in the State of Rio Grande do Sul. An act regulating concerning the MTO (multimodal transport operators) should facilitate investments in multimodal chains by allowing a single operator to be present at the different steps of the process without excessive bureaucracy and taxation. Around thirty operators were agreed in April 2005.

4. GOVERNMENTAL MEASURES STRENGTHENING AN INTERMODAL TRANSPORT SYSTEM

In this section, some important governmental measures taken to bolster intermodal transport are discussed, including measures at both national and international (European Union) level.

4.1 INTERMODAL TRANSPORT NETWORKS AND TRANSPORT PLANS

Governments need transport plans that include a strategy for freight and in which all relevant modes of transport are taken into account: roads, railways, inland waterways, short-sea and deep-sea shipping (included pipelines). And while most countries have a plan for road infrastructure, for railway infrastructure and perhaps one for shipping, no country has a plan for intermodal transport.

An important measure strengthening intermodal transport is when intermodal networks and infrastructure are included in national transport plans, action programmes and state budgets – plans that cover the entire transport chain and not just isolated parts of the common network. Development within business logistics and supply chain management ought to be considered when national transport plans are being drawn up. Based on political goals and on the needs of the logistics and transport industry, the necessary intermodal transport network and infrastructure have to be secured within a national transport plan. Containing the macro locations of existing and planned intermodal terminals, and also the connections with important seaports and other terminals, the plan can form the basis for funding requests, i.e. only terminals or intermodal connections (start-up funds at the beginning of the service) that are integrated within the transport plan can be funded.

The European Union has defined a trans-European transport network and given priority to 30 different infrastructure projects for road transport, railway transport and waterborne transport, as well as for intermodal terminals. Intermodal transport is supported by measures in the railway system and in sea lanes (motorways of the sea). The development of a framework strategy for freight transport logistics in Europe, followed-up with an action plan, will further strengthen the notion of intermodal transport.

National transport plans have to show how and where the government is planning transport infrastructure of national importance, and intermodal transport infrastructure is usually at least of national importance. National transport plans contain the objectives, strategies and priorities of the national transport infrastructure policy, and coordination between the modes of transport and land-use planning is integrated. Intermodal projects are also part of the transport plan, as in Switzerland for example. In some countries, regional transport plans include measures and projects that are only of regional relevance.

4.2 INTERNATIONAL AGREEMENTS ON THE DEVELOPMENT OF AN INTERMODAL NETWORK AND INFRASTRUCTURE

International agreements are also one way to strengthen intermodal transport (ISIC 2005). The European Agreement on Important International Combined Transport Lines and Related Installations (AGTC 1999, status 2005) defines a European network and also the requirements for railway infrastructure, trains, terminals and public goods stations. The following minimum requirements for efficient handling at terminals have to be met (AGTC 1999, status 2005):

- the period from the latest time of acceptance of goods to the departure of trains, and from the arrival of trains to the availability of wagons ready for the unloading of loading units shall not exceed one hour, unless the wishes of customers regarding the latest time of acceptance or disposal of goods can be complied with by other means;
- the waiting periods for road vehicles delivering or collecting loading units shall be as short as possible (20 minutes maximum);
- the terminal site shall be selected so that:
- it is easily and quickly accessible by road from the economic centres,
- it is well connected with long-distance lines within the rail network and, for transport connections with wagon-group traffic, has good access to the fast freight trains of combined transport.
- further requirements concern terminals and intermediate stations (AGTC 1999, status 2005):

- there has to be sufficient train capacity per day on feeder lines to avoid delays of trains in combined transport;
- entries and exits to and from the feeder lines shall allow the trains to filter in and out without delay. Their capacity shall be large enough to avoid delays of arriving and/or departing trains of combined transport;
- there has to be sufficient track capacity for the various types of tracks, as required for the specific work to be carried out in a station, in particular for arrival/departure tracks, train formation tracks, sorting lines and turn-out tracks, loading tracks and gauge interchange tracks;
- the above-mentioned tracks shall have loading gauges that correspond to those of the railway lines to be used (UIC B or UIC C);
- the length of track shall be sufficient to accommodate complete trains of combined transport;
- in the case of electric traction, the tracks shall be accessible by electric tractive units (at frontier stations: to electric tractive units of the connecting railway concerned);
- the capacity for transhipment, wagon group exchange and gauge interchange
- and frontier control shall guarantee that necessary stops can be made as short as possible.

These requirements cover only rail/road combined transport and not inland waterways or short-sea shipping. Twenty-six countries (including some outside the European Union, i.e.: Switzerland, Russia, Croatia, Turkey, etc.) signed this agreement, some of them with reservations. Besides infrastructure elements, service elements are included.

4.3 CONSTRUCTION, MAINTENANCE AND OPERATION TO GET BETTER ACCESSIBILITY TO THE INFRASTRUCTURE

A precondition for the provision of effective and high quality intermodal services is a sufficient infrastructure. Barriers to the development of intermodal transport are bottlenecks in the intermodal transport infrastructure. The main problems are:

- lack of capacity at inland and seaport terminals;
- unsuitable terminal infrastructure (e.g. loading tracks too short);

- lack of capacity at connections between terminals (e.g. railway system, inland waterways, etc.);
- lack of capacity at terminal access roads for pre- and end-haulage;
- insufficient interoperability and lack of standardisation of infrastructure and equipment.

Efficient transport networks and terminals are needed if these barriers are to be overcome, and therefore a focus on construction, operation and maintenance of infrastructure leading to elimination, or at least reduction, of these bottlenecks is paramount.

Strategies and measures designed to improve the intermodal transport infrastructure and operation should include (ISIC 2005, FIAP 2003, Rapp Trans/IVT 2005, Rapp Trans AG 2005):

- identification of today's and of future bottlenecks in intermodal transport networks, including identification of capacity needs and requirements;
- intermodal terminal location planning considering the most important macro and micro criteria;
- improving terminal layout and design based on common requirements and standards;
- improving road access to inland and seaport terminals;
- adaptation of priority rules in railway transport in favour of intermodal freight;
- management of intermodal transport on terminals and on the transport networks;
- benchmarking of the operation of intermodal transport chains including terminals;
- further standardisation of infrastructure, equipment and services.

It is recommended a joint effort by administrations, industry and other interested organisations to identify and solve the bottlenecks in intermodal freight transport logistics. The European Commission plans to arrange for a set of meeting places to discuss freight logistics. These so called "focal points" will be composed of industry, social partners, member states and other interested parties helping to carry out this work, but coordinated efforts are needed on a national level, too.

4.4 FINANCIAL SUPPORT FOR INTERMODAL SOLUTIONS

Financial support for intermodal transport is given in different forms throughout the world. In this section, the Marco Polo programme in the European Union is presented and best practice in government measures on a national level.

4.4.1 Funding the TEN-T network in the European Union

The trans-European transport network comprises infrastructure (roads, railways, waterways, ports, airports, navigation aids, intermodal freight terminals and product pipelines) and the services necessary for its operation (see ISIC 2005). The priority measures are:

- completion of the connections needed to facilitate transport;
- optimal efficiency of the existing infrastructure;
- achievement of the interoperability of network components;
- integration of the environmental dimension in the network.

Decision no. 1346/2001/EC amending the guidelines adopted in 1996 for seaports, inland ports and intermodal terminals was adopted by the European Parliament and Council on 22 May 2001. The text included, in the TEN-T combined transport network, intermodal terminals equipped with installations permitting trans-shipment between railways, inland waterways, shipping routes and roads (European Commission – DG TREN: Trans-European Transport Network – Implementation of the guidelines 1998 – 2001, 2004).

Expenditure on Trans-European Transport Networks has still to be determined by the European Parliament, but it is likely to be between 4 and 4,2 billion Euros. At least 55% of funds for TEN-Ts will be given to railway projects and not more than 25% to roads.

The funding possibilities of the European Union are limited to the TEN-T network and the following main rules apply:

- the European Union may only fund projects identified in the guidelines (and shown on the maps);
- the European Union will fund not more than 50% of the cost of preliminary
- studies (feasibility studies) and 20% of the cost of projects;
- the balance must be met out of public or private sector funds;

- the project must offer guaranteed financial viability and have an adequate degree of maturity;
- the project must be consistent with the Union's other policies, notably as regards the environment, competition and rules on the awarding of public contracts;
- the Commission may cancel its financing decisions if the project is not under way within 2 years.

For ports, European funding rules take into account contributions to modal shift, quality, viability and credibility and effects on competition. Five quality elements are considered:

1. quality of the port services (one-stop administrative services, service to the ship, cost-based prices);
2. quality of the hinterland connection and services – good intermodal hinterland connections between the selected ports and the rest of the TEN-T guidelines network;
3. overall information systems and monitoring in the transport chain;
4. characteristics of the shipping services involved (e.g. frequency and regularity, safety and security);
5. TEN dimension: integration of a project within overall network development.

To finance projects it will be essential to obtain the best mix of the three existing sources of funding, i.e. national budgets, the Community budget and resources generated by direct contributions from users. Co-funding with the private sector is also important (i.e. PPP).

4.4.2 The Marco Polo programme

The Marco Polo programme was adopted on 22 July 2003 with the objective of reducing road congestion and of improving environmental performance of the freight transport system within the Community and of enhancing intermodality, thereby contributing to an efficient and sustainable transport system. To achieve this objective, the programme supports actions in freight transport, logistics and other relevant markets. These actions have to contribute to maintaining the distribution of freight between the various modes of transport at 1998 levels by helping to shift the expected aggregate increase in international road freight traffic of 12 billion tons-kilometres per year to short-sea shipping, rail and inland waterways or to a combination of modes of transport in which road journeys are as short as possible.

All segments of the international freight transport market are within the scope of the programme. The first stage of the Marco Polo programme ran from 2003 to 2006, with a budget of 100 million Euros for the EU25.

Marco Polo II

On 15 July 2004 the Commission presented the COM (2004) 478 proposal establishing a second, significantly expanded, “Marco Polo” programme for 2007 onwards. Marco Polo II includes new actions, such as motorways of the sea and traffic avoidance measures. It has a budget of 740 million Euros for 2007-2013 and has been extended to countries bordering the European Union.

The general objective of the Marco Polo II programme is to reduce road congestion, enhance traffic safety and improve the environmental performance of the freight transport system within the Union, thereby contributing to an efficient and sustainable transport system. The specific objective of the Marco Polo II programme is to shift at least the expected increase in international freight transport in the period 2007-2013 off the road.

Two main ways of delivering this objective are identified: modal shift and Traffic Avoidance actions. The Marco Polo II programme defines six actions:

1. modal shift action,
2. catalyst action,
3. common learning action,
4. motorways of the sea action,
5. rail synergy action,
6. traffic avoidance action.

An overview of the relationship between the general objectives, specific objective and the six defined actions is presented below.

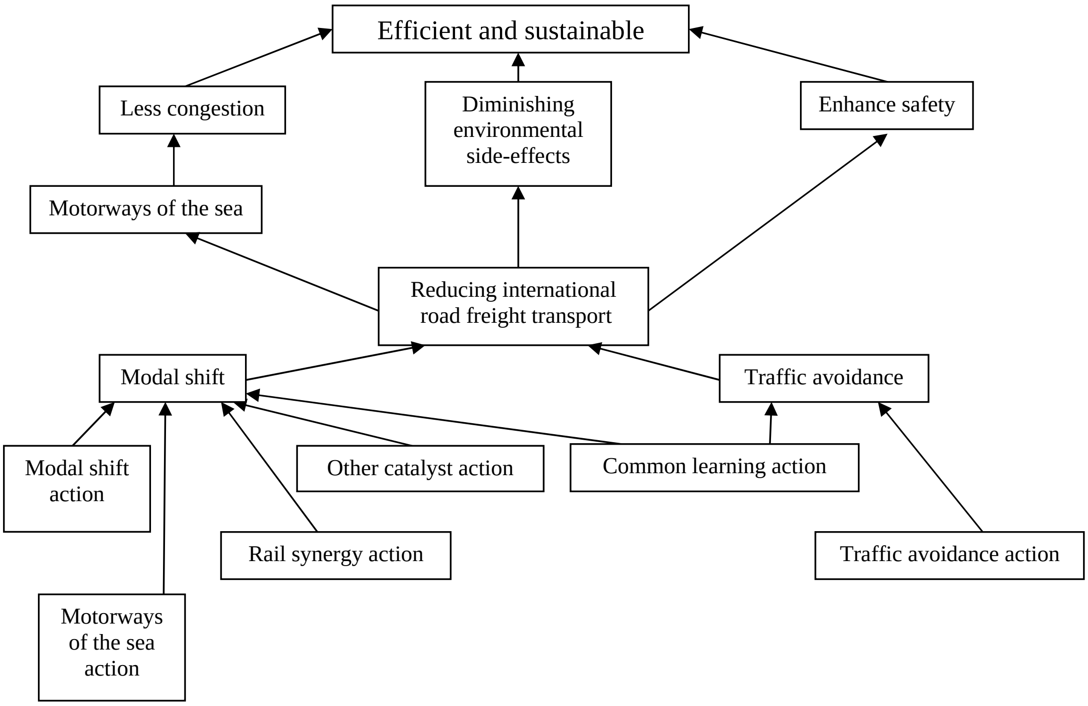


Figure 12 - Objectives for the Marc Polo programme (EU Marco Polo II, 2004)

Scope-determining aspects of Marco Polo II are:

- Marco Polo II covers the period 2007-2013;
- the main geographic scope of Marco Polo II is EU25, i.e. the current 25 European Union Member States. Additional countries can fully participate in Marco Polo II upon signing bilateral agreements;
- Marco Polo II is aimed at providing assistance in the form of risk-reducing subsidies to bottom-up logistic services. Infrastructure funding can be part of the assistance in cases where this infrastructure supports the logistic services.

4.4.3 National funding

Many countries in Europe (Austria, Belgium, Germany, Italy, The Netherlands, Switzerland, United Kingdom, etc.) fund intermodal terminals based on national regulations that are part of a strategy to support intermodal transport. The funding rules are very different because of national framework conditions (ISIC 2005), but the following conditions are common to the different funding instruments analysed:

- funding is (especially for new transport services) aimed at supporting the project at the start-up phase, after which the project should be self-sustainable;
- the project is to shift goods transportation from road to rail/waterways (the extent of the shift has to be quantified and is generally a component of the agreement).

Differences exist about:

- the kind of project/measure supported (infrastructure, equipment, operating costs, feasibility studies, etc.);
- the kind of eligible costs;
- the prerequisite for aid (any of the following criteria are considered: degree of innovation of a measure, type of goods to be shifted, environmental
- standards of vehicles, origin/destination of goods flow, effect on competition, compatibility with national political objectives, etc.);
- the amount of aid (30% to 85% of different kinds of costs);
- the period of support (3 to 5 years or unlimited);
- the controlling and enforcement mechanisms.

There is clearly a need for harmonisation and coordination of national funding systems. Intermodal operators benefit from different kinds of support depending to the land where they operate. This leads to a distortion in competition, and uncoordinated and unequal development of the intermodal traffic sector in different countries. If each country has their own system, international operators in intermodal transport will have difficulties with the complexity of funding requests and to overview the result of the different aid practices.

Funding instruments also exist at regional level, as shown by the Cantons of St. Gall and Graubünden in Switzerland and by the Italian regions Friuli-Venezia Giulia and Sicilia (construction of parking and assistance areas for road haulage vehicles, implementation and conversion of combined transport terminals, installation and upgrading of new computer systems, equipment for combined transport, etc.).

4.5 SECURITY ISSUES IN INTERMODAL TRANSPORT

Transport security has become a vital issue worldwide. The sustained threat of terrorist action has rendered transport both a target and an instrument of terrorism. Following the events of 11 September 2001, many control regimes have been implemented in aviation and maritime transport. Security rules may be extended to land transport and intermodal logistic chains. Careful consideration needs to be given to international cooperation in order to improve worldwide standards and prevent unnecessary and costly duplication of controls.

The introduction of security measures by the United States for certain imports has already had an impact on the supply chains of all continents. The European Commission has also reacted quickly on different areas to meet new security demands.

The Commission has introduced a proposal to the Council, the European Parliament, the European Economic and Social Committee and the Committee of Regions for regulation of the European Parliament and of the Council on enhancing supply chain security (SEC (2006) 251). This proposal does not cover passenger transport security, in particular in mass transport systems, which could be addressed at a later stage if necessary.

The objectives of the Commission's proposal are to:

i. increase the level of security along the supply chain without impeding the free flow of trade;
ii. establish a common framework for a systematic European approach without jeopardizing the common transport market and existing security measures;
iii. avoid unnecessary administrative procedures and burdens at European and national levels. The measure proposed by the Commission:
    - establishes a mandatory system requiring Member States to create a security ("secure operator") quality label which can be awarded to operators in the supply chain meeting European minimum security levels, thus allowing mutual recognition of the label on the internal market;
    - introduces, within the mandatory provisions for the Member States, a voluntary scheme under which operators in the supply chain increase their security performance in exchange for incentives;

- makes operators in the supply chain responsible for their security performance in European freight transport;
- allows “secure operators” to benefit from facilitations where security controls are carried out and to distinguish themselves positively from other competitors in the area of security, giving them a commercial and competitive advantage;
- allows regular updating and upgrading of security requirements, including recognised international requirements and standards, through the committee procedure.

In view of the size and complexities of the market, a voluntary, but controlled, framework for land transport supply chain security is the most appropriate course of action.

The framework would stimulate interconnectivity between the various modes of transport and operators, thereby enhancing security along the supply chain as a whole. “Fast track treatment” could stimulate national authorities into enhancing cooperation between various administrative institutions and with industry, thus reducing administrative burdens.

The framework has to be put in place and can be further developed over time in line with the assessed security risks and the level of acceptance of commercial operators. It will encourage supply chain operators to introduce new security management tools and to improve existing ones in accordance with specific minimum requirements.

4.6 STANDARDISATION: The current situation

Standards are consensus agreements between national delegations representing all the economic stakeholders concerned - suppliers, users, government regulators and other interest groups, e.g. consumers (ISIC 2005). They agree on the specifications and criteria to be applied consistently in the classification of materials, in the manufacture and supply of products, in testing and analysis, in terminology and in the provision of services. In this way, standards provide a reference framework, or a common technological language, between suppliers and their customers, a framework that facilitates trade and the transfer of technology (based on www.iso.org). In relation to transport or intermodal transport, standards aim at:

- common understanding on language and definitions related to intermodal transport;
- interoperability relating to intermodal transport infrastructure, equipment and services;
- liberalization of procurement of services and products in the intermodal transport sector;
- improving collaboration and exchange of goods in intermodal transport units;
- improving service quality over the entire intermodal chain.

Interoperability is only one (but important) reason for standardisation. Other important reasons are the improving of service quality and a common understanding of language and definitions.

Compared to regulations, standards cannot be forced to fulfilment, but the client or user of intermodal transport can claim the fulfilment of certain standards. Standardisation can generally be used as an instrument for improving efficiency and quality of terminals, coupled with quality labels or benchmarking systems. Against the background of internationalisation and globalisation of markets and the growing increase and interdependency of goods flows, standardisation in the field of freight transport is an important issue. In relation to freight and intermodal transport, standardisation is done at international (ISO), European (CEN) and national levels (national standardisation organisations). Intermodal transport is mostly international or European, seldom national transport alone. It is therefore obvious that standardisation should be established at international (ISO) and European level (CEN) and only exceptionally at national level. UIC is highly important for technical standards in rail freight transport. However, it is foreseeable that within the European Union in the future certain standards will be administered either by a ‘European Rail Authority’ or by CEN, CENELEC and ETSI.

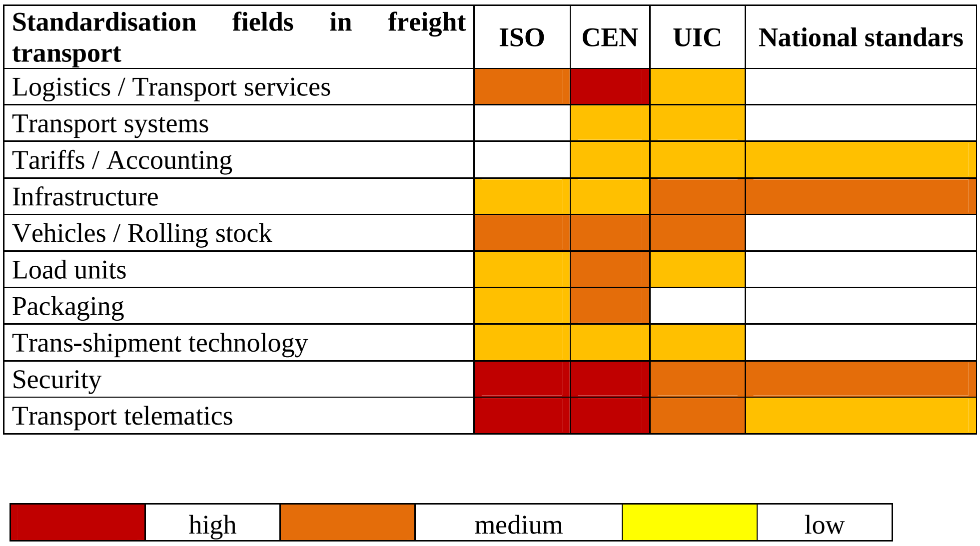
The current state of standardisation in intermodal transportation can be assessed as follows:

- standardisation is relatively advanced for vehicles, rolling stock, loading units, packing and transhipment equipment. The standards are being updated continuously;
- standardisation is still in its infancy for logistics and transport services, tariffs/accounting, transport telematics and security, but is developing rapidly in transport services and telematics;

- the standardisation of transport infrastructure is mainly a national issue today, but is becoming increasingly important on an international level (e.g. Trans-European Networks TEN). Standardisation of road infrastructure is highly advanced at the national level. Construction and operation of rail infrastructure are based on national laws and regulations, but international regulations of interoperability on the main international railway lines have also to be considered;
- today, international and European efforts for the establishment of standards for freight transport are concentrated mainly on services, transport telematics, security and the adaptation of existing standards to new developments.

The standardisation of integrated intermodal transport systems and interfaces is likely to gain importance too. Further standardisation needs in intermodal transport cover IT solutions, security, loading units, equipment, services and the planning and design of infrastructure. For example, there are already standards for intermodal terminals in Austria, and Switzerland, too, is currently developing such standards. The role of government is not simply to produce standards, but in addition financially to support the development of standards designed to overcome interoperability problems for the benefit of society. This could be done at the level of International Communities (like the European Union) and/or also at national level.

Figure 13 - Intensity of standardisation activities in the field of freight transport (Rapp Trans AG 2005)



Standardisation will reduce technical, operational and organisational barriers and contribute to a higher quality and efficiency of intermodal transport. Related to planning and the design of terminals and terminal equipment, it will also lead to a reduction in procurement costs.

4.6.1 The current standardisation work in the field of intermodal transport

The European situation in the field of loading units does not cover all needs of the trade and forms a hurdle to the further development of intermodal transport.

This is due mainly to two facts:

- the current ISO containers, as standardised in ISO 668 and 1496, do not fit into the needs of European logistics. They do not offer as much volume as comparable road vehicles and are, in consequence, not competitive against road transport. Furthermore, and even more severe, the standard pallet accommodation patterns of the ISO containers are very bad compared to those of similar size class road and rail vehicles. Thus, the ISO container is rarely used in inter European transport.

- the current swap bodies as standardised by CEN are optimised for road and rail transport only, and do not offer economic solutions of inland waterway and short sea transport. If these two modes shall be included into a truly intermodal European concept, loading units have to be designed that are stackable and that are fitted with top corner fittings for lifting by spreader. Such units can offer greatly improved transport economics for these two additional modes and contribute to a truly intermodal system in Europe with a positive effect on the overall political aim of sustainable mobility.

Therefore, building on the work of different standardisation bodies and keeping in mind the importance of technical harmonisation in the field of intermodal transport, the European Commission has launched the UTI-NORM study, in the framework of the Communication on "Intermodality and Intermodal Freight Transport in the European Union (COM (1997) 243)".

The operational conditions and design requirements of a future European loading unit that overcomes the current shortcomings by:

- offering as much interior volume for cargo accommodation as European road vehicles, and offering similar palletisation patterns, thus being fully competitive with European road transport as far as the design of the cargo carrying device is concerned,
- offering improved transport economics for inland waterway and short sea transportation while keeping full compliance with road and rail operation needs as current swap bodies.

4.6.2 Non standardised units and their role in intermodal transport

4.6.2.1 General

The early success of the ISO container created a widespread opinion in the transport world that this unit was to become the universal unit load in world-wide transport and replace all other types of unit loads such as small boxes, box pallets, flat pallets, rail containers. Box type semi-trailers and rail box cars were to be replaced by skeleton trailers or platform railcars to carry containers as superstructure.

On the other hand, the ISO container as any other world-wide standard unit was a compromise that could not fully meet all logistic systems requirements in all parts of the world.

Generally speaking, most industrial countries have a rather high salary level and an excellent infrastructure. Road vehicle drivers are costly, and the economic forces look for a solution with a road vehicle plus driver carrying as much cargo as possible to achieve low unit costs. The infrastructure allows for long and heavy vehicles - roads are wide with a strong surface and heavy duty bridges. These countries would look for vehicles and containers as big as possible.

Many developing countries will have low drivers salaries, so there is no great economic pressure for large vehicles. The infrastructure, mainly on road, is considerably poor and cannot accommodate heavy vehicles. So, these countries prefer smaller vehicles and containers. In effect, the advantages of a concept of world-wide uniformity have to compete against the disadvantages of such vehicles and containers on local markets that can be served, alternately, by tailor-made units that are optimised to the local economic conditions. Another problem of rather similar nature is generated by differing needs of the industry. While ISO standardised a general purpose container and a wide selection of special purpose containers, standardisation could not and cannot cover all logistic needs that might come up. The garbage removal companies, e. g., have meanwhile developed their own container system that is almost completely outside the standardised international and domestic container field. Such special needs will certainly remain and containers outside the standard system for such needs will be continuously developed and used.

In the end, the idea of a world-wide uniform transport systems clashed against the reality of local economies, and the ISO container was partly replaced by various local developments with more or less deviations from the basic principles laid down in ISO 668, ISO 1496 and ISO 6346.

4.6.2.2 The European domestic container – rail

The development of a European domestic container demonstrates how cautious the economic driving forces had been in their way to leave the ISO development and to migrate towards their own local optimisation.

In the 1960s, European railways looked at the container mainly as a means to establish door-to-door offers for clients without private rail siding. Another attitude was brought forward by British Rail: They dropped the idea to modernise their over-aged railcar fleet for the markets of today, and they decided to organise a new operational concept for the day after tomorrow: They replaced the single wagon load traffic operated by conventional box cars by a system of dedicated trains connecting road-rail transfer terminals. The cargo was carried in containers of 8 ft exterior width (according to the British legislation on road vehicles maximum width at that time). These containers did by far not show the strength features fixed in ISO 1496 because they were not intended for sea transport in stack. This service was called Freightliner. The ISO container could easily fit into the Freightliner system, and Freightliner took over the inland rail transport of ISO containers as far as rail could offer competitive services for the relatively short distances between the British ports and the industrial hinterland.

Some years later, Spanish rail copied the system and introduced the TECO Service. At that time, Spanish road transport legislation allowed for a vehicle and container width of 2 500 mm, but the TECO service was so dedicated to the ISO container and Freightliner container models that they introduced containers with only 8 ft. (= 2 438 mm) width.

In a similar way, the European railways co-operating in UIC elaborated a specific rail container standard for a unit called T container (T standing for terrestre). This container had all outside dimensions of ISO 668 containers, but only very limited strength, having only such strength features that were needed in rail and road operation and in inland terminal transfer.

This first step to leave the dimensional concept of ISO containers when creating a European container was taken by Deutsche Bundesbahn (DB - German Rail) which dared to make the large step to dimensional variation and conceived the Binnen-Container with a width of 2500 mm, the low strength values of the UIC T container, and the modular length concept of ISO 668. The top corner fittings remain at the top corners of the box but they are located a bit inside to accommodate the twist locks at the same width as ISO containers so that all spreaders which can handle ISO containers easily can lift these Binnen-Container as well. This box was standardised in Germany as DIN 15 190. This container design was rather successful, but road transport on the Continent continued to offer larger boxes. To meet this competition, rail took finally over some features of the concept developed with swap body standardisation and designed the Htg 7, a domestic container with 2 500 mm width and 7 150 mm length.

Looking back into this development, this leaving of the ISO concept one step after the other, needs some explanations, mainly on the questions:

- Why did European Railways develop a *weak* container , when it is well known that the tare weight savings and the cost savings in manufacturing of such a weak unit are - compared to those of an ISO container - minimal, but the infringements in international operation was severe?
- When the German rail expert decided to abandon the ISO width concept to gain more cubic space, why did they not abandon the ISO length concept as well to generate even more additional cubic space?

The main reason for the design of a weak container was created through the necessity of a side door. A large part of road-rail container operation was moved in transport chains departing from a private siding, where the rail container was loaded when mounted on a railcar. The container went through the container train network to a road/rail terminal in the delivery area with final delivery over the road. So, the container was presented on the one side for loading through a rail ramp, on the other side through a road ramp. The roadside ramps offered easy access to the container mounted on a road chassis through its end door. But on a classical rail ramp, loading through the end door was a most cumbersome process needing a complicated arrangement of transfer bridges - all of them must be capable to be used safely by a 5 t fork lift truck - and a direction change of the fork lift driving into the railcar. It was much more practicable to offer a container with a side opening and direct access from the side ramp. At best, the container should offer free access over the whole side.

This motivated railways to design containers with side doors. But in such a case the strength values of ISO 1496 matter greatly. It is quite easy and state of the art to design a container with full ISO 1496 strength features as long as this container has a full bearing side wall made from corrugated steel panels. But once such a side wall is left open and only covered by a curtain, the problem of racking and stacking under high forces becomes difficult to be solved. Difficult means in practical life: more expensive and less payload. So, railways preferred to go the less strength way and to design weak containers with side door openings.

The length question followed as well specific rail transport related considerations. The main market for European railways in container transport had been always the hinterland transport of sea borne ISO containers. So, railways organised their fleet of platform railcars accordingly (see figure 14):

- 2 axle railcar 40 ft. loading length,
- 2 bogies railcar 40 ft. loading length,
- 2 bogies railcar 60 ft. loading length.

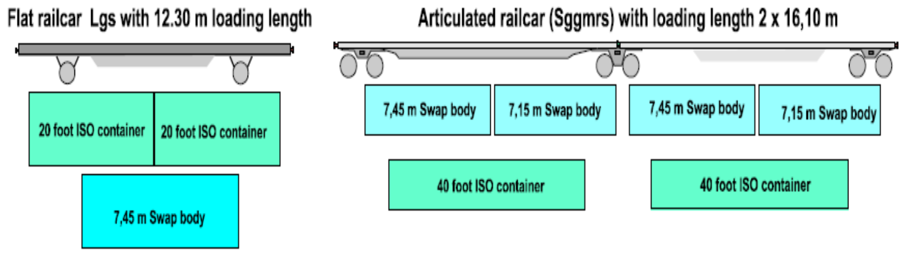


Figure 14 – Flatcar and articulated railcar are designed to transport oversize goods and cargo that must be loaded from the side or top (http://www.worldtraderef.com/WTR_site/Rail_Cars/Guide_to_Rail_Cars.asp)

This railcar fleet was initially built with loading lengths according to the ISO length module. Any longer box would disturb this system. Later, when 7 150 mm swap bodies came in large numbers into combined transport, other rail-car types were designed (such as the current 2 x 18 m loading length articulated car), and a rail transport offer for longer units was made easier. Today, the main owners and operator of domestic rail containers (other than European swap bodies) are:

- DB Cargo AG, Germany,
- DSB, Denmark,
- ÖBB, Austria,
- Freightliner Ltd., Great Britain,
- CNC Transports, France.

4.6.2.3 The European domestic container – road

Road transport followed the line of local container development with even more consequence and changed both, the width and the length to allow for a maximum of cubic space (see figure 15). The length concept followed a calculation as follows:

allowed road train length	18 000 mm
- truck-trailer coupling device	1 200 mm
- driver’ s cabin incl. berth	2 500 mm
= load space length	14 300 mm

This 14 300 mm available length could be divided

either in 6 100 mm + 8 200 mm, or in 7 150 mm + 7 150 mm.

The first concept was near to the classic German road train with a 2 axle truck (with a 6,1 m loading length) + a 3 axle trailer (with a 8,2 m loading length). Soon it became evident that the system 7 150 mm + 7 150 mm was more practicable because the swap bodies of similar length could be easily exchanged between truck and trailer. In the end, the concept of 2 swap bodies of similar length was standardised in Germany and later in Europe.

The swap body is today moving some 65 % of all European intermodal volume. This success story has two main reasons. The swap body was the first domestic container that appeared at the shipper’s ramp with all features of a common road vehicle. Since road transport is the overwhelming market leader in European freight transport, most logistic systems are designed to meet the basic conditions offered by road transport.

Any other transport system would have to overcome this hurdle, i.e. its promoters must request at the shipper’s freight department to install special equipment and organisation to meet the new systems requirements - a task that is, as any experience tells, most difficult. Very often the shipper will tell that he is not even willing to consider a change in his shipping organisation just because the service provider requests it.

The swap body had not to overcome this hurdle: A road train equipped with swap bodies appears at the shipper’s ramp in the same manner and shape as a conventional road train - there is nothing specific to be prepared for or organized. This does not only relate to the physic interface at the ramp. The swap body is a transport unit offered by road operators - the most successful cargo carriers in the last decades.

These enterprises could rely on well established business relations between shipper and the transport economy, and they integrated the swap body into their successful strategy to conquer the freight markets. The second feature that contributed to the success of the swap body system has been the inherent advantages of this engine: The swap body, when used with road trains, is a very useful instrument to promote efficiency in road operation, alone by the possibility to exchange the swap body easily between various road vehicles. The freight motor industry offered, together with the swap body system, the air suspension for truck and trailer.

The air suspension is somewhat more expensive, but it contributes to a smooth run of the road vehicle and its cargo. Most important, it enables a simple swap body exchange without the need for lifting devices or additional personal to serve it. The driver can remove the swap body by a simple operation: He unfolds the standing legs of the swap body until they touch ground. Then he unlocks the twist locks that have fixed the swap body on the chassis. Now he can release air pressure out of the air suspension system: The road chassis will lower some centi-metres and now it is free to drive alone, leaving the swap body free standing on its legs.

The take-over of a swap body goes similarly easy: The driver lowers the chassis by its air suspension and manoeuvres it under a swap body standing free on its legs. This operation is facilitated by a guidance tunnel in the bottom construction of the swap body that guides the truck and swap body assembly into the exact position.

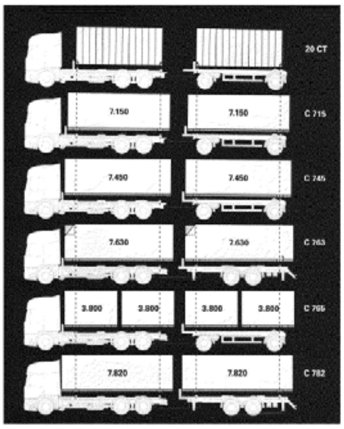


Figure 15 – Chassis and standard swap

When the swap body standardisation was completed, many operators changed to the system chassis + standard swap body and were able to exchange such units freely within their fleet and between partners. This grants, even in pure road operation, a wide set of organisational advantages:

- If the shipper needs more time for loading and discharging at the ramp, the road operator can leave the swap body on its standing legs at the ramp of the shipper while the vehicle and its driver is available for other activities.
- Swap bodies enable the establishment of a relay system: On a north to south run, the driver stops at an intermediate place to meet his colleague who drives, in the same night, the south to north run. They exchange their set of swap bodies and return to their home base. So, each driver will be at home after his shift, driving all the way with the motor vehicle he is responsible for. Drivers welcome this working scheme, and the operator saves costs for overnight stay of drivers
- Swap bodies can easily be exchanged between long distance operation and local pick-up and delivery. In less than truck load business, the forwarder can set the swap body on a truck to pick up some consignments. Then the swap body will be set down on its legs at one specific ramp position of the forwarders cargo assembly centre. Some additional consignments will be loaded into the swap body, and when the swap body is completely loaded it will be taken over by a long distance road vehicle or by combined transport for the main course. Local deliveries in the arrival area can be organised in a similar manner.

- Swap bodies will facilitate downtown delivery. Many downtown areas do not permit access to large road vehicles and to road trains. So, the driver can uncouple the trailer with the second swap body at a freight station in the outside area of the town and deliver, this time as a single truck, the first swap body at its destination. Afterwards he returns, picks up the second swap body, and drives again downtown for the second delivery.

The various combinations and separations that the swap body system granted to road operation led to a development that, in the end, the vast majority of road operators in Central Europe, when purchasing a road train, ordered it in the version „swap body + chassis“ - even if it was slightly more expensive than a rigid truck + rigid box trailer. The savings that could be achieved through the increased flexibility would easily offset the additional purchase costs of the swap body system.

So, the road transport industry, without needing any additional incentive, equipped its fleet with standard swap bodies, even if they never intended to participate in combined transport. But they were fully equipped for such a change at the very moment when the intermodal carriers would offer them interesting line haul services.

This history of swap bodies as the most successful domestic containers in Europe is limited to class C swap bodies , i.e. the 7 + m long type that normally is carried by road trains. The road carriers that have based their operations on semi-trailers hesitate to alter their transport system into a combination „platform trailer + swap body“. This is caused by the reason that the combination truck + semi-trailer offers practically the same flexibility as the swap body for road train: the separation of the costly motor engine part and driver from the cheap cargo carrying device. A further separation of the semi-trailer into a platform chassis and swap body does by far not generate the same amount of additional flexibility as the separation of road trains into chassis and swap bodies. Furthermore, the class A swap body (see figure 16A), i. e. the 13,6 m long box for semi-trailer, cannot be that easily exchanged as the class C swap body because the long and heavy unit cannot be set on standing legs for interchange. All interchanges between one chassis and another (road/road) and all intermdoal interchange operations (e. g. road/rail) need a lifting device with some 34 t lifting capacity. So, there is practically no incentive to overcome the additional investment costs and the potential loss of payload when separating the road vehicle in platform chassis + class A swap body.

In the end the European road vehicle market shows a clear segmentation:

- Many long distance carriers prefer truck and semi-trailer combinations and remain outside combined transport .
- Other operators, mainly those in the less than truck load business, prefer road trains, and very often purchase these road trains as a combination platform truck + platform trailer + 2 class C swap bodies. Most of these swap bodies are operated in road transport only.
- Some forwarders operating into countries with clear dominance of semi-trailer in road transport have purchased class A swap bodies and hire local drayage capacity from carriers that own platform chassis. These class A swap bodies are mainly operated in combined transport.

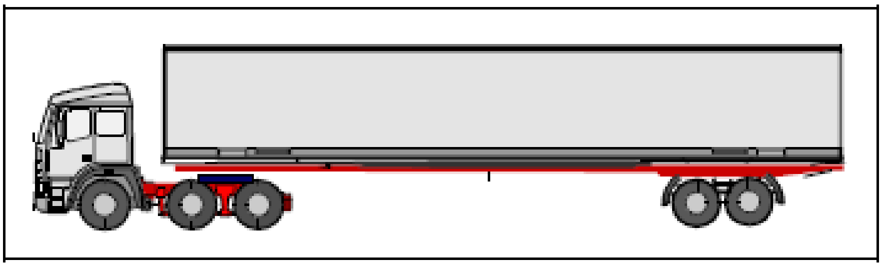


Figure 16A – Class A swap body (http://www.edimobilesystems.ee)

4.6.2.4 Units used in European short sea transports

European short sea carriers are faced with a widespread variety of units offered to them by road transport companies and forwarders. The main types of units are:

- semi-trailers with a length up to 13 600 mm,
- swap bodies according to European standards, Class A and mainly Class C,
- ISO containers, mainly 40 ft. and 20 ft., mostly in on-carriage after or before a deep sea carriage,
- European containers of any shape and almost any size.

These European containers come in width of:

- 2 500 mm side walls width, but corner posts at 2438 mm to offer palletisation and to comply with ISO containers,
- 2550 mm to make full use of European road vehicle width allowed,
- 2600 mm with temperature isolation.

A similar variation exists in lengths offered. The main sizes in current use are:

- 6,1 m and 12,2 m (20 ft. and 40 ft.) as main ISO sizes,
- 7150 mm and 7450 mm and 7820 mm for standard swap bodies class C,
- 13 600 mm for larger boxes to fit on semi-trailer chassis,
- 13 720 mm (45 ft.) to meet some individual carriers systems.

Finally the strength features will vary as well. Standard swap bodies and ISO containers have well known strength features as given in the relevant standards EN 283 and ISO 1496. The other boxes may be built for stacking or not, and the overstacking capability may vary.

This wide variety creates some problems in operational safety. Normally, Ro-Ro carriers have to make certain which exact type of unit with which strength values they are confronted with before organising the transfer on board ship and the lashing.

The most interesting compromise between ISO container dimensions and the need for better palettisation patterns has been approached with special containers designed for the trade between Ireland, Great Britain and the European Continent. The first design had been realised by Bell Lines, a short sea carrier operating in these markets. These containers had an outside width of 2 500 mm and offered an inside width of 2 440 mm. They were carried on specific short sea ships of cellular type. The cell guides of these ships were laid out to carry either these containers or ISO containers. The inside width of 2 440 mm needs some additional consideration. As already pointed out in chapter 1.4.3, the European logistic service providers asked for an inside width of vehicles of 2460-2480 mm and argued that 2440 mm was not sufficient. On the other hand, the operators of these pallet wide containers with 2440 mm width inside reported that their clients had no difficulties to accommodate palletised cargo in theses boxes. Some experts even say that any width beyond 2440 mm inside could be detrimental to sea transport because it offers too much room for slippage and creates the need for additional load securing [Wolfram Bläsius: Neue palettenbreite Seecontainer für die EU-weite Küstenschiffahrt, in: Der Containerverkehr, Frankfurt am Main/Neu-Isenburg, JAN/FEB 1999, p.7].

These containers need rather wide cells, with other words a cellular ship for ISO containers with rather generous tolerances in the cell guides. A new design for pallet wide containers has been meanwhile offered, the SeaCell container. This container has specific corrugation in the side walls that makes it fit even in more narrow cell guides.

Finally, the North Sea operator Geest Lines introduced a pallet wide container with 2500 outside width and 45 ft. (13 720 mm) outside length.

All these developments try to find a compromise between the need to compete with European road transport (or to offer optimised short sea crossing for European road vehicles) under the basic condition that the logistic service providers ask today for maximum cube and palletisation patterns, and the need to use ships that have been designed to carry ISO containers.

4.6.2.5 Small and medium size containers

As already reported earlier, small and medium size containers dominated the discussion in the period before the ISO containers came into operation. The United Nations Economic Commission for Europe made a clear set of definitions for containers of various sizes that shall be used in this report as well:

- small containers: freight containers with an internal volume of 1 cubic metre until 3 cubic metres,
- medium containers : freight containers with an internal volume of more than 3 cubic metres, but an exterior length of less than 6 m (20 ft.),
- large containers : freight containers with an exterior length of 6 m (20 ft.) and more.

In the field of small containers the railway owned A-, B-, C-containers dominate: Boxes equipped with small wheels to carry consumer goods from factory into railcar, from railcar into downtown delivery truck, and then into the department store to become unpacked there. They had been used mainly for glassware, china ware, toys and similar consumer goods.

In the field of medium containers the European railways had various designs of containers with a loading capacity of 5 - 10 cubic metres. Central and West European railways had designed the „pa container“ for easy interchange between railcar and road vehicle. This type of container needed very specialised equipment on road and rail and was mainly used in the 1950s and 1960s to carry small bulk consignments.

Some of these containers had been especially designed to be carried intermodally on transport chains road-rail-deep sea. The containers are practically out of service today.

A very comprehensive report on all these historic developments in the field of small and medium size containers had been elaborated and finalised by the United Nations Economic Commission for Europe in 1967, published as Document W/Trans/WP 24/94 and Add.1; a German language version had been published in Rationeller Transport [Frankfurt am Main] No. 06/1967, p. 189...245.

Russian Rail was reported to operate large numbers of medium size containers, specially designed for road-rail operation in the Soviet-Union. No clear information is available whether these containers continue to be in service and which economic role they play in the East European transport system.

ISO standardised in ISO 668 a medium size container of 10 ft. (3,05 m) length with 8 x 8 ft. diameter. Some of these boxes had been built and operated. When the air cargo industry made some experiments with air / surface intermodal containers of ISO dimensions, they built a small number of 10 ft. containers. This type never gained any importance.

Since 1995, a new discussion about medium size containers had started from two ends:

- Railways planned to consolidate their small consignment business (which created high deficits) and discussed to use medium size containers that could possibly be integrated into existing combined transport systems.
- Freight forwarders active in the consolidation business tested medium size containers, modular fitting into their swap body transport system, for better separation of consolidated consignments.

A specific consideration was to use such systems for downtown and supermarket delivery. Such deliveries might easily combine items of various temperature control needs such as

- ice cream and deep frozen products at -15º- 20ºC,
- refrigerated products (milk, fresh cheese, meat products) at +5º - 10º C,
- normal products at outside temperature.

The basic idea was to pack these items in separate containers each of them with a specific temperature regime and to carry all of them with one delivery turn to the retail shop.

Most systems of medium size containers are modular designed:

- either bottom-up as a multiple of pallet loads,
- or top-down as a cut of standard swap bodies, either 1 swap body of 7650 mm length cut into 2 units of 3800 mm length each, or in 3 units of 2538 mm length each, offering inside 2400 mm clearance for palletisation.

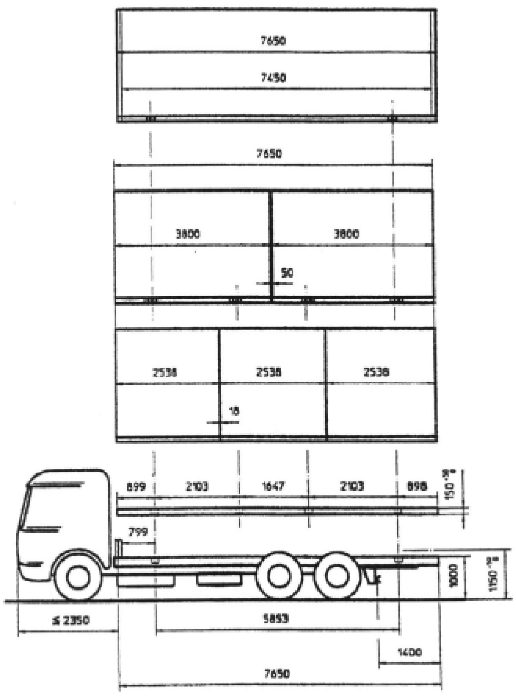


Figure 16B – Container modular design (http://www.edimobilesystems.ee)

The top down approach led to one half or one third swap body design, i. e. boxes of 2550 mm width and lengths of 2500 mm or 3710 mm or 3900 mm.

Deutsche Bahn (German Rail) introduced for their less than car load freight traffic a new organisational approach and based this on new medium size containers of 2500 x 2500 mm. The basic idea was:

- such a container can be loaded lengthways of transverse on a load carrier,

- this container can take over 6 pallets of 800 x 1200 mm,
- 6 of such containers can be carried on a road train with a loading length of 7500 + 7500 mm.

Discussions were conducted how such containers could be introduced into current German and European intermodal transport systems. One idea aimed at an intermediate frame to accommodate 3 of these medium containers. The terminal would have to lift only the frame, and so in one move to transfer 3 containers. Or some special railcars would have to be equipped with additional fittings to accommodate these containers without intermediate frame. In the end, both ideas were rejected: The intermediate frame was regarded as too costly and to complicated to manage, especially in intermodal transport terminals which are anyway often overcrowded and have management problems. The transfer of these containers one by one from road vehicle to railcar would involve prohibitive costs: An efficient well organised terminal charges today per transfer some 17 Euro to the client. A six-pack of such small containers to be transferred between a road train and a railcar would involve costs of more than 100 Euro at both ends - this is an amount that allows to buy in road carriage for a considerable distance, possibly up to 300 km. In the end, these boxes did not appear in intermodal transport.

Eliminado:

The line of development that starts with pallet based small containers has culminated in a work on European standard on „Small load carrier system“. Three parts of such a standard are envisaged:

- Small Load Carrier Systems - Part 1: Requirement and test methods
- Small Load Carrier Systems - Part 2: Column stackable systems (CSS) Small Load Carrier Systems - Part 3: Bonded stackable systems (BSS)

A rather similar consideration on a family of intermediate containers is generated by a Dutch team that has lately elaborated a report on loading units. [TRAIL and RUPS: „Continental Loading units for intermodal transport“, Schiedam, August 1998.]

They go the same way as CEN TC 261 Packaging and look for a series of small load carriers to avoid packaging waste, going up from there to a series of boxes that make multiple of the main European pallets and keep within the framework offered by European road vehicle sizes. The main boxes suggested in this study are as follows:

- Pallet box with external dimensions of 1220 x 820 x 1020 mm (length x width x height) that accommodates practically one pallet load, bringing the same patterns as the box pallet;
- Tribox box with external dimensions of 2550 x 1280 x 1350 mm (l x w x h) that accommodates two 1200 x 1200 square pallets or smaller units, limited in loading height;
- Urban box with external dimensions of 2550 x 2150 x 2150 mm (l x w x h) that accommodates 4 pallets 1000 x 1200 mm or double of it in two layers when each pallet load does not exceed 1000 mm height;
- Midbox with external dimensions of 2550 x 4300 x 2900 mm (l x w x h) that represents practically a European standard swap body of 7820 mm length with extra height cut in two half pieces.

The European Union has in 1998 started a COST action to study technical and commercial aspects of medium size containers in Europe, COST 339. The results will be available after the termination on this report on European loading unit standardisation needs and should be, when available at a later stage, attached to this report.

4.6.2.6 Semi-trailers in combined transport

a) Semi-trailers in combined transport road/rail

The semi-trailer had been the first large unit load to be carried in combined transport road / rail, in North America and in Europe.

Europe had from the start many difficulties to achieve a combined transport of a similar technique, because practically no European rail network has a gauge that allows a full height trailer to be carried on a normal height platform car.

Another problem aggravated the situation: As each network has another gauge - and as some differences are rather severe - , there was no opportunity for an initiative to develop a joint strategy to overcome such a problem.

The most infringed networks are in Great Britain, France, Italy (mainly Central and South). Great Britain decided to go the way of box traffic and developed the Freightliner system. France and Italy developed special type semi-trailer with infringed roof construction and special wheel arrangements to lower the added height of semi-trailer and flat car. The main problem was that all these solutions were based on a special design semi- trailer, while the great fleet of standard design semi-trailers never had a chance to enter intermodal transport.

The railways with a more generous gauge profile, mainly in Central Europe and in Scandinavia, tried to design rail-cars that could accommodate full height semi-trailers. The problem was that a standard semi-trailer had to be driven onto the rail-car assembly via a circus ramp and then to be driven over all platform towards the end of the train. But the specific place on the flat car that took over the semi-trailer wheel assembly had to be lower than the general platform to allow full semi-trailer height within the gauge line. One design in Germany was the Wippenwagen. On this special rail-car, the part of the platform on which the wheel aggregate of the semi- trailer rested was lowered down after loading. This decreased the general height of the unit and contributed to the fixing of the semi-trailer on the rail-car. In the 1980s this technique was given up because the loading and discharge process was too time-consuming and too costly.

Another design foresees a pocket in the platform of the flat car between its axles. The pocket is situated between the bogies of the flat car and can thus be considerably lower than the platform height of the car. This type of rail- car (pocket wagon, wagon poche, Taschenwagen) is today very popular in European intermodal transport because it can carry semi-trailer or swap body or containers alike.

The main problem of this technique is the fact that the semi-trailer must be vertically transferred on the pocket wagon, i. e. the semi-trailer must be prepared for lifting. This needs some minor reinforcements mainly in the longitudinal bearing member and slightly increases the price and the tare weight of the semi-trailer. In consequence, most operators prefer the cheaper version without lifting capability.

Major German producers estimate that some 98 % of all semi-trailer produced are light design without lifting capability and only 2 % can be lifted. This relation limits the market potential of combined transport in Europe considerably.

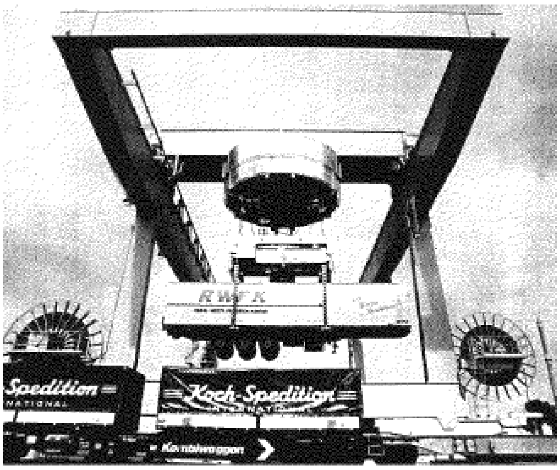


Figure 17 – Semi trailer prepared for lifting during the handling process in the grappler arms of a spreader (http://www.liebherr.com)

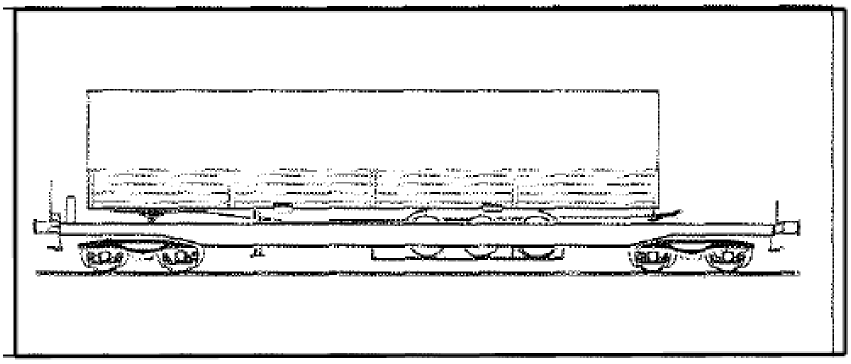


Figure 18 – Semi trailer at a pocket wagon (http://www.ekk-wagon.pl)

Another problem was removed quickly: the preparation of lifting facilities for semi-trailer transfer. Most container cranes in the inland terminals in Europe could be easily equipped additionally with grappler arms and a lifting mass capability to lift a semi-trailer with 33 t from the ground into a pocket wagon.

The other serious problem remains: The networks of France and Italy and the Alps transit lines cannot accommodate the assembly of a full height semi-trailer on a pocket wagon. Swiss Rail has announced that from the year 2000 onward the Loetschberg - Simplon transit route will be capable to accommodate full height semi- trailers on pocket wagons, but all other parts of the mentioned networks do not. This limitation becomes grave in these days because more and more lightweight cargo comes into the transportation market, and the road operators generally tend to order semi-trailer with maximum cubic capacity, i.e. with full height. These units cannot be carried intermodally in Great Britain, France, Italy ... - whatever rail-car design is realised.

Currently, some 30 % of all UIRR combined transport movements are executed by semi-trailers on pocket wagons (see figure 18).

b) Semi-trailer in roll on/roll off - transport

While the carriage of the semi-trailers in intermodal transport road/rail decreased in market share in Europe, the semi-trailer became the most important unit load on short sea crossings, mainly between Great Britain and the Continent and Scandinavia and Central Europe.

Until the 1950/1960s, the main method of short sea crossings had been the unloading of road and rail vehicles in the port, loading the cargo on board ship, sea crossing, and to re-loaded into road or rail vehicles in the destination port.

A limited amount of intermodal transport existed: Some short sea crossings were served by special ferry boats that were equipped with rails on the main deck. In the port, the railcars had been shunted into these ferry boats, and in the arrival port the rail-cars entered the other rail network. Most of these ferries had been owned and operated by the railways.

Since 1968, ISO containers had been added to this market, mainly between Great Britain and the Continent. Some short sea carriers specialised in that type of business and operate small ships of cellular type. The load and discharge operation is performed by lift on/lift off technique. The short sea lines operating this trade have partly introduced special non-ISO containers.

Some other containers of non-ISO design are used, in addition to semi- trailer based roll-on / roll off traffic, between the South Europe mainland and some islands in the Mediterranean Sea.

But the semi-trailer became the main means of short sea crossings in Europe. Currently, the roll on / roll off- traffic with semi-trailers is the most important means in Europe. The rail equipped ferry boat has widely disappeared. Only some Scandinavian trades continue to use this method.

Safety of short sea roll on/roll off operation became an issue of standardisation. So, a standard was elaborated covering the fixing devices attached to road vehicles that are designed to be used in roll on/roll off transport. This standard fixes the localisation and the strength of such fixing points. This standard has been agreed on in ISO, CEN, and national standardisation associations with similar wording. Road vehicles operating in short sea shipping in roll on/roll off transport are not mandatory required to be equipped with features according to the standard. But fixing and lashing of such vehicles on board ship is greatly facilitated if features according to this standard are included in the road vehicle design:

- ISO 9367-1 Lashing and securing arrangements on road vehicles for sea transportation on Ro/Ro ships - General requirements - Part 1: Commercial vehicles and combination of vehicles, semi-trailers excluded
- ISO 9367-2 Lashing and securing arrangements on road vehicles for sea transportation on Ro/Ro ships - General requirements - Part 2: Semi-trailers.

Besides the semi-trailer, the swap body plays a major role in some short-sea crossings. Normally, the swap body is loaded on a platform equipped with small wheels and trucked on board ship.

A very specific competitor has been added to the Great Britain / Continent market: the tunnel service that offers corridor facilities for combined transport trains, mainly loaded with swap bodies, between England, France, Spain, Italy. Furthermore, the tunnel operators offer shuttle services between the English Coast Line and North France carrying complete road vehicles including motor truck and driver. Similar new transport patterns will appear when the various links - tunnels and bridges - between Sweden and the Danish Islands and the Continent come into service.

4.6.3 Scenarios of intermodal transport systems

The future European loading unit will fit into the current European transport modes as follows:

Road transport

The proposed European loading unit is recommended in two sizes, one size designed for European road trains as a twin unit, one to be carried on the rigid truck and the other on the trailer, and the other size designed for transport by European articulated road vehicle carried on the semi-trailer. The unit is proposed with a height making full use of current design in road vehicles and the European legislation allowing an overall road vehicle height of 4000 mm. The proposal takes care of the possibility to achieve a light weight construction to avoid tare penalties compared to conventional road vehicles. Furthermore, the proposal aims at a loading unit that can be built rather cheap.

Rail transport

The proposed unit takes care of the current loading length of railcars, making best use of the loading patterns offered with the majority of the current European railcar fleet. The loading unit is proposed with an outside height that can be accommodated in most important European rail corridors when carried on standard platform height railcars, and in many other corridors, that offer reduced gauge on railcars, with special design for lower platform height, such railcars being state of the art.

Inland waterway transport

The European loading unit is designed to be stacked at least four high in inland waterway transport making full use of the loading patterns of the most important European inland waterway, the Rhine river and its coastal canal connections. By merits of stacking, the loading unit offers greatly improved transport economics in inland waterway. The loading unit includes some difficulties in transport within the Central European canal network, because its width impedes full loading of inland waterway barges that are designed to pass through the locks in this system. Further considerations are needed in this area.

Short Sea Transport

Once a stackable loading unit is offered, modern Roll on/Roll off ships can switch from one layer transfer and transport to double stack transfer and transport on board of the ship. This development will considerably improve the economics of loading and discharge, and the volume accommodation patterns on board ship. Roll on/Roll off ships are so flexible in their loading unit accommodation that the proposed sizes of the future loading unit do not create any difficulty. Cellular ships operated in short sea transport create more difficulties to adapt to the sizes of the future loading unit, because these ships are mainly built to accommodate ISO containers with other width and length. While the width problem can be overcome rather easily (and today short sea cellular ships are already operated that can carry either ISO containers or pallet wide containers, the adaptation of the cell guides to the different length of the future unit might create difficulties **-** not in technical design as adjustable cell guides are state of the art **-**, but daily in operation because these ships might have to carry a changing mix of ISO containers and European loading units. No experience has been gained yet about the feasibility of cell adjustment in the short period when the ship stays in a port terminal.

Another problem will come up if stacks of more than two layers are incurred in short sea operation. Normally, such ships are built for stacks of three layers on deck, and of six layers under deck. The design of a large European loading unit with full six high stackability ability in sea transport will need to a difficult construction, leading to a rather heavy and costly unit that might no longer be competitive in road and rail mode. Further considerations are needed in this field, once first experience has been gained about concrete conditions of operation of such units. In general, European short sea shipping will benefit from a move to standardised units that might replace the great variety of different sizes and shapes that are today used in this trade. Standardised units will contribute to more efficiency and more safety in this operation.

4.6.4 Effects of standardization. Research and development

Today, a wide variety of different boxes is moving in European intermodal transport. This affects the economics of the transport system.

Transport operators have to care for a wide variety of solutions with trailers and platform railcars to be able to participate in various segments of the market. This adds to operation costs and, in certain situations, reduces optimum space utilisation.

The most difficult problems are incurred with short sea transport. Quay to ship transfer has to care for an ever growing variety in design for handling. Top corner fittings, grappler arm lifting recess, no lifting possibility at all, arrive in mix. The loading units arriving in the sea port terminal vary in width and in strength features. Each box has another specific maximum overstacking mass, racking capability, side wall strength and more. In such a situation, the ship officer has, as usual under time pressure, to decide for each unit how and where to stow it on board ship. This situation incurs some unnecessary risks in European short sea transport.

In addition to the variety of European loading units, short sea transport is confronted with the usual range of ISO containers for re-distribution out of gateway ports alongside the European coast lines. A European loading unit designed to similar strength features as ISO containers would certainly facilitate this situation and add to traffic safety. Insofar, a standardisation that on the one side includes the main needs of road, rail, sea and inland waterway transport, on the other side brings a wider degree of uniformity into European intermodal transport, will add considerably to the economy of the European transport system as a whole. When aiming at such a standardisation, not only dimensional features must be looked after. Safety of European transport needs as well standardisation of strength requirements and standardisation of a clear outside marking which forces can be applied to the unit.

4.6.4.1 Standardisation

Standardisation of a stackable European loading unit of 13,6 m length must be promoted.

As the 13,6 m long semi-trailer is the most important cargo carrying unit in European trade, a stackable loading unit of this size is urgently needed to include European railways with limited gauge, inland waterway transport and short sea transport into intermodal transport.

Currently CEN TC 119 Swap bodies for combined transport has successfully prepared the standard on a 7,45 m stackable loading unit, but the work for a standard on a 13,6 m unit is urgent but has not yet started.

Standardisation in CEN TC 119 is based on voluntary European co-operation and the experts are not paid for their contributions. As the European manufacturers of swap bodies have only limited interests in such a development, the future of standardisation work in that field , when based on voluntary work only, will only move forward in slow speed. The standardisation work can be greatly accelerated if CEN sets up, in close conjunction with the European Commission, a selected experts team, paid with a normal commercial salary for their effort, with the clear task to draw up the necessary draft standard documents in a given short time period.

The instrument of speeding up European standardisation by promotion through the European Commission has been successfully applied in many cases, and should be seriously considered in case of a stackable European loading unit of 13,6 m length as well.

4.6.4.2 Research

Demonstration projects should be made eligible under the 5th framework program once a CEN standard for loading units has been decided.

European research shall look after the development of European inland waterway transport barges thatcan accommodate 4 rows of European loading units side by side.

Barges that can accommodate 4 rows of European loading units side by side and keep the maximum width (currently 11,45 m) for operation in Central European inland waterways are currently technically impossible. As most Central European inland waterways are equipped with locks of nominal 12 m width allowing only the passage of barges up to 11,45 m width, a barge design that offers an inside clearance of 10,5 m to accommodate 4 rows of European loading units with 2,55 m width each of them side by side plus the necessary tolerance can greatly improve the economics of inland waterway transport in Europe. Various concepts have been suggested to overcome this problem, and European research is invited to take over this question in research, prototype development and pilot operation.

European research shall look after the development of European railcars with platform height of 800 - 900 mm above rail and sufficient cargo carrying capability.

The development of European railcars with platform height of 800 - 900 mm above rail and sufficient cargo carrying capability will lead to the development of increased axle loads with small diameter wheels. Such small wheels can be used today, but only with reduced axle loads that might infringe the payload of the railcar.

While a 2900 mm high European loading unit can be carried on most parts of the European rail network without too serious gauge problems, European intermodal transport is meanwhile faced with the need to operate units with an inside height of 3000 mm resulting in an outside height of 3150 mm. Such demands come currently from the European automobile industry which is a major client in intermodal transport. A loading unit with a height of 3150 mm would need a platform railcar with low diameter wheels which will lead to limited load carrying capability. Research can contribute to find technical solutions that offer a low platform railcar with sufficient payload for European intermodal transport.

European research in technical, commercial and economic patterns of European short sea transport with a view to optimise transport conditions for future European loading units shall be intensified.

This research must aim at a technical development to improve inter-operability and cover items such as:

- flexible cellular systems,
- ship design in general,
- ship propulsion systems,
- sea terminal optimisation, especially in ro/ro operation of stackable loading units,
- specific design and operation concepts for tri-modal terminals connecting road, rail and inland waterway transport, information flow in intermodal road-rail-sea transport systems such as already initiated in the European research projects APRICOT and MARTRANS.

The inclusion of small European short sea carriers into harmonised EDI and Internet systems for communication between ocean carrier, terminal operator and forwarder shall be promoted by pilot projects.

While communication using harmonised EDI systems, partly via Internet and partly via current added value services, is state of the art for larger ocean carriers, many of the smaller shipping companies that operate in European short sea traffic have not realised such systems. On the other hand, a harmonised information system will greatly reduce commercial transaction costs, speed up communication between the partners and assist to achieve high quality services. A close look must be taken on the current patterns of such small ocean carriers to determine the reasons why they did not realise such systems up to now and how to promote the use of them in the future.

4.6.5 Specification for a system of European loading units for intermodal transport

Any European loading unit has to follow certain requirements that are mandatory.

The following basic features of European logistics have to be met under almost any consideration:

Considerations from the logistic demand side:

- must offer a good answer to the logistic demand of the European industry.
- must offer as much cubic space as technique and legislation allows.
- must give good loading patterns for European pallets and small load carriers 800 x 1200 mm and 1000 x 1200 mm base dimensions.
- since the European loading unit operates mainly on short and medium length corridors, it will be loaded and discharged frequently, and it will must be designed to offer easy access to the inside loading room.

Consideration from the side of the transportation industry:

The European loading unit must keep within the dimensional envelope of European road vehicle legislation.

- must be designed to fit in most of European rail corridors.
- must be designed to fit in most of the important European inland waterway corridors.
- must be designed to fit in European short sea shipping.
- must fit into well established systems of intermodal transport, such as container and swap body transport systems, especially as regards lifting devices and fixing on vehicles.
- must offer a good safety record, as the well established systems of intermodal transport do today.
- must keep within the marking and coding systems used by the established systems of intermodal transport.

4.6.5.1 Dimensions - *outside and inside* - *and payload*

a) Length

The length consideration offers many parameters that ask for optimization. European palletised unit loads ask for an inside module of 800 mm, 1000 mm, or 1200 mm. European road vehicle legislation allows for an outside load carrier length of the articulated road vehicle of 13 600 mm, and for the road train of 7 820 + 7 820 mm. Transport economics would prefer a system of units, that is modular, i. e. 2 smaller units make up 1 larger unit, e. g. the 2 units that form a road train make up 1 full load of a semi-trailer.

As a rule of thumb, a need of 100 mm for each end wall or end door must be calculated, so that from any selected outside dimension 200 mm have to deducted to arrive at the inside length offered for loading. The actual value for these wall and door construction will finally depend from the strength feature needed for such parts of the unit (see Furthermore, if the inside is organised as a multiple of pallets, one must consider that palletised units loads need a certain plus tolerance for loading, because they might come into transport not correctly stowed, i. e. with an overhang, and the loading operation needs some small side shift to manoeuvre the pallets by fork lift truck. In the end, a need of 10 to 20 mm space between all palletised units and the unit and the side or end wall must be realistically calculated to offer sufficient room to offer accommodation for such needs.

If the 3 pallet dimensions that are mainly occurring in European logistics are taken into account, i. e. 800 mm, 1000 mm and 1200 mm, the first common denominator is a length of 12 000 mm. 100 to 300 mm further length for space between the pallets + 200 mm additional length for the walls is needed, so the theoretical calculation ends at a need for 12500 mm outside length to form an optimum in flexibility of accommodation of palletised loads.

If the rigidity of the common denominator is reduced, as one can assume that pallets can be loaded lengthways or transversally in the unit, the optimum must take into account only the 800 or the 1200 mm of the above pallet values, and the calculation ends up with some additional nominal optimums of

6000 mm + 50/100 mm space + 200 mm end walls = 6 300 mm,

8000 mm + 100/200 mm space + 200 mm end walls = 8 400 mm,

16000 mm + 200/400 mm space + 200 mm end walls = 16 600 mm.

If transport operators desire to realise a modular system of European loading units that would best fit into transport optimisation of road trains and articulated road vehicles alike, two possible concepts can be designed: 16 250 + 6 250 mm length for the road train, and 12 500 mm length for a semi-trailer, or 8 300 + 8 300 mm length for the road train and 16 600 mm length for a semi-trailer.

These optimum concepts have their short comings in current practical life:

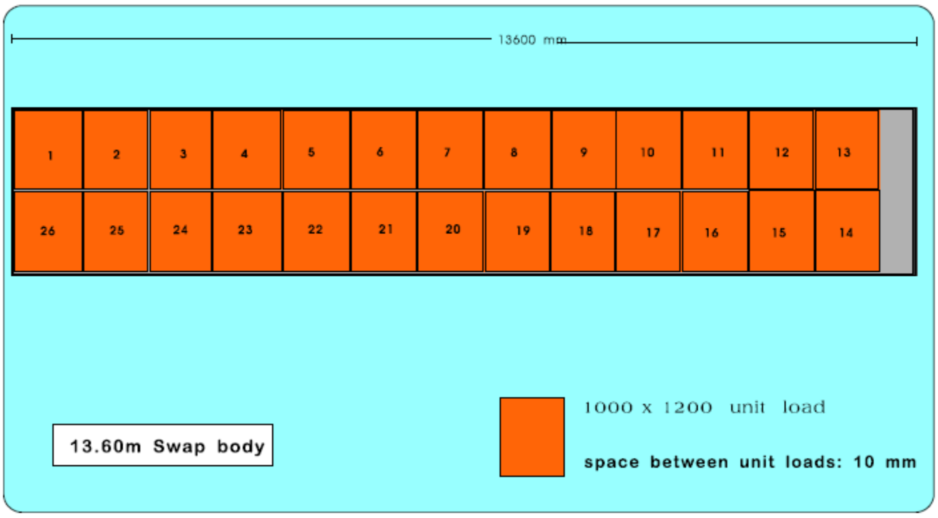
- Since road transport carries some 80 % of all European freight volume, we have - whatever we do - toconsider the compatibility with the legal environment and the infrastructure of road transport as a main issue.
- The 6250 + 6250 mm length for the road train, together with the 12 500 mm length for a semi-trailer concept reduce currently possible road vehicles loading length by some 10 %, and decrease overall productivity of the
- system road transport considerably. Such a concept will not be acceptable for the European economy and for the European Council.
- The 8300 + 8300 mm length for the road train and 16 600 mm length for a semi-trailer ends up at a road vehicle with some 20 000 mm overall length, and this seems currently not accepted by the public and the transport policy. Nevertheless, most modern highways in Europe would be capable to accommodate such units. The main problem from the point of view of infrastructure is the operation of very long road vehicles in downtown areas and in historical villages.

Given these considerations, the optimum concept from a view of palletisation must be dropped, and a “second best” solution must be approached. When doing so, the maximum length currently allowed must be checked against the palletisation patterns and the modular concepts.

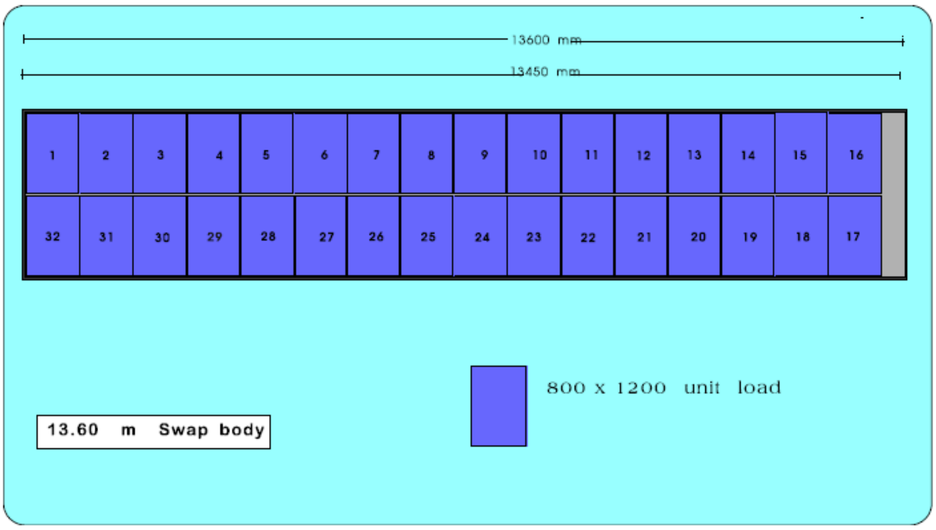
A European loading unit optimised to European semi-trailer legal length would have an outside length of 13600 mm, offering an inside length of 13400 mm. This would allow for pallet loading (including a 15 mm space between the pallets) of:

- 13 rows of 1000 mm pallets, resulting in a total loading length of 13 210 mm with a loss of 190 mm, or
- 11 rows of 1200 mm pallets, resulting in a total loading length of 13 380 mm with a loss of 20 mm, or
- 16 rows of 800 mm pallets, resulting in a total loading length of 13 055 mm with a loss of 545 mm
- 33 pallets of 800 x 1200 mm with some pallets loaded lengthways, some sideways.

Summing up: A 13600 mm long European loading unit loaded at a lengthways loading pattern can achieve a space utilisation of 96 % to 98 % in normal case; this is a fairly good figure that approaches nearly full optimum.



13,6 m swap body loaded with palletised unit loads 1000 x 1200 mm



13,6 m swap body loaded with palletised unit loads 800 x 1200 mm

Figure 19 – Swap Body loaded

A 45 ft. semi-trailer would offer additional some 120 mm inside loading length; this would not add up in any additional pallet loading. The offer of additional loading length must be further reduced, because for legal requirements such a unit must have placed the front corner posts at a 13600 mm length concept so that any additional lengthways loading space cannot be offered over the full width of the unit.

A European loading unit optimised to European road train dimensions includes a small additional complication: The operator can select a road train with special short coupling device (which is rather costly and cannot be freely coupled to each available trailer) offering a loading length of 2 x 7820 mm, or European road train with a "normal" coupling system offering 2 x 7450 mm loading length. In all cases, the calculation must be based on a solution with 2 similar "twin" European loading units on a road train. This allows to change them freely between lorry and trailer, and it follows a concept that is widely preferred by European road operators that use such road trains.

Taking the 7820 mm units that offer 7620 (max. 7720) mm inside length, this would allow for a pallet accommodation (including 15 mm space between the pallets) of

- 7 rows of 1000 mm pallets, ending at 7120 mm, having a loss of 500 mm, and achieving a length utilization value of 93 %,
- 6 rows of 1200 mm pallets, ending at 7305 mm, having a loss of 315 mm, and achieving a length utilization value of 96 %,
- 9 rows of 800 mm pallets, ending at 7350 mm, having a loss of 270 mm, and achieving a length utilization factor of 96 %.

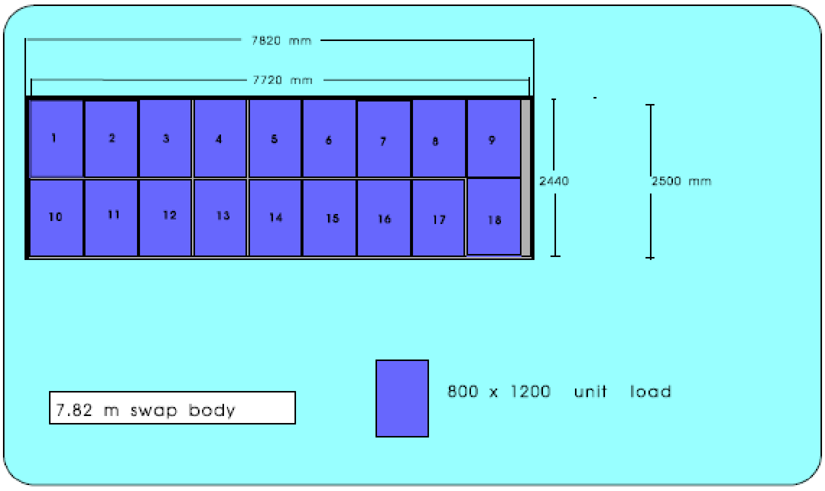
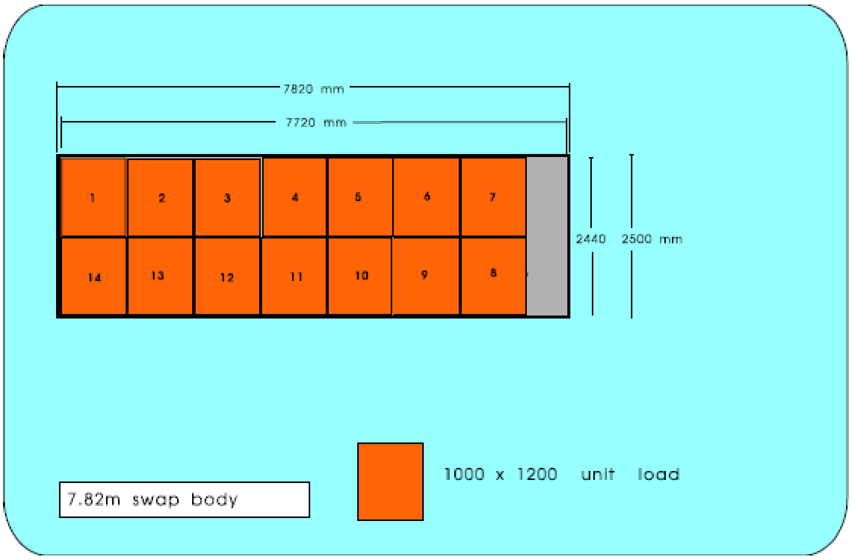


Figure 20 – Swap Body loaded

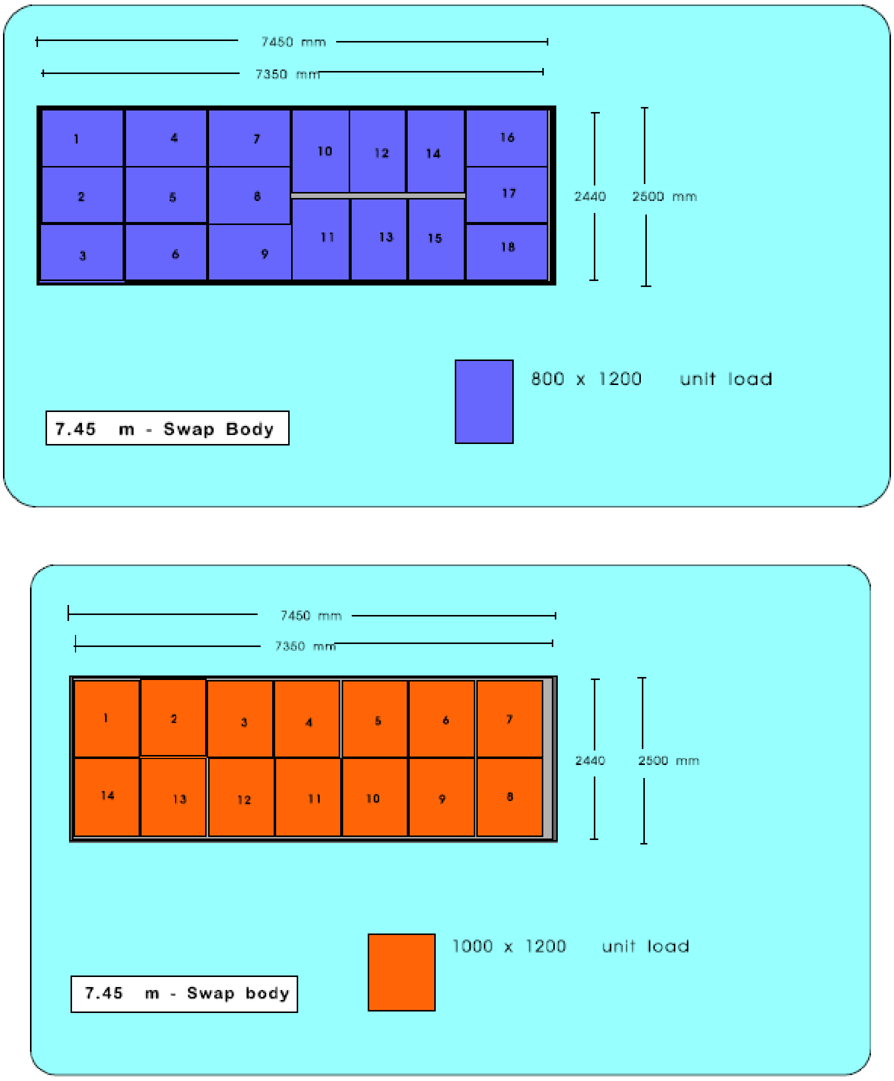


7,82 m swap body loaded with palletised standard unit loads

Figure 21 – Swap Body loaded

Taking the 7450 mm units that offer 7250 (up to 7320 max.) mm inside length, this would allow for a pallet accommodation including 15 mm space of

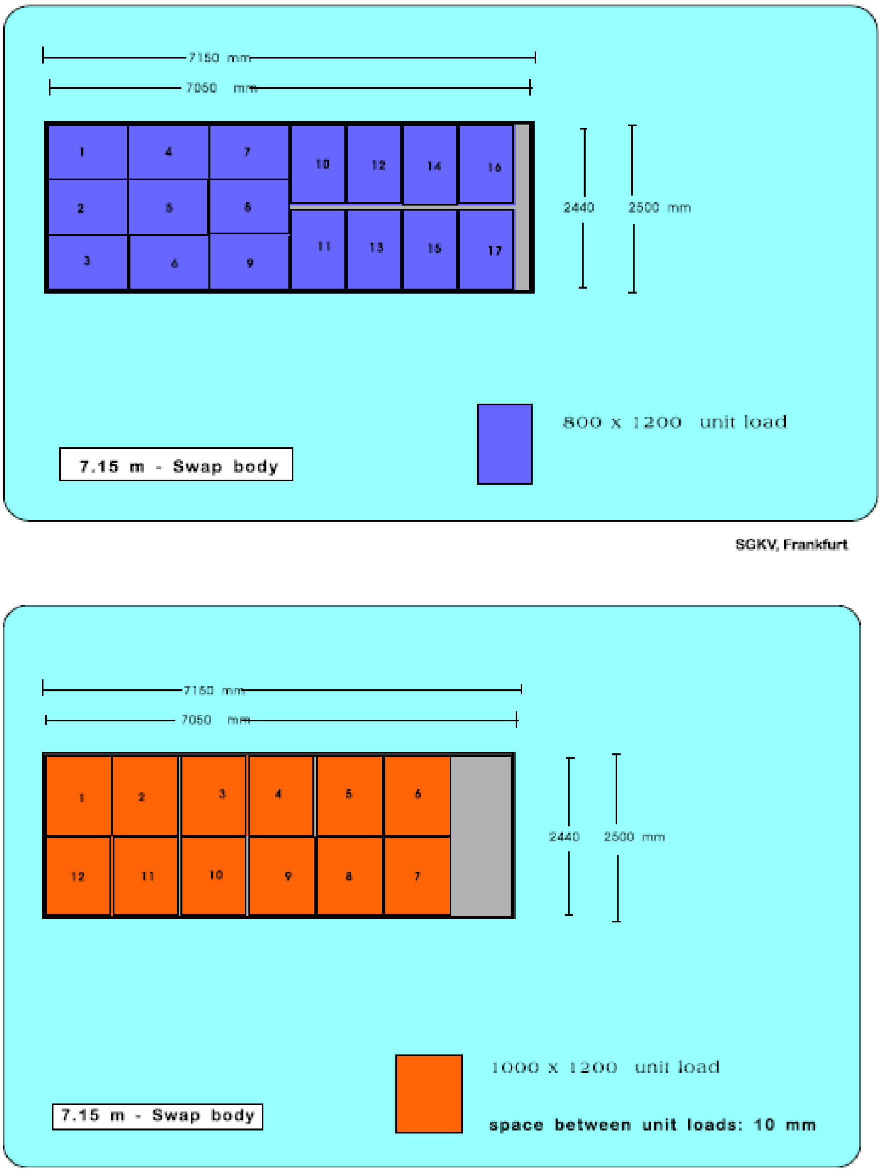
- 7 rows of 1000 mm pallets, ending at 7 120 mm, having a loss of 130 mm, and achieving a length utilisationvalue of 98 %,
- 6 rows of 1200 mm pallets, ending at 7 305 mm, needing a special design to achieve additional 50 mminside length (e. g. by smaller width of front end wall), and then offering a length utilisation value of 100 %,
- 9 rows of 800 mm pallets, ending at 7 350 mm, which would come up with a rather complicated design toachieve a further increased inside length, but if this can be really achieved, offering a length utilisation factorof 100 %.



7,45 m swap body loaded with palletised standard unit loads

Figure 22 – Swap Body loaded

The traditional 7,15 m swap body does, compared to these configuration, not provide any advantages.



Pallet loading capacity of a 7,15 m swap body

Figure 23 – Swap Body loaded

Summing up: The 7 820 mm unit does not offer additional pallet accommodation compared to a 7 450 mm unit with an inside length of some 7 300 mm which can be achieved under realistic strength features. The 7 450 mm box does not need a specific coupling system road train. It can be operated by standard road equipment, and can be basis for a standard solution.

But some cases may occur when an operator has to carry palletised cargo into one direction, and non-palletised high volume items into the other direction. In such a case, the use of a swap body with maximum cube, i. e. a 7820 mm long unit, can be desirable even if such a unit does not accommocate any more pallets than a standard 7450 mm long swap body.

The solution with a class A European loading unit with 13 600 mm length and a class C European loading unit

- with 7 450 mm length creates a system
- with the disadvantage to be not modular,
- with the advantage to fit into current European legislation on road traffic,
- with the advantage to offer load space utilisation for palletised European loading units between 97 and 100%.

Possibly, a swap body used for delivery operation might need specific additions such as doors that can be folded upwards, or a hydraulic lift at the end door, which will add to the outside envelope. But as 7450 mm length is not the very limit of European road legislation, there should be sufficient room for such additional features within the envelope legally allowed.

b) Width

The discussion of an optimum width concept will be organised the same way as the consideration with the length question.

Basic assumptions are:

- A construction depth for the two side walls of 50 mm each is needed so that the side walls use some 100 mm of the total available width. Special side wall constructions with less thickness are available, but with either less strength or with some infringements for the design. Such side walls would end up at a thickness of 35 mm each, and so need a space of 70 mm for the side wall construction.
- A 10 - 20 mm space between the pallets and the pallet and the wall is needed, in average 15 mm.

Two 1 000 x 1 200 mm pallets side by side need an available width of 2 445 mm, three 800 x 1200 mm pallets need an available width of 2 460 mm. If we add 90 mm for the side wall, we arrive at 2550 mm. This value is similarly the legally allowed maximum in European road transport. A design with small thickness side walls could save another 20 mm outside width and arrive at a unit of 2530 mm. When reducing the inside possibilities for pallet side shift, possible another 10 - 20 mm width can be saved. Some experts have offered the opinion that especially units that go on short sea routes might preferably built to smaller inside to offer a minimum of space between the pallet loads and so to avoid a side movement of the cargo during sea transport.

In rail transport, most corridors that can accommodate intermodal transport loading units with a height up to 2900 mm and a width of 2 500 mm, can as well accommodate such units with 2550 mm width. The additional 50 mm upper corner distance has to be checked carefully, but today such units are operated without too much trouble in most parts of the European intermodal rail network. A semi-trailer with full 4000 mm height can be carried in Central and East and North European rail networks, and cannot be carried in West and South European networks, whether it is 2 500 mm wide or 2 550 mm wide.

The value of 2550 mm seems ideal mainly from the point of view of road transport and road/rail intermodal transport, but includes two smaller disadvantages:

- The US domestic system of loading units has introduced a width of 2 590 mm, and European thermosinsulated units have a width of 2 600 mm. These variation might create difficulties when later all loading unit systems merge to a worldwide system.
- The European inland waterway vessels, as far as they are specially designed to operate in the West and Central European canal network, have to follow the standard width of the locks in these canals and can, under consideration of the need for a free board, not offer more than 10 000 mm inside width, allowing for fourrows of containers with a width of up to 2 500 mm each. A container of 2 550 mm width could only be accommodated in three rows, this resulting in a capacity loss of some 25 %. This argument does not apply to such container transports that are operated on the Rhine and the Danube, because these two river systems do not have locks, or have wider locks.

- A European loading unit with reduced outside width of 2520 mm might offer some advantages in short sea transport: It might be designed similarly to the current SeaCell concept and so carried in the cells of a container ship that has been designed to carry containers with 2500 mm width. But the length deviation (ISO 20/40 ft. containers have a length of 6180/12200 mm, the proposed European loading units have a length of 7450/13600 mm) has to be solved anyway, and this will inevitably create the need for either an adaptiation of the cell structure or for the design of a flexible cell structure when uisng cellular ships.

c) Height

When considering the height, the height limits offered in various modes of transport shall be investigated, and the needs of European logistics shall be asked for, basing all these considerations on the obviously everlasting need for additional cube capacity of the logistic service providers.

European road traffic legislation foresees a height limit of 4000 mm. Taking into account bridge underpass height in most European through roads, this height limit reflects the possibilities in large parts of the infrastructure.

The loading platform of a semi-trailer is normally 1000 **-** 1100 mm above road surface, so road transport as a general rule will be able to move a European loading unit up to 3000 mm height. Platform heights of 800 mm (and even less) seem to be technically possible, but go together with difficulties in design and operation. Special design tractors with very low 5th wheel and low diameter tires that might infringe the load (mass) carrying capacity are needed. These special features will be certainly more costly than normal design vehicles. So we conclude that road will be confronted with some difficulties when loading units exceeding 3000 mm height have to be carried.

Rail is certainly much more infringed. ISO containers of 8 ½ ft. height (2590 mm) can be operated on almost all major European rail corridors. ISO containers with 9 ½ ft. height (2950 mm) can be moved rather freely in Central, North and East Europe, but need very specialised equipment for Italy, France, Spain, and in Alps mountain transit, especially when they are 2 550 mm wide. Units of almost 3 200 mm height have been reported in rail traffic operation between Germany and Spain, so that we may conclude that railcars are available even for the operation of such units on rail. Chapter 5 will deal in more detail about the options in this type of movement. Generally speaking, it seems like that rail can move - sometimes with special equipment needed - a European loading unit with a height up to 2900 mm.

Short sea shipping often transfers two loading units one on top of the other mounted on low bed special trailers on board ship in Ro-Ro operation on some of their decks. Many modern ships are prepared for such type of transfer. These decks are normally equipped with door openings and deck clearance of 7000 mm height that care for the combined height of two containers up to 9 ½ ft. height + the low bed trailer with a 700 mm platform height. Loading units with a height of 3000 mm or more would create difficulties in this type of two layer transfer. They must be moved in one layer on board ship, decreasing the productivity of the transfer operation by almost 50 % for loading and unloading of the decks that allow double height stacking.

It is more difficult to calculate from the outside height to the inside loading height offer, since this calculation includes some far reaching assumptions about the design construction of the unit. If the design of the loading unit is based on a steel frame and full supporting material (corrugated steel panels) side and end walls, bottom and roof construction need some 150 - 200 mm. If a swap body type design is applied with a floor part to take over alone most of the load stresses, and eventually a full side wall left open and covered only by a tarpaulin that does not add anything to the strength of the construction, the floor will have to be designed considerably stronger, i. e. with higher longitudinal bearing members resulting in less usable height for the interior. Furthermore, some design of corner fittings in units longer than 40 ft. will result in infringements of usable height in the roof area.

Taking about palletized loading units, we come to loading height needs as follow:

- Light weight cargo in normal mixed distribution will be stowed in pallets of some 1 800 mm height, needing door heights and inside heights of the vehicle or the European loading unit of 1900 mm. Road transport offers for such cargo high cube trailers that can accommodate up to 3 000 mm loading height inside.

- Normal weight cargo in general distribution will come up with 1100 mm/1200 mm height palletised cubes.

- Road transport can take 2 layers of these unit loads, either one stacked on top of the other, or with an intermediate loading deck inside the vehicle or swap body. All this results in loading height needs of 2450 /2500 mm.
- Heavy weight items, e. g. bottled liquids, may be loaded up to 1 500 mm height. In many cases one single layer fills the weight capacity of the road vehicle or swap body.
- Meanwhile some new small load carriers are introduced in European logistics, mainly in the logistic pipe-line from sub-contracting delivery plant to the assembly factory. Such small load carriers have the same base dimensions as standard pallets, and heights up to 1000 mm. As long as they carry rather light material, the logistic industry will wish to have them carried in three layers, and road transport can follow this desire offering vehicles with an inside height clearance of 3020/3050 mm. If intermodal transport wishes to be included in this trade, it has to consider similar offers. If intermodal transport carries only 2 layers, it will offer 33 % less capacity than road in certain trades, and has to offset such limitations by a transport price reduction of 33 %, and this seems to be a rather hopeless case.

An outside height of 2900 mm for the European loading unit is recommended. Increasing demand for special European loading units offering an inside loading height of 3000 mm can be foreseen and may have to be accommodated in standardisation in future.

d) Payload

Class C swap bodies are today rated to 16 t, taking into account the normal gross weight limits of a European road train.

Class C tan containers are rated to 30,5 - 32,5 t to achieve a maximum of payload within the possibility to operate with a 44 t gross weight in intermodal transport pick-up and delivery.

Class A swap bodies have been discussed, and some current types have been designed, to a gross weight of 32,5 t. Such a weight can be carried legally in European road transport if a lightweight tractor and a lightweight chassis are used and if a 44 t operation is allowed. Normally, the lifting equipment in European terminals are capable to handle units with 32,5 t. The European loading unit has, as far as possible, to show similar cargo accommodation patterns as road vehicles.

The experts recommend to foresee the following gross weights (masses) for the European loading units: The 13600 mm long unit shall be designed to a maximum gross weight of 32,5 t, the 7450 mm long unit shall be designed to a gross weight (mass) of 16 t, and specific heavy duty loading units of 7450 mm length can be designed with a gross weight (mass) up to 32,5 t.

4.6.5.2 Lifting devices

a) Corner fitting

Europe is covered with intermodal transport terminals, all of them being equipped with lifting devices with spreaders to meet a standard corner fitting according to ISO 1161 or compatible to this design. So, there is no question that a European loading unit needs to be equipped with such corner fittings.

While ISO containers are equipped with top corner fittings for top lifting, European swap bodies are designed bottom lift only without such top fittings.

The top corner fittings are not only needed for lifting but for stacking , so that any unit designed for stacking will necessarily be equipped with top corner fittings. As the future European loading unit must be specified with some stacking capability to meet the requirements of inland waterway transport, short sea operation, and some type of terminal handling, these units will be equipped with top corner fittings for top lift transfer.

Most modern spreaders are adjustable to meet all length distances of corner fittings between 20 ft. (6 058 mm) containers and 40 ft. (12 200 mm) containers. As width is concerned, the standard width of 2 438 mm for ISO containers has set a standard that even wider boxes adhere to. Insofar, corner fittings on wider units normally offer a design with the openings to take in the twist locks at a 8 ft. distance, i. e. exactly the same distance as ISO series 1 containers.

The top corner fittings for the class C units can be positioned at 20 ft. distance or at the corners of the units, i. e. at 7 450 mm length distance. Experience from intermodal transport terminals say that transfer operation by spreader lift is much easier and quicker, if the spreader can meet corner fittings at the real corner rather than somewhat inside located fittings. Insofar, a location of the fittings at the outside corner will be preferable. As most spreaders can be easily programmed to adjust automatically to such a length configuration, this should be the preferable location.

Having the corner fittings at the outside corner gives another advantage: In such a case, the corner fitting can be integrated into the corner post construction, and most vertical forces introduced into the container when carried in stack aboard a ship can rather easily be accommodated by this design without too much additional tare penalty. So, a rather lightweight container with 4 - 6 high stacking capability in sea transport can be realised.

Bottom fittings shall follow another regime, i. e. the compatibility with ISO 20 ft. bottom corner fittings location. Most road chassis and platform railcars have twist locks foreseen at 20 ft. distance position, so that even larger units should offer the accommodation for such twist locks at 20 ft. ISO container location.

Bottom corner fittings of ISO containers are built and tested at a strength value that they can hold the container on a moving road and rail vehicles during transport, and so that they can be used for lifting by slings (with some minor limitations such as certain sling angles). This feature might add to the building costs when the bottom fitting is located inside mainly as a hole to accommodate a twist lock in the longitudinal side beam. If so, it might be reasonably considered not to foresee lifting forces applied through them.

During transport and storage of the units in stack, the vertical forces are mainly guided through the corner fittings from the upper layers to the lower layer units. This means that a loading unit of 7 450 mm length with a top corner fitting at the outer top corner has to be equipped with enforced areas at the floor underside in the same location, i. e. at the very outside corner. The vertical load transfer within the stack must be transferred from this reinforced area into the top corner fitting of the bottom layer unit, and from there through its four corner posts further into the floor of the bottom unit.

The class A European loading unit incorporates specific problems with the top corner fitting, and in consequence of the vertical load transfer. As practically all spreaders in European inland terminals end at 40 ft. length distance, the openings of top corner fittings must not exceed a length distance of 40 ft. (12200 mm). So, either one or both pairs of corner fittings have to be located inside the roof construction and cannot be integrated in the corner post assembly. This will create extra problems with full strength container design because the vertical load transfer in stack has to be guided either through the fittings at 40 ft. distance - creating the need for reinforced load transfer zones in the side walls and on the underside of the units -, or through the corner post, or through both construction parts of the units. The other problem is that such corner fittings will infringe into the interior of the container and limit its inside usable height. Some special design should be looked after to limit this effect as far as possible.

If the container has to be designed to be operated in 4-6 high stack in sea transport, this would result in very heavy stacking forces to be accommodated in its construction. Normally, these vertical forces have to conducted through re-inforced parts of the side-walls at 4o ft. distance. This is not only a cumbrsome (and consequently costly) design; it might as well lead to a side-wall thickness in these areas that abuses all inside clearance for palletisation that has been achieved through the 2550 mm width concept.

The other question concerns corner fitting location: They can either have a rather symmetric inside location, each top corner fitting of a 13 600 mm European loading unit being 700 mm inside, or one pair of top corner fittings can be at the corner of the box and the other pair 1400 mm inside. This question has to be carefully considered from a viewpoint of container design and of container transfer operation.

Terminal experts point out that a rather symmetrical location of the corner fittings at 40 ft. distance is a paramount issue of handling safety, so that this concept will be preferable.

The bottom corner fittings at a class A unit shall be similarly as those of the class C unit mainly designed to take in the twist locks of rail and road vehicles and to take over forces generated through road and rail movement. It might be rather difficult to design such corner fittings for lifting purposes taking into account the bending forces that will be introduced into the container during such an operation.

The European loading unit shall be equipped with top corner fittings. Such fittings shall be designed compatible to ISO 1161. The fittings on top of a class A unit shall be a 8 ft. width and 40 ft. length distance and preferably symmetrically located inside the frame, the fittings on a class C unit shall be at 8 ft. width and 7450 mm length distance and integrated into the corner posts. The European loading unit shall have bottom corner fittings at 8 ft. width and 40 ft. length (class A) and 20 ft. length (class C). The bottom fittings must not be designed to take over lifting forces. The underside of the unit must be equipped with reinforced load transfer zones at the same dimensional location as the top fittings.

b) Grappler arm recess

Most European swap bodies are lifted by means of grappler arm lifting devices that meet the swap body at a grappler arm recess built into the bottom construction. A similar grappler arm recess is foreseen in semi-trailers prepared for vertical transfer.

If a European loading unit is equipped with both, top corner fittings and grappler arm recess, terminals will prefer to use the top corner fitting for spreader lifting rather than the grappler arm equipment, because the lifting by spreader and corner fitting is normally quicker and more safe than the lifting by grappler arms. So, it might be easily considered to drop the need for grappler arm recess once the European loading unit is equipped with top corner fittings.

This does, of course, not remove the need to have dual mode lifting equipment in European terminals with spreaders and with grappler arm devices. Whatever success a possible European loading unit without grappler arm recess might have, the current more than 150 000 swap bodies will continue to be in intermodal transport operation, and a semi-trailer continues to offer only grappler arm lifting capability.

Once the European loading unit is equipped with top corner fittings for lifting, grappler arm recess in addition to that is not needed.

c) Fork lift pockets

Many containers are equipped with fork lift pockets. This enables operators to use rather cheap terminal equipment to move such units, mainly when they are empty. This is especially true for repair shops and for depots that handle only empty units.

ISO has recognised the need for fork lift pockets with 20 ft. ISO series 1 containers. But ISO TC 104 experts have considered that a fork lift pocket on the large 40 ft. units might invite for dangerous handling and therefore such fork lift pockets shall not be foreseen by the manufacturer. Some major users of ISO containers ignore these considerations and order their 40 ft. ISO containers “with fork lift pockets”.

We suggest to follow the safety considerations of ISO TC 104 and specify the small European loading unit Class C with “fork lift pockets as an optional feature”, and class A “no fork lift pockets to be provided”.

The small European loading unit Class C shall foresee fork lift pockets as an optional feature, and class A shall not be provided with fork lift pockets.

4.6.5.3 Strength requirements

a) Side wall strength

The side wall must withstand the forces of all modes that the European loading unit is operated in.

This unit could be use for road, rail, inland waterway and short sea shipping. While road, rail and inland waterway operations introduce only limited forces from the cargo into the side walls, short sea shipping might create similar forces as deep sea shipping. As many European short sea corridors lead over waters where often very heavy weather occurs, and as schedule reliability is a key factor in typical European short sea operations (so that the captain of the ship cannot wait for calm sea before leaving the port), a unit in European short sea operation must be designed to withstand forces created by similar movements as occur in deep sea transport. Insofar, they need a similar side wall strength as ISO containers.

On the other hand, a major European manufacturer of stackable European loading units often operated in sea transport has reported, that according to his experience the container does not need full ISO side wall strength but a less strong design. The European loading unit shall be equipped with side walls offering the same strength capability as those of ISO series 1 containers. Further enquiries must ascertain whether possibly a lower value might render sufficient strength.

b) End wall and end door strength

Whatever has been stated for side walls is, as well, true for end walls and end doors.

Insofar, end walls and doors must show similar strength values as those of ISO series 1 containers.The European loading unit shall be equipped with end walls and end doors offering the same strength capability as those of ISO series 1 containers.

c) Stacking capability

The stacking capability of a European loading unit must refer to the various situations in which such a unit will be operated. In road transport, no stacking will be applied. In rail transport, no stacking will be applied. Rail transport in double stack seems not to be possible under commercial considerations with European rail operation.

In inland waterway transport, stacking is a normal feature. Stacks on Rhine barges are up to 4 layers high. Given the slow motion of inland waterway barges, no acceleration forces have to be added to the value of the overstacked mass when calculating the stacking capability.

In current short sea transport using Ro-Ro ships, stacking in 2 layers on a low bed trailer is normal operation. The stack on board ship has to consider an additional vertical acceleration force introduced by the ship motion. These additional vertical forces may go up to 0,8 g.

In short sea transport on board of cellular type ships, the stacking values will vary according to the ship design. Deep sea ships operate container stacks of 6 layers and partly even for 9 layers), and short sea cellular ships might be designed to similar loading height. An additional force created by vertical acceleration through ship motion must be added, this additional value being 0,8 g.

On intermodal transport terminals laden units will be seldom stacked more than 3 or 4 layers high. A small acceleration might be added if a loaded container is dropped on top of a stack. Generally speaking, the stacking capability of a European loading unit will improve the economy of intermodal transport terminals by offering more flexibility in handling organisation and better land use, especially with interim storage of units.

Summing up: Stacking capability is advantageous in terminal operation and in Ro-Ro ship loading. Stacking capability is compulsory in efficient inland waterway operation and in short sea transport using cellular type ships. Insofar, stacking capability must be a feature of the European loading unit. Handling of intermodal loading units in stack can often be not performed by use of grappler arm lifting equipment, so that a European loading unit with stacking capability must be equipped with top corner fitting for spreader handling. The 7450 mm long European loading unit will have to bear the vertical forces of the stack mainly through its corner posts. This is a considerable strong part of the construction, and full ISO stacking load should not create too much additional tare weight for reinforcement.

As long as the 13600 mm long European loading unit has its top corner fittings inside at 40 ft. position, and as long as the main vertical forces are pressing onto these corner fittings and have to be conducted through them into the side wall, a full ISO stacking load design would need reinforced side walls; this design could create prohibitive additional costs and tare weight, and could give the need that the reinforced side walls protrude into the inside of the loading unit reducing the inside width clearance. Insofar, great care has to be taken for a compromise between stacking capability and design of the unit especially to take into account the need to operate such loading units on cellular type ships on longer European sea voyages such as voyages from North Europe into the Mediterranean Sea. Possibly, engineers will find a solution that combines high stacking capability with low tare. The European loading unit must be designed as a stackable unit with top corner fittings. The minimum stacking capability must be at 4 layers without additional vertical acceleration. This includes a capability of 2 layers with additional vertical acceleration of 0,8 g. Full ISO series 1 container stacking capability will be advantageous and can be easily realised with 7450 mm loading units. For 13600 mm long loading units, an acceptable compromise between stacking capability and acceptable tare has to be found.

d) Racking capability

Racking forces are mainly introduced into a container when it is moved in a stack and external forces act upon it e. g. a ship rolling. The racking force is greater on those containers that form the bottom layers of a stack that is subject to the external motion. The magnitude of the racking force will depend upon:

- the height of the stack,
- the mass of the units in the upper layers of the stack,
- the speed and intensity of motion of the vehicle carrying the stack.

A European loading unit will be carried in stack on board of:

- an inland waterway vessel in maximum 4 layers, but without any heavy vehicle motion,

- a short sea Ro-Ro ship in 2 layers, with heavy motion in rough sea,
- a short sea cellular ship as a deck load in 3 layers, with heavy motion in rough sea areas.

European loading unit must be designed to withstand limited racking forces if moved only on Ro-Roships. If such units will be carried in stack on deck of short sea ships, a racking capability up to that of ISO series 1 containers is needed.

e) Floor strength

ISO TC 104 has foreseen in ISO 1496 a floor strength for its containers that enable the containers to withstand the forces introduced by a fork lift truck with full load diving into the box during loading and discharge operation.

CEN TC 119 has foreseen in EN 283 a somewhat less floor strength. Manufacturers report that many clients order their swap bodies with “full ISO floor strength”. Therefore, it may be questioned if the lower value as given in EN 283 really covers the needs of the market.

As a future European loading unit will be operated in marine environment as well, and as the actors in this field may assume automatically ISO floor strength, it might be advisable to foresee full ISO floor strength for such units. European loading unit shall have the same floor strength as that of ISO containers, specified in ISO 1496.

f) Roof strength

The relevant standards foresee a minimum roof strength (if a roof is provided) to allow a man walking on the roof without breaking through the roof. Furthermore, doubler plates are foreseen in the area of the apertures of the top corner fittings to shelter the roof construction against eventually mis-guided spreaders coming down, and otherwise punching a hole into the roof by their twist locks. Similar features make sense with a European loading unit that shall have the same roof strength as that of ISO containers, specified in ISO1496

4.6.5.4 Marking requirements

Currently, various marking concepts for containers and swap bodies are in operation. The main concepts are

- ISO 6346, to be applied generally for all containers, parts of the concept reserved for full strength ISO series 1 containers only;
- UIC 596-6 prescribing a yellow approval plate for all swap bodies for road-rail transport in Europe; this approval plate consist of coded data giving the swap body dimension, further coded data indicating the approving agency, and an individual number of the unit;
- prEN 13044 which establishes a new marking concept for swap bodies, partly based on the concept of ISO 6346, partly based on special European needs;
- The International Convention on Safe Containers (CSC) prescribed a Safety Approval Plate as a compulsory marking on all containers, while the member states of the European Union have agreed not to apply this regime to European swap bodies which are not stackable and not equipped with top corner fittings.

At this stage of the work, it seems like that the new European Standard on marking of European units will be widely accepted and applied.

This new standard EN 13044 takes full regard of current and future European load units. It is elaborated to be as near to the ISO 6346 standard as possible. Therefore, it should be easily fit for the marking of the future European loading unit as well, when it is once accepted.

The exemption from the provisions of CSC installed for European swap bodies does no longer concern to the units specified here. Insofar, the European loading unit has to undergo the approval procedures of CSC and be marked accordingly.

4.7 RESEARCH AND DEVELOPMENT

4.7.1 European Union

To help overcome reluctance to invest in new, more flexible transport technologies, the European Union – as part of its R&D framework programmes, which cover a wide range of scientific fields – has supported many projects seeking to give operators the tools they need to run intermodal services effectively and improve the framework conditions for intermodal transport. The Commission allocates millions of Euros each year to support research teams across Europe and develop effective and efficient technologies for intermodal transport services. By bringing together researchers from different Members States, this support encourages the development of technologies with wide application. European Union research funding is targeted closely towards policy aims.

In 2002, the European Parliament and the Council took a decision concerning the Sixth Framework Programme for research and demonstration activities for the period 2002-2006. The Third call for proposals, published on 29 June 2004, included two intermodal tasks concerning:

- Intermodal freight transport -- terminals and technologies
- Intermodal freight transport -- management system.

A task concerning logistics best practice has also been launched in this call.

Framework Programme 7, the European Union's chief instrument for funding scientific research and technological development over the period 2007 to 2013, is one of the most important elements in realising the Lisbon agenda for growth and competitiveness.

The Commission's proposals for the Seventh Framework Programme (FP7) was published on 6 April 2005. The European Parliament approved the Framework 7 Programme on 30 November 2006. The total expenses are estimated to about 54 billion Euros.

FP7 aims towards simplified instruments and procedures for funding and participation. Collaborative research will be based around broad research themes, rather than instruments, with much continuity from FP6 as well as the addition of two new topics, space and security.

The broad objectives of FP7 have been grouped in four categories: Cooperation, Ideas, People and Capacities. For each type of objective, there is a specific programme corresponding to the main areas of European Union research policy. All specific programmes work in tandem to promote and encourage the creation of European poles of (scientific) excellence. There are nine themes within Cooperation, transport being one of them.

European research projects on intermodality

According to the transport RTD work programme, research on Integrated Transport Chains and intermodality has the objective of increasing the commercial use of effective intermodal operations within Europe.

The main objectives of the research projects developed are the following (acronyms of some projects are given):

- to take into consideration the structure and organisation of the transport chains, transport nodes and terminal (e.g. FV-2000, IMPULSE, TERMINET);
- to set up new communication systems to improve the data exchange between transport chain actors and to provide better information, including tracking and tracing (e.g. CESAR, GIFTS, COMBICOM, X-MODALL);
- to identify and quantify key factors affecting modal split and to identify barriers to intermodality (e.g. STEMM, EMOLITE, PROMOTIQ, SPIN);
- to study, implement, demonstrate and evaluate new solutions with relevant technical, operational and organisational aspects (e.g. ITP, SAIL, INTEGRATION, IDIOMA, INHOTRA);
- to define guidelines or policies (e.g. INTERMODA, SPIN);
- to establish broad dissemination and improve exchange of knowledge in the thematic network on terminals and transfer points (e.g. EUTP, ITIP);
- to improve pre- and end-haulage of intermodal transport (e.g. IMPREND);
- to increase efficiency and quality of intermodal transport (e.g. BRAVO);
- to analyse specific quality aspects influencing intermodal transport (e.g. IQ);
- to improve safety and security in intermodal transport (e.g. SIT, SIMTAG);
- to promote the use of intermodal transport (e.g. SPIN, PROMIT, PROMOTIO).

More information about european projects is available at: www.cordis.europa.eu. A European Intermodal Research Advisory Council (EIRAC) was launched in May 2005 in Brussels to focus on future research needs. Stakeholders of this council are industrial companies, the European intermodal industry, the European Commission and the European Union member states. The council identified interoperability, logistics, security, socio-economics and education and training as key research areas and the funding target is 60 to 100 million Euros each year for the period 2007 – 2013. More information about EIRAC is available at: www.eirac.net.

4.7.2 USA

By the year 2020, the total domestic tonnage of freight carried by all United States freight systems will have increased by about 67%, even at moderate rates of economic growth, and international trade will almost have doubled. With ongoing growth in travel demand on virtually every system of transportation in the United States, transportation capacity is seriously inadequate. Congestion, reliability, safety and system preservation will be major problems for the foreseeable future, despite improved operational efficiencies. The Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st century (TEA-21) emphasized the need for state and metropolitan multimodal and intermodal transportation planning and programming activities to include freight along with passenger transportation.

The Transportation Research Board

The Transportation Research Board (TRB) is a division of the National Research Council, which serves as an independent adviser to the federal government and others on scientific and technical questions of national importance. The National Research Council is jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The mission of the Transportation Research Board – one of six major divisions of the National Research Council – is to promote innovation and progress in transportation through research. In an objective and interdisciplinary setting, the Board facilitates the sharing of information on transportation practice and policy by researchers and practitioners; it stimulates research and offers research management services that promote technical excellence; it provides expert advice on transportation policy and programmes; and it disseminates research results broadly and encourages their implementation.

The National Cooperative Freight Research Programme

The National Cooperative Freight Research Programme (NCFRP) was authorized in the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The NCFRP will be sponsored by the United States Department of Transportation's Research and Innovative Technology Administration (RITA) and managed by the National Academies, acting through its Transportation Research Board (TRB), with programme governance provided by an Oversight Committee including a representative cross-section of freight stakeholders.

The NCFRP will be expected to cover a broad range of issues related to the objective of improving the efficiency, reliability, safety and security of the nation's freight transportation system; multimodality will be one of them. More information is available at: www.trb.org.

5. BEST PRACTICE IN SUPPORTING INTERMODAL TRANSPORT

In this section, best practice in governmental measures in support of intermodal transport is presented.

5.1 EUROPE

5.1.1 Austria [RAMBØLL AS, Oslo, 2006]

Background and main problems

Austria is a landlocked Alpine country in the heart of Europe with a large share of freight transit traffic. Main problems on a national level related to freight transport are:

- increasing road freight traffic in mileage and tonnes-kilometres (especially on Alpine crossings and in conurbations); growth rates are higher than economic development (GDP) and passenger traffic development;
- capacity problems on road networks in conurbations (affecting productivity, accessibility and reliability of road freight transport, including location attractiveness for enterprises);
- limited capacity of the railway and intermodal network (priority conflicts between freight and passenger transport).

Freight transport policy and the role of intermodal freight

Objectives of the national transport policy are:

- single modes should be used to comparative advantage and be linked practically (intermodal transport);
- modal shift from road freight transport to rail and intermodal transport: On longer distances, and especially in Alpine crossing traffic, a modal shift from road to rail (including combined transport rail/road) is an objective;
- the different modes to bear the external costs;
- the use of inland waterway connections in intermodal transport chains to be supported.

Intermodal freight is important in the freight transport policy of Austria. The modal focus is on rail/road and to a certain extent inland waterways (Danube)

Overview of measures to support intermodal transport

Governmental measures that directly influence intermodal transport:

- funding of intermodal freight terminals rail/roads/inland waterways;
- subsidies for intermodal freight consignments through the Alps;
- subsidies for rolling motorway consignments through the Alps;
- reimbursement of taxes for trucks used in intermodal transport (15-100%);
- increased weight limit for trucks used in intermodal transport (41 tonnes for semi-trailers, 44 tonnes for containers and swap bodies);
- funds for studies, equipment and training, including innovations (containers, vehicles, new technology, market studies, training costs, etc.) (max. 30 to 50%);

Intermodal transport has increased by about 50% in the past five years. Rail and river transport have about 40-45% of total inland freight transport.

- environmental premium for intermodal inland waterway services;
- Austria gives priority to five main corridors for intermodal transport: Brenner, Tauern, Phyrn – Schoberpass, Danube and Pontebbana.

Funding of intermodal freight terminals

Austria can fund terminals to promote intermodal transport and reach a modal shift. The funds are used for subsidies and loans. Elements financed are: Building, acquisition or renewal of infrastructure, installations and equipment; extension of railway infrastructure for intermodal terminals; other investments to facilitate intermodal transport. The share paid by government is dependent on the kind of measure and intermodal effect (normally 30-50%).

The European Union has approved four different support schemes for intermodal transport in Austria, on railways and on the river Danube.

Other measures

Truck traffic is strongly regulated in Austria, and there is a relatively high toll to pass through Austria by truck as well as other restrictions on road freight transport. These measures include:

• road charging for trucks (especially passing through Austria),

• enforcement of road freight transport regulations (driving hours, weight, etc.).

Effects

There is growth in intermodal transport in Austria, but it is difficult to estimate the effects of the measures in place. The combination of measures supporting intermodal transport and measures which affect road transport is satisfactory.

Conclusions and outlook

There is strong political willingness in Austria to support intermodal transport as a way of reducing road freight transport through Austria and the Alps region.

5.1.2 Belgium [RAMBØLL AS, Oslo, 2006]

Background and main problems

Belgium is a country located along the North Sea. Main problems due to freight transport are:

- increasing road freight traffic in mileage and tonnes-kilometres, growth rates higher than economic development (GDP) and passenger traffic development;
- high share of freight transport to and from large ports along the North Sea;
- capacity problems on road network in conurbations (affecting productivity
- accessibility and reliability of road freight transport);
- increasing share of environmental burdens and energy consumption of road freight (especially NOx, particles, $CO2$ emissions, noise);
- inland waterways used efficiently.

Rail and river transport stand for about 20-25% of total inland freight transport.

Freight transport policy and the role of intermodal freight

Objectives of the national transport policy are:

- the single modes to be used to comparative advantage and linked practically (intermodal transport);
- modal shift from road freight transport to rail, river and intermodal transport;
- the use of inland waterway connections in intermodal transport chains to be supported;
- more efficient use of the ports along the North Sea coast;
- more operations to be arranged at night to reduce congestion problems during day time.

Overview of measures to support intermodal transport

Government measures that influence intermodal transport:

- funding of intermodal freight terminals, both railways and inland waterways,
- subsidies for combined transport,
- construction of new railway links to ports.

Funding of intermodal freight terminals

Each region has its own system for funding intermodal terminals, especially at inland waterways. There is a general subsidy of 25%; 40% for investments in infrastructure (up to 80% for quays) and up to 60% for projects of special national interest. The European Commission has approved this scheme.

Other measures

Subsidies to combined freight transport operators. In order to promote combined rail freight transport on the Belgian network (journeys of at least 51 km) a subsidy is granted (Royal Decree of 30 September 2005) to combined freight transport operators whose place of business is on the territory of a Member State of the European Union. The main objectives of this subsidy are maintenance of the existing traffic of 300,000 ITU (intermodal transport unit) on rail by preventing their shift to road, especially for short distances, and achieving a traffic increase of 20% over a period of 3 years.

This aid comprises a premium per transport unit depending on the distance covered between the trans-shipment centres and a lump sum covering the fixed transport costs, including trans-shipments. Aid may not exceed 30% of transport costs and the system is retroactive to 1 January 2005 and will expire on 31 December 2007. The budget amounts to 15 million Euros in 2005 and to 30 million Euros per year for 2006 and 2007.

The subsidy could be used for:

- any intermodal transport unit (ITU)
- container for surface or maritime transport,
- swap body or box/tipper suitable for rail transport;
- any rail transport of ITU as from 51 km on the Belgian network carried out between 1 January and 31 December of the current year;
- any journey between:
- either public or private trans-shipment centre,
- either a hub and public or private trans-shipment centre.

The combined transport operator is obliged to pass on the subsidy granted to the client who orders transports. In the event of a breach of this condition, the operator may be excluded as beneficiary of this subsidy.

Conclusions and outlook

Belgium has a strong willingness to use the railway and inland waterways for freight transport. Therefore intermodal transport will continue to receive support.

5.1.3 France [RAMBØLL AS, Oslo, 2006]

Background and main problems

France had strong growth in intermodal transport between 1993 and 1997 (+ 64%), but in recent years intermodal transport has declined. One explanation could be that governmental support is substantially reduced. Rail and river transport now constitute about 20% of total inland freight transport. Main problems on a national level related to freight transport are:

- increasing road freight traffic in mileage and tonnes-kilometres;

- capacity problems on road network in conurbations (affecting productivity accessibility and reliability of road freight transport including location attractiveness for enterprises);
- limited services with low quality and high prices on the railway system and intermodal network (priority conflicts between freight and passenger transport);
- increasing share of environmental burdens and energy consumption of road freight (especially NOx, particles, CO2 emissions, noise).

Freight transport policy and the role of intermodal freight

France has had no clear policy for development of intermodal transport, but has recently been financially supporting combined transport infrastructure.

Overview on measures to support intermodal transport

France blends two systems to encourage intermodal transport. The first consists of governmental facilities within the framework of the European Union Rome Treaty to reduce competition imbalance with other European countries and to improve quality. Tax reductions, such as professional tax for road transport according to weight and environmental performance, or for sea transport, aim at favouring sustainable transport within fair competition. Governmental aids for training concern the social aspect of sustainability. The second system consists in subsidies through the Agency of Environment and Energy Mastery, ADEME, to develop the use of intermodality and of combined transport.

ADEME aids can be studies to facilitate hauliers, carriers and shippers in decision-making, e.g. feasibility studies on combined transport (rail-road, river-road, short-sea shipping), or investment aids in intermodal or combined transport for hauliers, carriers and shippers.

Funding of intermodal freight terminals

The government's role in intermodal terminals is limited to financing the French Railway, SNCF.

Other measures

There are two kinds of ADEME investment aid aimed at developing intermodal transport: subsidies for the purchase of specific equipment for combined transport and subsidies for demonstration and innovative model operations of modal transfer.

Subsidies to purchase specific equipment concern intermodal loading units such as swap bodies, trailers that can be griped, swap body sub-frames (1 sub-frame for 2 swap bodies) and trans-shipment equipment (for shippers only). The subsidies are 25% of the duty-free investment (limited to one million Euros) if the beneficiary accedes to the technique, 20% if he develops the use, within the limit of 100 Euros by carbon tonne avoided during the five-year period corresponding with traffic objectives. The beneficiaries are hauliers, carriers, furniture removers, combined transport operators (for their demonstration fleet), shippers.

Subsidies for demonstration and innovative model operations of modal transfer towards rail or river are a function of the overcost of the innovative investment by reference to an equivalent classical investment. Subsidies also depend on the operation planned and on the size of the firm. Beneficiaries are hauliers, carriers, combined transport operators, shippers. The operations concerned should be innovative, either by the technology implemented or by the organisation process, energy efficient while reducing greenhouse gas emissions, and demonstrative concerning their technical and economic feasibility. An energy and environment assessment of the operation should be carried out and the results widely published.

The European Commission has approved two schemes of support in a starting phase for short-sea shipping and a rolling motorway between France and Italy.

Effects

A decline of intermodal transport when governmental funds were reduced.

Conclusions and outlook

France has to improve its efforts to strengthen intermodal transport if it is to prevent all the recent growth in freight transport from going on to the road.

5.1.4 Germany [RAMBØLL AS, Oslo, 2006]

Background and main problems

Germany’s roads, waterways and railways all carry a great deal of traffic. Traffic from Scandinavia and from Eastern Europe passes through Germany. Main problems on the national level related to freight transport are:

- increasing road freight traffic in mileage and tonnes-kilometres (especially on Alpine crossings and in conurbations); growth rates are higher than economic development (GDP) and passenger traffic development;
- capacity problems on road networks in conurbations (affecting productivity, accessibility and reliability of road freight transport);
- limited capacity of the railway and intermodal network (priority conflicts between freight and passenger transport);
- increasing share of environmental burdens and energy consumption of road freight (especially NOx, particles, CO2 emissions, noise).

Rail and rivers carry about 30% of total inland freight transport in Germany. Intermodal transport has increased from 1998 to the present.

Freight transport policy and the role of intermodal freight

Objectives of national transport policy are (www.bmvbs.de):

- modern transport policy encompasses all modes of transport: Roads, railway infrastructure, waterways and air traffic. Only a modern, high-capacity and efficient transport infrastructure can be a guarantee of mobility;
- transport policy pursues the principle of sustainability. Ensure mobility and simultaneously overcome its negative effects. This includes reducing resource consumption and pollutant emissions achieved by optimizing the transport system as a whole and the innovativeness of the mobility industry itself. New transport telematics and traffic guidance system applications smooth out traffic flows, trace optimal routes and logistically track freight. Transfer and combined usage are additionally facilitated with the linking of various modes of transport;
- the Federal government’s aim is for all modes of transport in union to form an efficient and modern overall transport system. Resulting from this, regions of

high traffic density will be relieved, creating development opportunities for structurally weak areas. With innovative system solutions, such an overall transport system also ensures increased traffic safety.

Intermodal freight is important in freight transport policy in Germany. The modal focus is on rail/road and on inland waterways.

Overview of measures to support intermodal transport

Government measures that influence intermodal transport:

- funding of intermodal freight terminals through the state railways DB (Deustche Bahn) and directly to private terminals (max. 85%);
- subsidies for equipment to intermodal transport, vehicles, new technology, information systems, training, etc.;
- funds for measures to strengthen capacity and quality in rail and waterborne transport;
- subsidies for operation costs for loading and reloading in a starting phase;
- enforcement of road freight transport regulation (driving hours, weight, etc.);
- exemptions for trucks in intermodal transport.

Funding of intermodal freight terminals

The government finances intermodal railway terminals constructed by DB within the law on the construction of national railways. Private operators constructing terminals can get up to 80% subsidies if the terminals are open to all transport and operators. In addition, experts have to consider the cost/benefit of the investments and the effect of modal split. Germany has many so-called freight villages with large intermodal freight terminals, often developed in cooperation between many different stakeholders, including federal and/or regional administrations.

Other measures

- subsidies to private railways: new constructions, extension of existing railways, loading units, vehicles, planning and investigations. If the project does not result in the movement of freight transport from road to rail, the operator has to pay back the subsidies;

- subsidies of combined transport rail and inland waterways: Up to 30% of operation costs for new intermodal services in a starting phase and up to 50% of investment costs for equipment for loading and unloading, vehicles and ships, innovative systems for information exchange;
- introduction LKW Maut (LKW-MAUT is a toll for goods vehicles based on the distance driven in kilometres, the number of axles and the emission category of the vehicle) on motorways.

Effects

Germany has had a positive development of intermodal transport in recent years. Intermodal transport road/rail increased between 1990 and 2005 by 80% related to volume. Inland waterway intermodal transport increased between 1996 and 2005 by 210% in relation to volume. Support programmes are designed to give an effect, and if not the subsidies must be paid back.

Conclusions and outlook

Intermodal transport is an important part of German transport policy, now and in the future. The combination of measures in support of intermodal transport and measures that affect road transport is satisfactory.

5.1.5 Italy [RAMBØLL AS, Oslo, 2006]

Background and main problems

Italy is the country in Europe with the largest growth in intermodal transport in the past 10 years. Intermodal transport in Italy receives both financial and political support. Today, 30 – 35% of inland freight transport in Italy is by train or boat. The main problems on a national level related to freight transport in Italy are:

- increasing road freight traffic in mileage and tonnes-kilometres; growth rates are higher than both economic development (GDP) and passenger traffic development;
- capacity problems on road networks in conurbations (affecting productivity accessibility and reliability of road freight transport);
- limited capacity of the railway and intermodal network (priority conflicts between freight and passenger transport);

- increasing share of environmental burdens and energy consumption of road freight (especially NOx, particles, CO_2 emissions, noise).

Freight transport policy and the role of intermodal freight

Objectives of national transport policy are:

- the single modes should be used to advantage and linked practically (intermodal transport);
- modal shift from road freight transport to rail and intermodal transport will be promoted;
- measures to support intermodal transport will compensate for the lack of internalization of external costs in truck transport.

Intermodal freight is important in the freight transport policy of Italy. The modal focus is on rail/road and to a certain extent on short-sea shipping.

Overview of measures to support intermodal transport

Governmental measures that influence intermodal transport:

- funding of intermodal freight terminals;
- subsidies to intermodal operators on railways if they transport a certain threshold of goods a year, or over a certain number of train-kilometres;
- subsidies for equipment to intermodal transport, vehicles, new technology, information systems, training, etc.;
- funds for measures to strengthen capacity and quality of the railways;
- subsidies for operation costs for loading and reloading;
- subsidies for rolling motorways.

The European Commission has approved 13 different Italian aid schemes for intermodal transport.

Funding of intermodal freight terminals

There are over 40 intermodal terminals for rail/road transport in Italy. The five largest (Verona, Bologna, Padova, Parma and Torino) handle about half of all freight transport in the country. These terminals are developed in cooperation between public sector and private industry. The public sector, for instance, has invested over 150 million Euros in Quadrante Europa in Verona.

Other measures

To compensate for the competitive advantage of road transport, the Italian government has established a fund supporting intermodal freight transport on the railway. This scheme has been approved by the European Commission.

Regions in Italy also have funds to support intermodal freight transport on railways.

Effects

Intermodal transport in Italy has had the most positive development in Europe.

Conclusions and outlook

Intermodal transport is an essential part of Italian transport policy.

5.1.6 The Netherlands [RAMBØLL AS, Oslo, 2006]

Background and main problems

The Netherlands is a densely populated country with crowded roads, railways and inland waterways. Freight transport is dominated by transport to and from the large ports to the North Sea. The inland waterway system is important for freight transport in The Netherlands.

Main problems on a national level related to freight transport are:

- increasing road freight traffic in mileage and tonnes-kilometres;
- capacity problems on the road network in conurbations (affecting productivity accessibility and reliability of road freight transport);
- limited capacity of the railway, inland waterways and intermodal network (priority conflicts between freight and passenger transport);
- increasing share of environmental burdens and energy consumption of road freight (especially NO_x, particles, CO_2 emissions, noise).

Inland waterways carry almost 50% of total inland freight transport in The Netherlands, railways 6% and roads 35-40%.

Freight transport policy and the role of intermodal freight

The Directorate-General (DG) for freight transport is part of the Ministry of Transport, Public Works and Water Management and comprises three policy departments: transport safety, transport industry and general freight transport. The Infrastructures, Ports and Intermodal Transport division is part of the general freight transport policy department. Intermodal freight transport therefore has a place in government administration in The Netherlands.

An association of Inland Terminal operators has been set up. Terminal operators need to enhance their operational position by developing new activities in areas such as EDI, liability, repositioning of empty containers. Furthermore, several regional organizations promote intermodal transport.

Inland transport by barge is receiving extra attention to encourage a shift from road to inland navigation. Intermodal freight connected with inland waterways has a very important position in freight transport policy in The Netherlands.

Overview of measures to support intermodal transport

Governmental measures that influence intermodal transport:

- funding of intermodal freight terminals;
- subsidies for equipment for intermodal transport;
- road pricing under consideration.

Funding of intermodal freight terminals

The following measures support favorable initiatives from the market and the liberalization of inland transport:

- support for the development of terminals for container trans-shipment: funds have been reserved in support of promising initiatives promoting intermodal transport, e.g. a container terminal at Utrecht-Lageweide;
- support for the development of terminals for regional distribution.

The basic principles underlying the scheme for subsidizing inland terminals that serve combined transport are as follows:

- private firms should take the initiative to invest in a terminal;
- over-capacity and cut-throat competition should be avoided;
- subsidies to be restricted to public terminals.

The European Commission has approved support schemes for intermodal terminals in The Netherlands.

Other measures

The government is considering a system of charging road transport in order to reduce growth.

Conclusions and outlook

Inland waterways will continue to be essential in freight transport in The Netherlands.

5.1.7 Switzerland [RAMBØLL AS, Oslo, 2006]

Background and main problems

Switzerland is a landlocked Alpine country in the heart of Europe with a large share of freight transit traffic. Main problems on a national level related to freight transport are:

- increasing road freight traffic in mileage and tonnes-kilometres (especially at Alpine crossings and in conurbations); growth rates are higher than both economic development (GDP) and passenger traffic development;
- capacity problems on the road network in conurbations (affecting productivity, accessibility and reliability of road freight transport including location attractiveness for enterprises);
- limited capacity of the railway and intermodal network (priority conflicts between freight and passenger transport);
- increasing share of environmental burdens and energy consumption of road freight (especially NO_x, particles, CO_2 emissions, noise);
- safety/security problems in freight transport.

Rail carries about 30% of total inland freight transport in Switzerland. Intermodal transport fulfils quite a high share of trans-Alpine freight transport (road 35%, traditional railway 30% and intermodal 35%).

Freight transport policy and the role of intermodal freight

Objectives of the national transport policy are:

- single modes to be used to comparative advantage and linked practically (intermodal transport);
- (public) land transport to relieve the roads of road freight transport;
- the high share in rail freight to be maintained;
- modal shift from road freight transport to rail and intermodal transport: On longer distances, and especially in Alpine crossing traffic, a modal shift from road to rail (including combined transport rail/road) is the aim;
- improve attractiveness and capacity for Alpine crossing rail freight transport;
- technical possibilities optimising infrastructure, vehicles and fuels to be utilised;
- the different modes to bear their external costs;
- the use of inland waterway connections in intermodal transport chains to be supported.

Intermodal freight is important in freight transport policy in Switzerland. The modal focus is on rail/road and to a certain extent on inland waterways (Rhine connection to the North Sea).

Overview of measures to support intermodal transport

Governmental measures that influence intermodal transport:

- funding of intermodal freight terminals;
- subsidies for intermodal freight consignments through the Alps;
- subsidies for rolling motorway consignments through the Alps;
- railway track pricing subsidies;
- information system truck information for transit road freight traffic

Funding of intermodal freight terminals

Based on national laws and regulations, Switzerland can fund terminals to promote intermodal transport and to reach a modal shift. Elements financed are: buildings, acquisition or renewal of infrastructure, installations and equipment; extension of railway infrastructure for intermodal terminals; the acquisition of rolling stock for intermodal transport; and other investments to facilitate intermodal transport. The maximum share of co-financing is 80%, with 20% financed by the terminal investor. The share is dependent on the political interest and the degree of economic viability. The following minimum requirements have to be fulfilled:

- a modal shift from road to intermodal transport has to be proved;
- for the location, a need for trans-shipment capacity has to be accounted for;
- investment is necessary for transport policy aims to be achieved;
- terminals will not be built without financial aid.

A main role for funding is achieving the political aims with an acceptable cost/benefit factor. Specific for the Swiss funding scheme is that it is possible to fund terminals in other countries if these cause a modal shift in Switzerland.

In addition to the law and regulations, there is a directive describing the process and content of how to deal with funding requests. The requirements to be fulfilled by the applicant are fairly strict, so there is a good chance that the conditions are fulfilled and the objectives are achieved.

Switzerland funded terminals in 2002 with 25 Mio CHF, 2003 with 75 Mio. CH and 2004 with 49 Mio. CHF. Busto Arsizio (Italy), Wiler (Switzerland), Hochrheinterminal in Rekingen and other terminals have been financed during this time period. In the coming years a funding of 40 Mio CHF per year is expected.

Experiences with the funding scheme have been positive. The directive (implemented in 2004) took account of some of the difficulties that occurred during execution of the regulations. The funding scheme speeded up the terminal realization and guaranteed that certain conditions (e.g. modal shift) are fulfilled.

Other measures

- Introduction of the heavy goods vehicle fee (including reimbursement for trucks used in pre- and end-haulage);
- heavy trucks management for freight trucks on Alpine crossings;
- subsidies to support operators in combined transport for unforeseen development costs (rolling motorways and combined railway transport without drivers);
- subsidies to railway operators on certain railway lines;
- development and construction of new infrastructure, e.g. new Alpine railways;
- regulations of truck transport, e.g. prohibition of freight transport by truck between 22:00 and 05:00 hours;
- road charging for trucks: 2.88 centimes CHF per tonne-kilometre;
- increased total weight for truck transport from 34 tonnes to 40 tonnes;
- enforcement of road freight transport regulations (driving hours, weight, etc.).

Effects

Intermodal transport road/rail increased in volume between 1981 and 2004 from 3 to 22 Mtonnes. The market share increased at the same time from 14 to 35%. The number of trucks through Switzerland reduced from 1.4 M to 1.2 M (14%).

An evaluation of the subsidy system for intermodal transport operation showed that this measure is in general efficient and effective, but that the rules can still be improved. Subsidies per shipment dropped by 30% between 2002 and 2006.

Conclusions and outlook

The modal shift policy of Switzerland is successful. Promotion of intermodal transport will continue to be an essential part of Swiss transport policy. Further modal shift actions will be needed to fulfil the challenging objectives of the Swiss freight transport policy. One approach under discussion is tradeable passage rights.

5.2 OTHER CONTINENTS

5.2.1 Promotion of transport on the Niger and Senegal rivers in Sub-Saharan Africa [PIARC,2005]

In Africa, rivers have always been the principal means of communication, exchange, trade and development. The best known is the Congo in the equatorial area. This use of rivers, however, is not evident in desert and Sahel areas.

In the Sahel, rivers such as the Niger and the Senegal are important, but in these specific cases of desert areas and drought, river transport is excluded during a major part of the year. Mali aims at implementing a strong policy of freight and passenger transport development by rivers and waterways.

A global survey of navigation projects on both rivers has been carried out with the objective of extending the navigation season from 3-5 months to 10-11 months. Implementation of this master plan for rivers and waterways requires improvement works at seaports and waterways, development of facilities and equipment, as well as an adapted shallow-draught fleet.

An additional network of linkage canals and secondary rivers allows navigation all year round in certain sections.

In the Niger basin, for instance, the central part of the river is already used for freight transport along 374 km from Bamako to Kouroussa, and the river Milo along 385 km from Bamako to Kankan, both cities with road and rail connections to Conakry harbour. Towards the north, the Niger can be used for freight river transport along 1,408 km. Three canals allow navigation throughout the year along 200 km and connections with three rivers along a 275 additional kilometres. Development of this waterways network requires equipment with 106 markers, 10 reflectors, overhaul and maintenance of the piers, purchase of a dredger and the dredging of three channels as well as access to the port of Gao.

In the Senegal Basin, the potential for development is greater with the river engineering project: irrigated agriculture, catering, woodcraft, fishing, mining, tourism, hydroelectricity and river transport could actually be developed for the 3 million inhabitants of the basin in Senegal, Mali and Mauritania. An international organisation, OMVS , was established in 1972 to develop this important global programme, and in

1986 and 1988 two dams were constructed including locks. The navigation systems still need improvement at the sea-river port of Saint Louis (Senegal): the creation of business riverside stations, the opening of navigable channels, re-arrangement of call places, organisation of navigation aids, purchase in public-private partnership of a fleet capable of shooting bores and rapids, the creation of repairs shipyards, development of environmental protection appliances, coordination of river transport with rail and road transport (including relocation of parts of the railway system and marshalling yards) and, of course, maintenance dredging.

These development projects of river and waterways transport in an area in the heart of the Sahel show that it is possible to implement and improve good practices in alternative freight transport, despite the difficulties and fundingorganisation, OMVS , was established in 1972 to develop this important global programme, and in 1986 and 1988 two dams were constructed including locks. The navigation systems still need improvement at the sea-river port of Saint Louis (Senegal): the creation of business riverside stations, the opening of navigable channels, re-arrangement of call places, organisation of navigation aids, purchase in public-private partnership of a fleet capable of shooting bores and rapids, the creation of repairs shipyards, development of environmental protection appliances, coordination of river transport with rail and road transport (including relocation of parts of the railway system and marshalling yards) and, of course, maintenance dredging.

These development projects of river and waterways transport in an area in the heart of the Sahel show that it is possible to implement and improve good practices in alternative freight transport, despite the difficulties and funding problems that can be encountered in low income developing countries.

5.2.2 Best practice in intermodal freight transport in Japan [IMANISHI , 2006]

Four different cases of best practice in Japan are presented in this section. The examples are of best practice other than the former presentations of governmental measures. However, here we present new intermodal solutions developed in Japan:

- experimentation with 12 ft container international intermodal transport by rack container;
- experimentation with modal shift between Himeji and Osaka by unit system;
- modal shift by liner train between Tokyo and Osaka;

- rail transport of domestic waste (Kawasaki city).

Experiment with 12 ft container international intermodal transport by rack container

Products made in China are transported in 40 ft containers, which are bigger than the containers used at the delivery centre of Japan. Therefore, the Mitsubishi Electric Home Equipment Corporation (MEHEC) developed “international seamless transportation through flat rack 40 ft containers”, which enables three 12 ft JR containers to be combined and delivered by ship.

MEHEC carried out the sea/land intermodal transportation pilot programme in which household electrical goods were delivered by flat rack containers in the period December 2003 to November 2004.

Experiment Outline

- by changing the port of debarkation of import goods (household electrical
- goods) to the other, the trip length by truck was reduced;
- by using rack containers, sea/land intermodal transport by 12 ft JR container was realized.

Figure 24 - Flat racks

Before the experiment the transport chain was:

Shanghai Port >>> (ship) >>> Tokyo Port >>> (truck) >>> Kumagaya >>> (truck) >>> Kobe, Okayama and Tosu

After the experiment the transport chain was:

Shanghai Port >>> (ship) >>> Moji Port >>> (truck) >>> Kyushu Terminal >>> (railway) >>> Kobe, Okayama and Tosu

The experiment resulted in a reduction of CO_2 emissions by 93%.

Experimentation of modal shift between Himeji and Osaka by the unit system

The Nippon Steel Corporation conducted the modal-shift pilot programme by December 2003 to November 2004. At the same time, the containers were handled using a quasi-unit system, which enables lots to be combined.

Experiment Outline

- modal shift from short HGV transport to marine transport;
- improvement of container handling by quasi-unit system;
- goods transported: iron sheet coil.

Before the experiment the transport chain was:

Himeji city (Hirohata) >>> (truck) >>> Hanshin, Nara and Wakayama

After the experiment the transport chain was:

Himeji city (Hirohata) >>> (ship) >>> Izumi-Otsu >>> (truck) >>> Hanshin, Nara and Wakayama

The experiment resulted in a reduction of CO_2 emissions by 59%.

Modal shift by liner-train between Tokyo and Osaka

The Sagawa Express Company implemented the modal shift from truck to train pilot programme in the period March 2004 to March 2009. The Super Rail Cargo, which was jointly developed by Sagawa Express and the Japan Freight Railway Company, is used on both train and truck.

Experiment Outline

- modal shift from truck to train;
- use of the Super Rail Cargo, which was jointly developed by Sagawa Express and the Japan Freight Railway Company;

- delivery of goods between Tokyo and Osaka by train in 6 hours, which is the same as by truck.

Figure 25 - The Super Rail Cargo

Before the experiment the transport chain was:
Tokyo wards >>> (truck) >>> Osaka City
After the experiment the transport chain was:
Tokyo wards >>> (truck) >>> Tokyo Terminal <<< (train) >>> Ajikawaguchi Station <<< (truck) >>> Osaka City
The experiment resulted in a reduction of CO_2 emissions by 81%.

Rail transport of domestic waste (Kawasaki city)

When Kawasaki city transported its domestic waste from the disposal centre to the landfill site by trucks, there was a delay caused by urban traffic congestion. In collaboration, the city and JR Freight therefore jointly started rail transportation of domestic waste in October 1995, followed by empty bottle rail transport at the end of 1998 and empty cans in April 1999. Domestic wastes are loaded into containers at the disposal centre. After the containers are washed and cleaned, they are transported to the freight terminal station by truck. The containers are then transported by rail to the destination station, which is 23 km away. The train has 17 cars and completes the return journey once a day. Kawasaki city reports a CO2 emission reduction by 1.5 million tonnes CO2 a year.

Figure 26 - Train used for domestic waste transport and for loading/unloading containers

5.2.3 Best practices of intermodality in Latin America [PIARC, 2006]

The best practices in Latin America concern mainly an original concept of road-rail motorway, the generalisation of dry ports and intermodal terminals and the development of multimodal corridors.

Rail-road transport is not operated and combined transport is fairly underdeveloped in Latin America, mainly because of height limits in tunnels. So, two bimodal vehicles concepts – coupling tyres and rail bogie on a trailer – have been developed in Brazil and are operated: NOMA Company Rodotrilho used by the operators CVRD along 650 Km (average speed of 70 Km/h) and by ALL between Sao Paulo and Buenos Aires; and Randon Company Transtrailer used by the operator MRS.

The generalisation of dry ports in Brazil and Mexico facilitates the use of intermodal facilities and participates to congestion reduction in ports. Seven intermodal terminals developed by financial partnerships between rail, river, port and even airport operators operate efficiently in Brazil in 2006: Santos, Paranagua, Bahia, Santa Catarina, TEV, CFN and Sumaré. The port of Zaraté, the first private port in Argentina built in the frame of the Ports Act is an example of successful experience. This port terminal has an intermodal centre, jointly built up with the railways concessionary NCA, allowing goods arriving from the west-north region of the country to be directly conveyed to the port.

Successful experiences of rail-road transport concern mainly ore transport in Brazil or raw produce (soy/cotton). Several multimodal corridors converging to the United States are also a reality in Mexico. In Bolivia, 8 multimodal corridors (rail-road-river-sea) have been developed, carrying more than 2 million tons a year since 2003.

6. BEST PRACTICE IN SUPPORTING INTERMODAL TRANSPORT: SPAIN

Intermodal transport is conceived as a component to rationalize and enhance the quality of goods transport, based on greater cooperation among all modes of transport, and a key point for improving costs in the logistic chain, influencing the final price of goods on the destination markets. This aspect is particularly critical in the international sphere, because globalization and the new world economy demand constant improvements to logistic processes.

Coordination between Administrations and between them and the operators is fundamental, because of the current distribution of faculties and the realities of goods transport. Plan of action is shown in figure 27.

Coordination in the area of goods intermodality refers not just to the modes of transport but to inter-administrative competences. The former contains a technical component linked to action in the territories of different Administrations, and may refer equally to a logistic node or to a territory of more or less extension. The second aspect affects the competences for the regulation of transport services, and will require increased cooperation, particularly in corridors with greater potential for the development of intermodality.

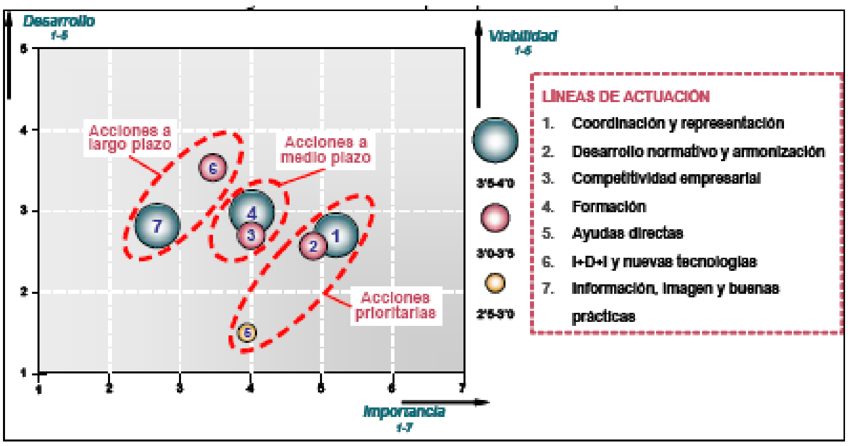


Figure 27 – Intermodality development in Spain: plan of action in long term, medium term and short term (PEIT 2005-2020, Ministerio de Fomento)

The ideal development of intermodal goods transport requires sufficient infrastructures in each of the modes involved but also imposes some demands of its own on the infrastructures, and calls for specific platforms where modal interchange takes place. It also requires particular services from the operators in the intermodal network, and for the handling of these cargoes. This makes it necessary to create an Intermodal Goods Plan dealing simultaneously with the following aspects:

- Infrastructure actions: nodes and corridors.
- The framework for the provision of services.

The priorities of the Intermodal Goods Plan focused in the period 2005-2008 on enhancing the efficiency of existing facilities, structuring the system by inter-mode connections, and the upgrading of some key nodes and, above all, on encouraging new operators through suitable regulation, accompanied by specific backup programs. These priorities are:

- To foment the territorial structuring of intermodality-based national and international logistic nodes, coordinated with regional and local Administrations (the areas of Madrid, Barcelona, the Basque Country, Valencia, Zaragoza, Algeciras and Seville).
- Development of a network of regional intermodal platforms inserted into the main areas of production and consumption in the Autonomous Communities.
- The enhancement of port intermodality with the development of Logistic Activity Zones at ports with potential to operate as national/international hubs, complemented by medium-traffic ports.
- Reinforcement of rail access to ports taking account, from the initial stages of the new zones of port activity, of the conditioning factors raised by rail.
- Integration of the goods rail network into land logistic platforms developed or planned.
- Development of intermodality in air cargo, through Air Cargo Centres (Madrid, Barcelona, Vitoria) and other airport infrastructures specialized in cargo.
- Startup of a specific program promoting intermodality, in coordination with the EU’s Marco Polo II program.
- Backing for new operators.
- To promote the launch of experiments in urban and inverse logistics (linked to waste management).

The priorities from 2009 are likely to target decongestion of the main nodes (Barcelona and Madrid), greater attention to the specific needs of urban logistics (requiring the prior creation of a suitable coordination framework) and progressive development of national operators in the European context. The last of these is in turn linked to increasing the capacity of rail links with France, with the promotion of the central trans-Pyrenees intermodal connection, putting down the bases for the inauguration of the new tunnel set for the year of the PEIT's horizon. Increasing backing will also be needed for operators, to introduce new intermodal transport techniques, or for them to internationalize.

Longer-term, there must be conditions for the startup of active goods traffic management measures, favouring the most sustainable modes in areas of greater environmental vulnerability, with the provision of fully competitive alternatives.

The Intermodal Goods Plan includes the following aspects:

- The structure of an intermodal network in Spain: basic definition of the system of hierarchical modal and intermodal goods corridors and logistic nodes connected to the international corridors.
- National and international intermodal corridors: their definition, the priorities of intervention and the main actions to improve infrastructures.
- The intermodal network nodes: their hierarchical organisation and multimode and logistic functions.
- Port intermodality: rail access, terminals and logistic activities zones.
- Rail node intermodality: functionality, road and rail access and logistic integration.
- Airport intermodality: air cargo centres and cargo facilities, and integration into the logistic environment.
- Route nodes: functions and centres.
- Non-infrastructure actions: for rail competitiveness and backup to get cargo off the roads, training, new technologies and promotion of short sea shipping traffic.
- Territorial intermodality coordination plans: intermodal plans at a regional or local level.

The map in Figure 29 shows a prospective scheme for this structure of trunks and nodes, based fundamentally on the present situation and action under way. It thus has no prescriptive force: any necessary decisions will in any case be taken as part of the Intermodal Goods Transport Plan.

That Intermodal Plan will on the other hand deal with these matters in terms of the territorial coordination of intermodality, and so include the following:

- Coordination of transport infrastructure policy and services.
- European and supranational coordination.
- Coordinated territorial policies and action (the state, the autonomous communities and local authorities).
- Programs of coordinated action at logistic nodes and in goods transport.
- Coordinated public and private action.
- Regulatory action and that in the institutional framework.

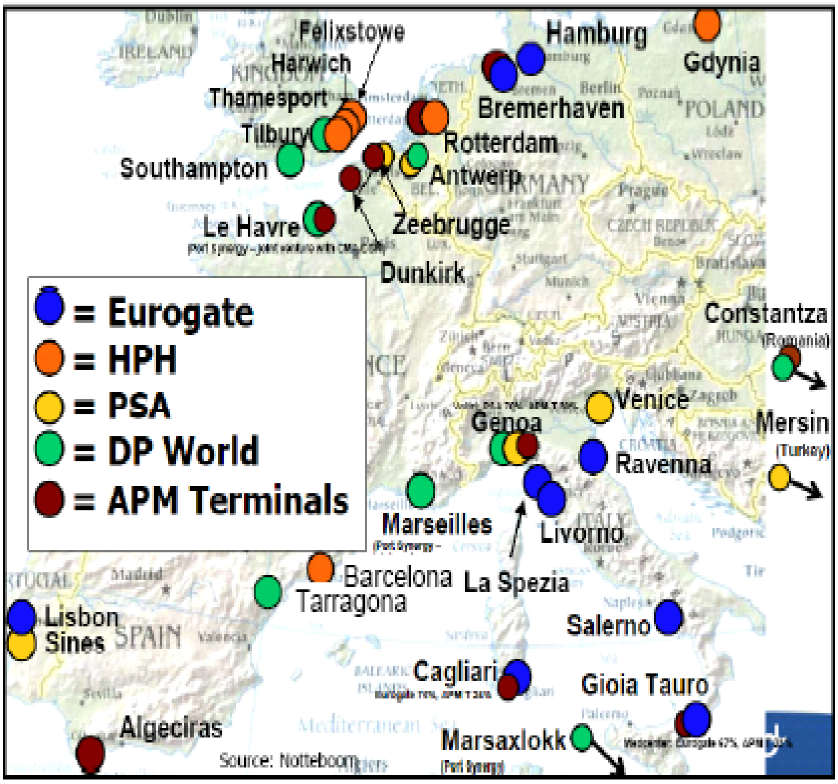


Figure 28 – Most important logistic terminals in Europe

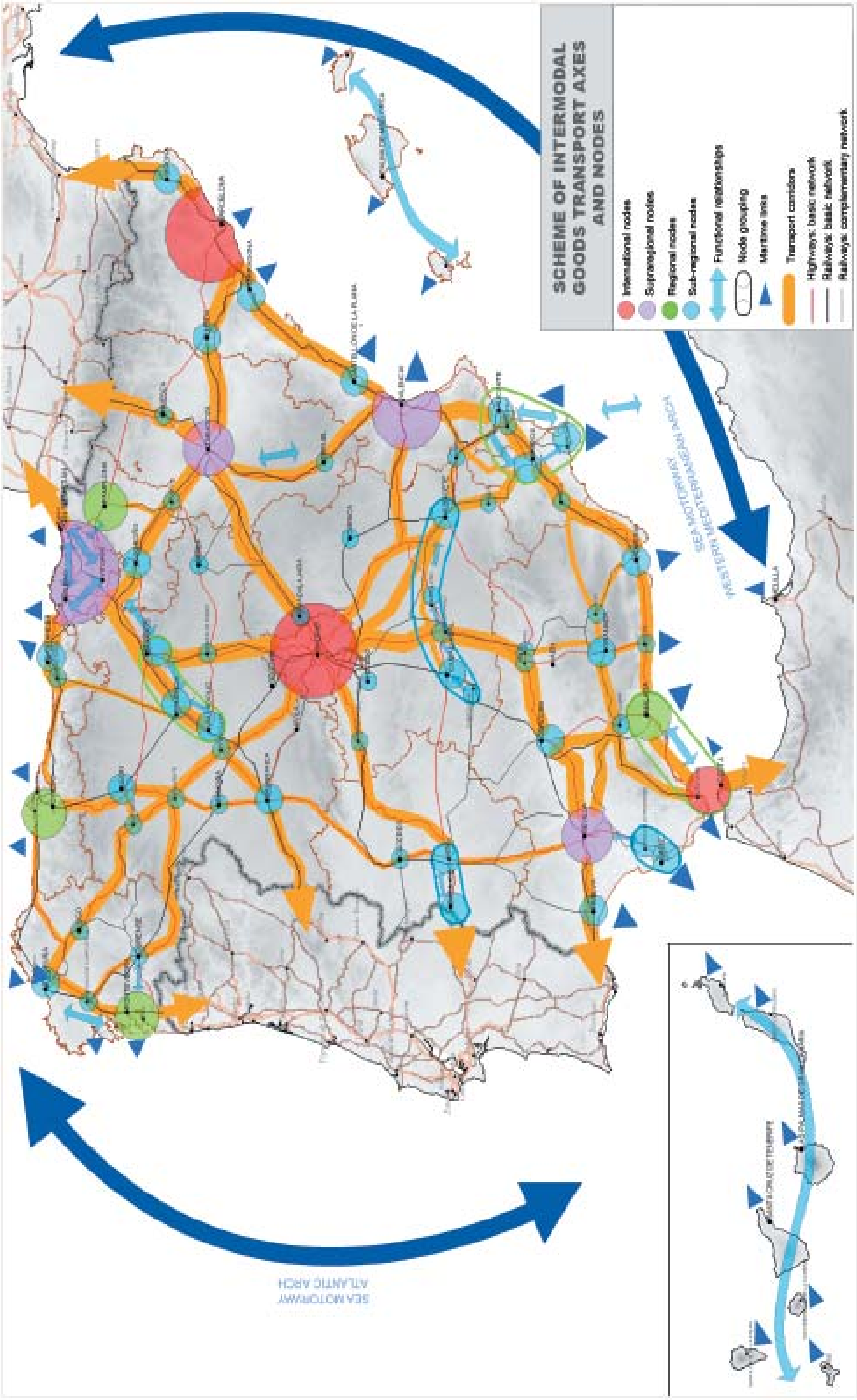


Figure 29 – Schemes of intermodal goods transports axes and nodes in Spain (PEIT 2005-2020, Ministerio de Fomento)

The structure of an intermodal network in Spain: corridors and nodes

The intermodal network is structured on international and national nodes, most of which offer all forms of transport, connected by both rail trunks and high-capacity roads. In rail terms, these nodes have adequate facilities, and the network joining these points must have a capacity for goods trains at least 600 meters long, as is habitual in the rest of Europe.

National and international intermodal corridors: the main actions

The main national combined traffic corridors are on the Mediterranean Axis, the Central Corridor (Asturias-Madrid, Basque Country-Madrid and from here to Andalucia) and the Ebro Axis. Traffic levels are also significant in the Madrid-Levante Corridor. The importance must be highlighted of the traffic at the border crossings at Irún and Portbou, and in Badajoz, at somewhat lower traffic levels.

Other corridors of great importance because of their goods traffic by rail are the connections with Galicia and the Galicia coastal axis, the Madrid-Badajoz-Portugal axis, the access to Cantabria, and the Andalusian corridors to Cádiz, Huelva, Algeciras and Málaga.

The priority actions in these corridors are the creation or consolidation of logistic platforms linked to existing and planned combined-transport rail terminals in the main intermodal transport corridors (see figure 30).

The system's insertion into the international corridors requires completion of the main international connections (Portbou, Irún and Badajoz), so that interoperability with the French and Portuguese systems is essential, and including a shift to UIC gauge at the first two and, at the third, in coordination with Portugal.

It will be a priority to invest in the creation of logistic interchange facilities using both gauges, located between the conventional network and the new one, and the boosting of the central Pyrenees link, guaranteeing the corridor's continuity with the rest of the Community rail system.

Figure 30 - Main combined transport flows (PEIT 2005-2020, Ministerio de Fomento)

Intermodal network nodes

Nodes are critical points for the functioning of the transport system, whose efficiency depends on the role they play. This is particularly decisive in the case of the goods transport system and logistics. The nodes are influenced by the various aspects of the system's three key factors: capacity, time/deadlines and quality.

The goods transport nodes are points of fracture for cargo or for traction, where a substantial part of the chains' total costs are concentrated, and decisive in the system's "overall logistics bill". These fracturing processes represent quantitative leaps in cost and time in the goods flowchart.

Intermodality is decisive in the structuring of the nodes:

- Sea-land intermodality: the correct organisation of road and rail accesses to ports integration of terminals, and the promotion of Port Logistic Activities Zones.
- Air-land intermodality: promotion of Air Cargo Centres and Airport Logistic Centres.
- Rail-road intermodality: the creation of the right network of rail nodes, and road access to stations, and the concentration of logistics platforms integrated into rail terminals.

Node potential should not in any way be limited to the processes for intermodality or change of mode, but must extend to multimodality in its entirety, that is, the availability of a range of modes and options for the channeling of goods by the end loaders (logistic operators or industrial enterprises) in a given field, so that multiple options are available depending on the type of cargo and the logistic urgency. This multimodality is a decisive factor for the range and level of quality of a given logistic node, conditioning as it does a substantial part of the logistic, entrepreneurial and productive functions located at and associated with that node.

The transport nodes are also configured as areas of potential economic development linked to the introduction of infrastructures and activities of an economic nature, and their impact in job-creation, investment, increased productivity or the diversification of the economic fabric.

The future logistic and goods transport system is structured around a hierarchical network of multimode nodes (at the international, national or supra-regional and regional levels). These form a principal part of the system of cities, they are completely integrated into the territory, and they constitute centers of logistic articulation with their hinterlands.

To deal with the territory as a whole, this network is complemented with a series of nodes which will need strengthening and consolidation, right now of more reduced scope, such as those located on the transverse Castilla La Mancha axis or the Extremadura axis, and others of a local nature in the main goods transport corridors, whose operability will thus be enhanced.

This system supports not just the structure of the traditional corridors (radiating from the centre, the Mediterranean trunk, the Ebro corridor), but also some alternative transversal routes, and particularly the Valencia-Zaragoza-central trans-Pyrenees corridor, and the transverse Castilla La Mancha axis. Cross-border logistic links will also be enhanced, not just the trans-Pyrenees route (the Atlantic, Mediterranean and Central corridors) but also the connection with Portugal (the Atlantic axis, the Valladolid-Portugal corridor (the N-620 highway), the axis with Lisbon and Sines, the Sevilla-Huelva-Algarve axis).

6.1 Sustainable transport

6.1.1 Introduction [Ministerio de Medio Ambiente, 2009]

It is expected that freight transport in the European Union will grow significantly and road transport will account for a major part of this growth. By 2020 almost 30% of CO_2 emissions in the European Union will be caused by transportation. It is obvious that our present patterns of transport growth are unsustainable. [Ministerio de Medio Ambiente, 2009]

One way toward more sustainable transport is to explicitly take greenhouse gas emissions into account in logistics decisions and to get freight traffic to switch from roads to alternative transport modes. This contribution discusses drivers and opportunities for intermodal transport planning. Related literature is surveyed and fields for future research are identified.

6.1.2 Sustainability [Ministerio de Medio Ambiente, 2009]

Improved environmental performance by the transport sector is articulated in two areas: a reduction of the global impact of transport (mainly with reference to climate change) and the quality of the environment in natural and urban surroundings. On the other hand, in line with the principles of sustainable development, this area also includes the enhanced integration of sustainability targets into decisions on transport policy.

Effects of a global nature. Development in line with the guidelines in the National Plan for the Allocation of Emission Rights: stabilization of transport emissions in 2005-2007 and, by 2012, to cut emissions to 1998 levels. Reduction of emissions of nitrogen oxide (NOx) and other pollutants in the transport sector according to the guidelines in the national program for the progressive reduction of this country’s emissions of sulphur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOC) and ammonia (NH3), bringing their subsequent trends into line with the targets set for Spain in Directive 2001/81/CE on National Emission Ceilings.

Environmental quality. Compliance with European Directives on air quality for 90% of the population (2012), cutting by at least 50% current excesses over the limits on air quality levels in the cities, in relation to pollutants for which transport is the main source. Compliance in the shortest possible term with the international standards on environmental quality, and promotion at the international level of their urgent review.

Identification of “sensitive territorial areas” which are particularly vulnerable to the impact of transport (2008) and the elaboration of specific programs for action (2012). Integration of public policies. To establish the bases for the progressive integration of the targets of territorial planning policies, protection of Nature and of public health into transport policy.

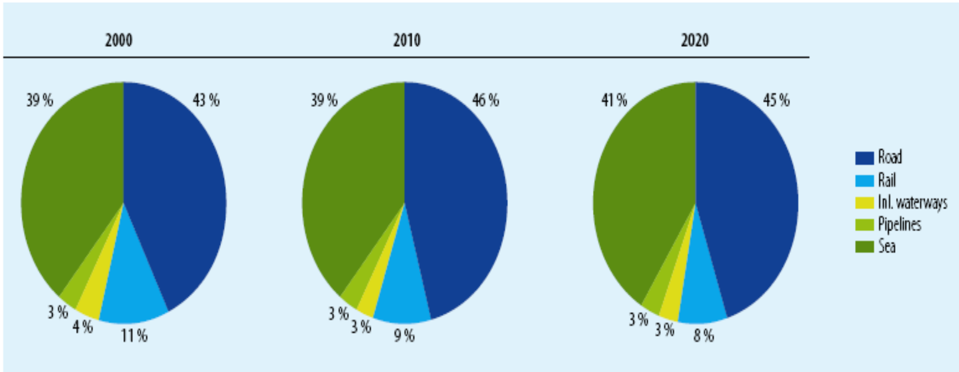


Figure 31 - Evolution of modal Split (European Comission)

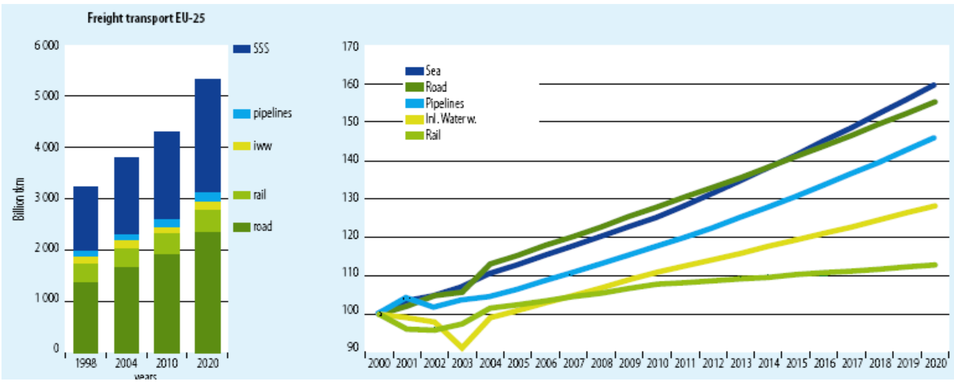


Figure 32 - Development of freight transport (European Comission)

6.1.3 Increasing sustainability [Ministerio de Medio Ambiente, 2009]

In order to facilitate a shift in the modal split it is indispensable to understand the reasons for the prevailing dominant role of road freight transportation. As a result of global competition many companies increasingly apply just-in-time practices in order to cut down inventory levels. Just-in-time practices necessitate punctual, reliable, and flexible transportation, as with reduced inventory buyers any mismatch between supply and demand can result into significant disturbances of supply chain performance. This is particularly important as one element of just-in-time practices is the reduction of order sizes and more frequent requests for deliveries with respect to the current demand and inventory levels.

Rail, short-sea and inland waterway transport, however, cannot satisfy the resulting requirements as effectively. On the other hand, road transport is the least environmentally friendly mode of transport.

Transportation services that are punctual, reliable, and flexible as well as sustainable can only be provided if the specific strengths of each mode of transport are combined according to the specific customer requirements. Transportation service providers currently focusing on road transportation can only provide more sustainable services if they include intermodal services into their portfolio. Without this integration of intermodal services they are at risk of losing customers when shippers are becoming increasingly concerned with environmental issues.

Today's planning tools for road transportation are mainly based on the vehicle routing problem and its variants. Most classical models for vehicle routing, however, cannot consider intermodal services. The general vehicle routing problem presented by differs from these models as it allows specifying transportation requests by a sequence of locations that must be visited in a predefined order. Time window constraints imposed on these locations allow for considering transportation requests in which a part of the transportation between origin and destination must be realized by a specific roll-on/roll-off train or ferry. Although the general vehicle routing problem has certain capabilities of considering accompanied intermodal transport, it can neither decide on whether intermodal transport shall be chosen or not, nor which specific train or ferry shall be used.

6.1.4 Non-infrastructure actions [PEIT 2005-2020, Ministerio de Fomento]

This section includes the policies and services related to intermodal transport and the progressive incorporation of environmental criteria and principles of sustainable development into logistics activity.

For transport-related policies and services, the following can be mentioned in the short term:

- Domestic rail competition: the success of the development of intermodality demands an ambitious program of support to new intermodal transport operators.
- Actions to foment the shift of cargo to rail, aimed at achieving a new modal equilibrium of greater economic and environmental efficiency. These actions must be aimed particularly at enhancing the conditions for change in road operators according to the possibilities for cooperation with the rail operator, and the availability of and access to rail infrastructures permitted under the new rail legislation.
- These actions will also include support to existing goods operators, including the rail operators, to make them genuine Europe-wide logistic operators, promoting policies for alliances, the sector's technological development and the interoperability of goods traffic in areas such as traction and the regulation of services, personnel authorizations, operational regulations and training.
- Technological programs for collaboration between operators and as backing for training in new intermodal transport techniques.
- Collaboration with regional and local public institutions to reinforce and promote intermodal logistic infrastructures.
- Flexible processing/operation at ports for short sea shipping traffic.

And, medium- and long-term:

- Support for new rail operators.
- To intensify policies backing understanding and collaboration among rail, road and short sea shipping transport operators, focused basically in the areas for the commercialization of services.
- Support for the generalized introduction in the sector of new techniques, technologies and thinking.
- The integration of environmental variables from the very outset of planning must cover not just the activities of the Administration but also those of the operators themselves, with the inclusion here of environmental targets. It will be essential to this process to fix design and operational criteria which as far as possible minimize the negative impact on the surroundings, and foment the launch of practices in areas like urban and inverse logistics

6.2 Air

6.2.1 Priorities

The priorities defined by the Strategic Infrastructures and Transport Plan (PEIT) aim at the progressive enhancement of the sustainability and the environmental performance of air transport, its progressive integration with the other forms of transport, and to facilitate the incorporation of the airport system into its local context.

Air transport system intermodal priorities are:

- Consolidation of a multipolar node system ("hubs") (based initially at Barcelona-El Prat and Madrid-Barajas) to avoid problems of congestion caused by over-concentration.
- The development of intermodality (land accesses) using ad hoc coordination and financing systems with the participation of all those involved.
- Air cargo: to structure the logistic airport nodes based on the development of Air Cargo Centres in addition to that already in existence at Madrid-Barajas (Barcelona and Vitoria) and backed up by complementary nodes: nearby airports, airport activity parks and air cargo terminals. The air cargo system must allow for the development of competitive services integrated into the intermodal goods transport system.

The objectives from 2010 aim at the progressive integration of air transport into the intermodal goods system and to ensure the long-term compatibility of air transport with the environmental targets fixed for the transport sector. To this end, the airport and air navigation infrastructures provided for in the Air Transport Sector Plan and each airport's Master Plan will be built, taking account of the associated analyses of financial profitability and environmental compatibility.

6.2.2 Structure of the Air Transport Sector Plan

There are 48 Spanish airports (including the military air bases open to civilian traffic and the heliport in Ceuta) which are run by the Ministry of Public Works and Transport through AENA (Spanish Airports and Air Navigation). Within this network, the opening of the airports at Burgos and Monflorite-Alcalá (Huesca) is pending .

In 2020, the Spanish airport network will comprise public airports and others run by private enterprise. Those in the public system may be owned by the General State Administration or the Territorial Authorities. The forms of participation of the various Administrations and institutions in the management of the public airports will be defined.

The incorporation of new airports into the public system will be conditional on the completion of studies of their socio-economic benefits and the environmental compatibility, and will particularly be carried out in a context of coordination among the various Administrations.

In a framework where sustainable development is the basis for attaining the remaining targets set, the Air Transport Sector Plan will develop strategies for the types of traffic likely to occur at the network's various airports:

- Hub & spoke traffic.
- Point-to-point traffic.
- Tourist and business traffic.
- Cargo traffic.

The Air Transport Sector Plan, to be prepared within a year following the approval of the Strategic Infrastructures and Transport Plan (PEIT), will set the guidelines for the review and updating of the Master Plans, which will define the State Network airport activities designed to ensure that airport infrastructures are appropriate to the demand forecast for the 2020 horizon, with suitable standards of quality, safety and operability, in the context of sustainable economic, social and environmental development. The Sector Plan will also include other actions aimed at providing airports with greater operational capability, maintaining high standards of operational safety or by allowing the demand met to differ from existing levels, so assigning greater growth potential to some airports in markets still in the process of maturing.

6.2.3 Infrastructure actions

Following table and figure show the main actions designed to provide sufficient capacity to airport facilities to meet the demand foreseen to fulfill the necessary operational, safety and security conditions, ordered according to objectives. These actions extend to all the airports in the State network.

AREA OF ACTION	OBJECTIVE	PLANNED INVESTMENT M€	% OF TOTAL
MANOEUVRING AREA (Runways, taxiways, parking aprons, ...)	To adapt flight field capacity to forecast air traffic demand.	2,150	13.69%
TERMINAL AREA (Passenger and cargo terminal buildings, technical blocks, ancillary buildings, ...)	To adapt capacity to forecast demand and improve the quality of services provided to passengers, luggage and cargo in airport terminal areas.	5,760	36.69%
SAFETY AND SECURITY (S.E.I. Systems and infrastructures /Fire-extinction, safety zones, hold baggage inspection systems, X-ray equipment, access control, etc.)	To enhance safety and security (aeronautical operations, protection of persons and property; job-risk prevention).	1,444	9.20%
AIR NAVIGATION SYSTEMS (Air traffic control systems, navigation aids, communications system, radar, ...)	To improve air traffic navigation and control, contributing integration into the Single European Sky.	1,780	11.34%
MAINTENANCE AND CONSERVATION (Backup and minor investments for replacement and maintenance of infrastructure)	To improve maintenance and conservation of aeronautical infrastructures.	1,179	7.51%
INTERMODALITY, THE ENVIRONMENT, EXPROPRIATIONS ETC. (Vehicle access and parking, urban development, environmental action, expropriations, etc.: computer systems and telecommunication networks, ...)	To increase the intermodality and sustainable development of air transport, facilitating the integration and sustainability of the total transport system.	3,387	21.57%
	TOTAL	15,700	100%

Table 6 - Main actions on infrastructure, and investment in the state airports system (PEIT 2005-2020, Ministerio de Fomento)

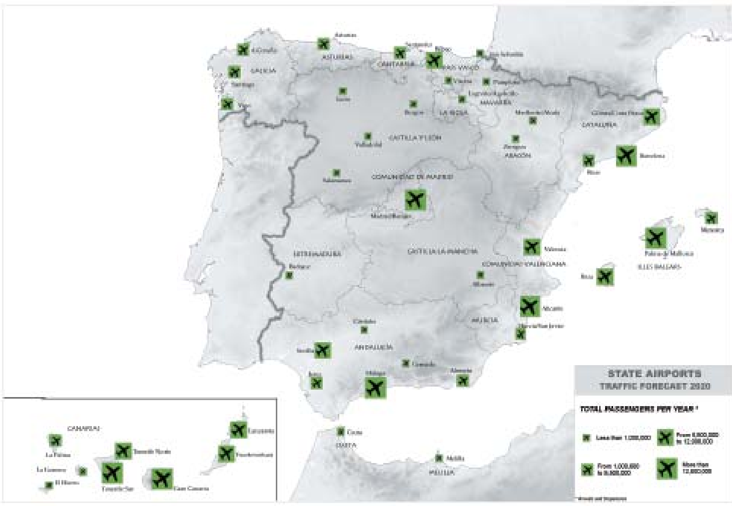


Figure 33 - State airports. 2020 traffic forecast (PEIT 2005-2020, Ministerio de Fomento)

6.2.4 Airport intermodality

In conclusion, the objective is to structure the airport logistic nodes around the Air Cargo Centres, integrating them into the intermodal system, to secure more competitive air cargo services. The Intermodal Plan’s proposal for Logistic Airport nodes can be structured into three large groups:

- Air Cargo Centres (mainland or regional nodes): logistic parks specializing in air cargo.
- Airport Activities Parks: installations for air cargo and other logistic and service activities.
- Air Cargo Terminals at airports with less traffic.

The Plan must take account of airports which might draw cargo away from the large Air Cargo Centers.

6.3 Road

The Mediterranean Axis, the central Axis, the Ebro Axis, and those from Madrid-Barcelona-French border and Madrid-Levante are the trunk routes with the most intense traffic in goods transport by road, followed by the corridors to Galicia and the connections with Portugal.

The road logistic nodes can be structured into two large groups: intermodal logistic nodes and road transport centres, in operation and those planned or possible.

Intermodal logistic nodes are those where two or more modes of transport converge, and their organisation must make the most of their multimode conditions to develop logistic infrastructures as backup to economic activity. The following can be identified as international or supra-regional intermodal nodes: the Area of Madrid, the Area of Barcelona/Catalonia, the Area of the Basque Country, and Valencia, Zaragoza, Algeciras and Seville.

The aim of the road transport centres is to provide service not just to through traffic but also to transport and logistics companies. They are located on the main corridors for the road transport of goods and, as a priority, at nodes where several of these corridors converge (see figure 34).

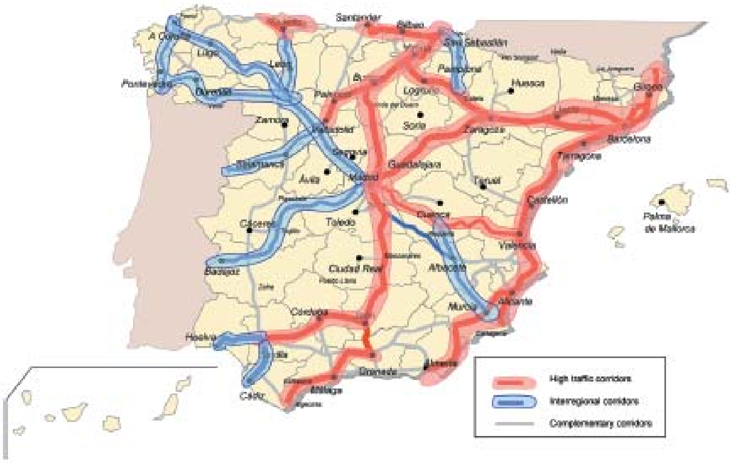


Figure 34 - Main corridors for the transport of goods by road (PEIT 2005-2020, Ministerio de Fomento)

6.4 Transport safety

There are three facets of safety and security in transport: in the first place, the risk to the user of being involved in an accident; secondly, the need to protect persons, the goods transported and the installations themselves, from illicit action; and finally, the prevention of job-risks.

These three facets are dealt with independently in each mode of transport. In many cases, safety demands arise from international commitments or agreements. Moreover, jurisdiction in the safety field affects various Ministerial Departments, where the appropriate coordination mechanisms will be set up. This independence must however be compatible with the aim of offering more consistent safety conditions from one transport mode to another, and the reinforcement of cooperation among specialists, so that risk assessment systems and the planning of actions may benefit from the experience of modes offering higher levels of safety in the three facets referred to.

To these ends, each Ministry of Public Works and Transport Directive Centre and Public Enterprise will provide information on its activities in the safety field as part of the biennial monitoring report on the Strategic Infrastructures and Transport Plan (PEIT), and a mechanism will be established for cooperation in the area of safety in transport, for periodic review of that information.

The creation of a Transport Safety and Quality Agency is intended to provide a specific body which will facilitate more integrated safety policies in the various modes, fomenting research and studies in the field, and favoring increasing autonomy in the analysis and evaluation of safety in each transport mode in the Centres and Public Enterprises responsible for the management of infrastructures and of services.

6.5 Rail

Because of the significant growth in combined transport in recent years, this has been converted from an aspect of residual capacity to situations of saturation at some existing terminals, particularly in the areas of Catalonia and Madrid.

This situation had already arisen elsewhere in Europe, and the spectacular growth in traffic foreseen by the rail operators (trebling the physical units transported in the period 1990- 2005) will not be able to be dealt with overall, partly because the necessary infrastructures are not available.

In the sense, the concept of the “terminal” has evolved, and it is now widely accepted that, without adequate terminals, growth in combined transport will not be possible, the terminal being a key facility where the transport is organised, and which has extended its function to the current conception, where it is a centre for mode interchange and logistics involving multiple activities, whose synergies enhance its capacity to generate transport, and able to carry on logistic activities of great added value.

In parallel there is at this time a liberalization process under way in Europe which, as it moves forward, makes evident the need for clear structures to manage Combined Transport terminals, which guarantee that all operators are treated equally, and for transparency of rates and the conditions in which they are applied, along with the provision of consistent, certified services in all terminals (see figure 35).

The proposal on logistic rail nodes developed in the future Intermodal Plan can be structured by organising existing terminals into a hierarchy in three large groups, complemented by new areas with development potential. Those highest in the hierarchy would be terminals like Madrid, Barcelona (both with saturation problems), Bilbao, Valencia-Silla, Irún or Portbou.

The future of the border rail installations at Irún-Hendaya and Portbou-Cerbère requires specific analysis of the future scenarios in the context of the introduction of the UIC gauge into the Spanish network, and its connection with the French system. The design of future border facilities must be coordinated with the French authorities (figure 36).

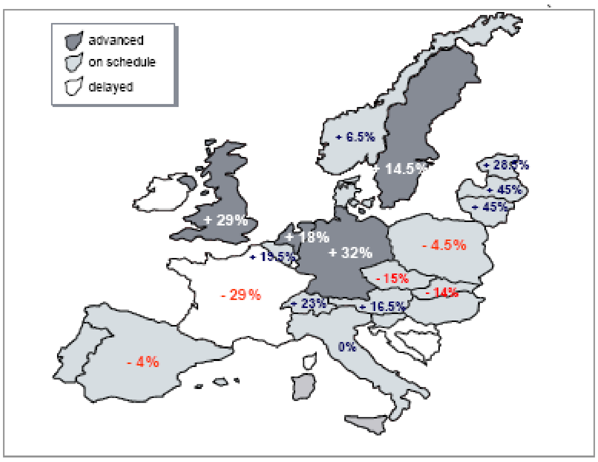


Figure 35 – Railway intermodal transport evolution in Europe 2000-2008 (Prog Trans AG "European Transport Report 2007/2008")

Figure 36 – Railway Spain/European network (European Comission)

6.6 Maritime

Structuring of the port logistic nodes must take two aspects into account: on the one hand, the importance of the port node (internationally, supra-regionally or regionally) and, on the other hand, its logistic potential, linked to existing or planned Port Logistic Activities Zones.

Most ports share the problems of land access, because of surrounding urban growth.

There are in fact currently problems in rail connections to the majority of ports. Rail accesses are subject to particularly intense pressure which has to be dealt with as part of urban planning so as to make transport requirements compatible with the current situation, and to prevent problems from becoming more acute in the future.

The Logistic Activities Zones (ZALs) are an element of great importance in the intermodal transport chain, and are configured as territorial nodes which generate economic activity linked both to transport and logistics and to productive activities. Only the ZAL at the port of Barcelona is currently in operation, but there are plans for such zones at most Spanish ports, at various stages of development and which must be fomented.

6.6.1 Short Sea Shipping

Short sea shipping is the transportation of cargo and passengers by sea between harbours inside the EU territory or between those ones and others located in non-european coutries sharing the same sea as European countries.

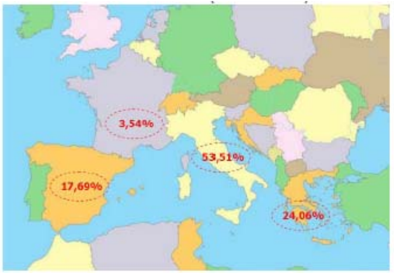


Figure 37 – Ro-Ro Transport Mediterranean countries (Grimaldi Group, Annual report 2006)

This kind of transportation includes national and international sea shipping, as well as feeder services along the coast, islands, rivers and lakes. This term is also applicable to sea shipping between countries being members of the EU and Norway, Iceland and other countries by the Baltic, Black and Mediterranean Seas.

Figure 38 – Short Sea Shipping loading (Short Sea Promotion Center Spain http:// www.shortsea.es)

Short Sea Shipping includes, obviously, internal coastal traffic in each country, being the main ones the regular services between continental harbours and the ones at the islands belonging to the same country. Taking Spain, many of the sea shipping services between Canary and Balearic Isles and the Iberian Peninsula can be matched with the idea of Short Sea Shipping in Europe, not only because of its regularity and high frecuency, but for being part of logistical chains able to have a railway section (Canary Isles-Seville harbour-Madrid by railway). In Spain, the following tracks are very important at present:

- Euro-Mediterranean track, in which short sea shipping services are available, showing its technical and economical feasibility and its potential future development (see figure 37).
- Atlantic track.Harbours in the European Norht Atlantic track (North Sea included) are the ones which currently have the biggest load concentration due to being next to the big European production and consumption areas. These harbours provide with good possibilities of consolidating the short sea shipping services with farther harbours (see figure 39).

In addition, inside the Mediterranean scope, the strategy on reinforcing this type of transport must take into account the possibility of Europe and Africa being connected. It is about a substantial link of the logistical chains under the economical development of Magreb (Morocco, Algeria, Tunisia), because of its own potential and the change of many european production centers to those latitudes. Sea shipping services network for rolling transhipment, in container and of passangers, is denser and denser each year and and thanks to the cooperation among Euro-Mediterranean harbours, more and more consolidated and with the perspective of being a free trade area.

In order to assess the potential development of short sea shipping in Europe, we need to refer to the European corridor that links the Iberian Peninsula and the rest of Europe. Through this corridor they take the shipment that Spain exports or imports from the rest of Europe. Alike other corridors, terrestrial transport was becaming more important in this flows, above all after Spain become a member of the EU in late 1985. The growth rate varied from 2,8% to an stable 8,4%, currently generating a traffic volume around 70 million tons in both directions. This means an average of 3500 trucks driving through the borders at Junquera and Irun, and the con-sequential side effect of the traffic jams. Leading the short sea shipping sector becomes a fundamental matter, specially having in mind the creation of a Mediterranean area of free trade in 2010, after the Declaration of Barcelona.

Región marítima	Millones de toneladas
Océano Atlántico	33946
Mar Báltico	16751
Mar Negro	11092
Mar Mediterráneo	83259
Mar del Norte	24840
Otros	7778

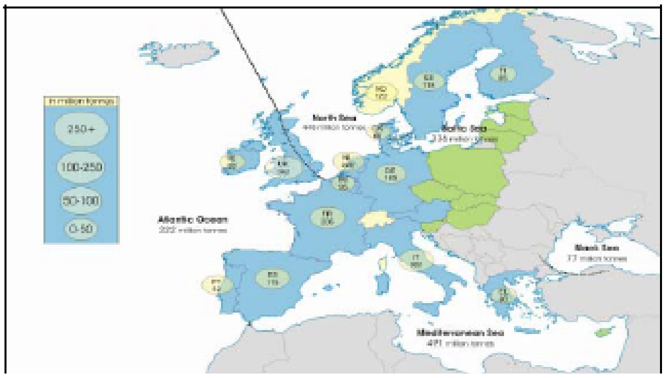


Figure 39 – Short Sea Shipping Spain/Europe (Eurostat)

6.7 Intelligent transport systems

The new technologies of information and communication work closely with transportation to the roads safer, reduce travel time, it cut costs and mitigate the environmental impact.

6.7.1 Introduction

Intelligent Transport Systems or ITS, appearing as a result of applying the latest technologies in telecommunications, computers, electronics, sensors and processing techniques, storage and display of information, to the fields of roads and transportation. The three key elements involved in the genesis and evolution of modern ITS systems and successfully implemented or still under development, are information, communication and road.

The aim pursued by integrating all this plethora of innovative technologies is to improve efficiency in transporting passengers and goods, increase road safety, reduce pollutant emissions, optimize travel time and facilitate operations such as tolls or travel planning. In short, it seeks to revitalize and expand the horizons of an industry that generates huge revenues, but precisely because of sprawl threatens to collapse the current road capacity, easily observable effect in large cities and its approaches.

This very recent development of ITS is rooted in the early '90s and was driven almost simultaneously by the three main socio-economic of the developed world: North America, Western Europe and Japan. In 1991 he founded the organization in Brussels ERTICO (European Road Transport Telematics Implementation Co-ordination Organization), bringing together around 30 companies and public sector bodies and private transport from the field and specifically the manufacture of automobiles, including involving the city of Bilbao and the Traffic Department. The products, features and services can be included within the category of STIs are very numerous. Table 1 presents the classification made by ERTICO, which has identified six sectors and 32 different functions.

6.7.2 ITS and the Internet

Of all the applications and services grouped under the name of STIs, only be given to those directly related to the Internet:

• Automatic Vehicle Location, which using global positioning techniques such as GPS, can know at any moment in a control center and displayed on a system for mapping the location of a moving vehicle to within a few meters, with application immediate commercial fleet management or tracking stolen vehicles.

• Automatic Vehicle Identification, thanks to the addition of some electronic tags to identify individual vehicles driven by a point at which a reader is installed without a halt, with clear applications for electronic tolls on highways automatic payment or car parks.

• Assisted navigation, in which a computer on board the vehicle, equipped with digital mapping and geo-referencing system allows drivers to provide instructions in both graphical and auditory format, to guide them to cities and places unknown.

The field of ITS is currently the subject of intensive research and in this climate of ferment emerge continuously stimulating technological applications. Of all these, a significant number who base their operation on the Internet, often drawing also on mobile communications. The most prominent are:

• Information on road conditions and route planning.

• Packed to load freight.

• Tracking through courier companies.

The following will describe each of them, explaining their operation, their use of Web technologies, and providing examples of companies and Spanish companies that have implemented these systems to their service offerings.

6.7.2.1 Information on road conditions and route planning

As the number of vehicles grows immeasurably increasingly occur more frequently and in larger slots jams and congestion. Arrive or depart from Madrid at certain times can become a nightmare return to Barcelona from the beach can take hours out on the weekends can create huge deductions and collapse entrances and exits of towns, accidents often interrupt the normal circulation. Continually occur in traffic incidents, some of which are recurrent and occur at predictable times or on certain days of the week, others are casual, and collisions or rollovers, and others are due to occasional events like football matches or bullfighting.

In these circumstances, drivers would receive with open arms tidbits of information to enable them to plan their trips, choose the detours and alternative routes, knowing the estimated times of travel, learn about the causes of unexpected retention, etc.. Very recently, and the hand of the emerging technologies of information and communications, are offering new information services to meet this demand distressing.

For years, radio and TV have been providing regular parts about traffic conditions on roads, but due to the characteristics of wide diffusion of these media, the information is often irrelevant to many drivers, outdated or incomplete. Thanks to the Internet through delivery of these information services at the driver and passenger in general, easier and comfortable customized queries to retrieve only the information relating to the position of the vehicle or personal needs.

Web technologies have significant advantages here for the operation and management control centers, and they combine existing ITS infrastructure under different skills can not make changes to any of the existing computer systems or software, even when based on platforms and incompatible protocols. Thus, it is possible to merge information from diverse systems, and present it on screen and interactive uniformly delivering the information in the present tense. This ensures that the maximum number of people will have access to information for all integrated ITS systems, without requiring more than an Internet connection. In the event that certain information be restricted using access control techniques can restrict the areas that will be exclusively used by internal staff or authorized, which will be publicly available.

Currently offering services in operation all or any of the following information:

• Weather conditions in the designated area.

• Statement of variable message panels, which show the active messages at any time in the selected panel.

• State works and suggested alternative routes.

• Average speed of vehicles on road segments and levels of congestion.

• Location and accident reports.

• Routes and bus position.

• Information about accident management.

• Information systems for commercial vehicles and information networks.

• Video images of intersections, bridges and other segments characteristic.

In Spain, the General Directorate of Traffic (www.dgt.es) offers an information service road, which provides data about the state of roads according to different types of incidents, highway tolls and fees, restrictions on movement in different regions of the country and Europe, traffic density at the entrance to Madrid, recommendations for the next days, calculating the optimal route between two points according to various criteria and upcoming openings stretches of road.

Some cities also have cameras, closed circuit TV, and even your webcam, connected to the Internet. Those interested can check the output of these cameras to obtain a real image and updated from an area of interest. Normally the refresh rate of images is low, for reasons of bandwidth, but they serve to get an idea of how traffic is at a given point.

As it stands, this consultation service is only useful when going on a journey and connects to the Internet from a computer. It allows to calculate optimal routes between two points or plan their route according to the present time reports on congestion at the various exits / entrances to the city. However, once in route, it loses its effectiveness due to the general difficulty to provide mobile Internet access. In the United States are emerging very sophisticated services customized traffic information, which can be accessed from any location via a mobile phone or handheld computer.

The information provided is very wide:

• Problems that are affecting traffic: road closures, congestion, sports events, traffic accidents and dumped goods or cargo.

• Description of incident: incident type, time of occurrence, estimated duration before clearing the scene and restore normal movement and impact on local traffic incident.

• Location of the affected area: exact coordinates of where traffic is affected, street name and direction of travel affected.

• Impact on time: how it will affect the expected time of travel.

• Optionally, the service may include news, weather, sports scores, personal messages or other information of interest.

Its strength is focused on continuous updating of the information and, above all, the mobile Internet access.

6.7.2.2 Packed freight burden

A freight exchange is the virtual meeting point between carriers and agencies vending goods. The former cover those companies or individuals that have one or more vehicles capable of transporting goods. A very common problem among this guild is the difficulty of locating usual cargoes back, so most trips back once delivered a commodity contract, is made in a vacuum. The virtual exchange streamlines the search for loads to minimize the number of empty return trips.

It also allows them to communicate the availability of your vehicle when considering a trip for which have not yet found a load of return, for if there were a shipper interested in carrying a burden that suit the characteristics of the vehicle offered.

Meanwhile, transit agencies or enterprises producing and / or distributing goods offer your goods in the bag to be transported, while demanding the services of a carrier whose vehicle is free, if he had been discharged previously held.

There are many advantages of this telematic system of supply and demand load. For carriers, the biggest advantage is the possibility of drastically reducing the number of returns in a vacuum, which is currently estimated at around 80%, with the savings that would result in time and especially money. Furthermore, being able to view a range of loads to national and even European level, it is possible to rationally plan delivery routes, reaching to take the same trip to deliver goods at various points along the route traced or which departs slightly from the same. Another possibility, though difficult, is the recruitment of half loads, and sometimes the trucks do not travel at the limit of their capacity. Agility search facilitated by electronic loads and loads mean getting to extract maximum performance from the same trip. Finally, the availability of this service through the Internet brings considerable management costs and recruitment, since this process to take place through email and web forms, this saves huge amounts of money on phone calls and faxes.

For agencies, the main advantage is focused on simplifying procedures and recruitment of vehicles for transportation and delivery of goods to their destinations. Instead of making phone calls and faxes, all logistics management and internal bureaucracy dynamises possible to transfer these tasks to the Internet field, where costs are much lower, and reduced use of paper: invoices, delivery notes, receipts etc.. A single charge can be consulted offered a few moments for all carriers affiliated with the virtual bag system, so time to find adequate transportation are significantly reduced. It gets so full optimization of the physical flow of goods and vehicles to reduce downtime of goods in stock and vehicles in garage, pushing the logistics operations of transport companies and reducing the overall costs of operation.

In Spain there is a considerable supply of virtual load bags on the Internet, among which are:

- RESSA (www.ressa.es),
- BCT-Movistar (www.cenoclap.es),
- Zona de Carga (www.legazpi.com/area),
- Wtransnet (www.wotrant.com) and,
- Routier (www.routier.com).

There are also other similar exchanges in other European countries, which also include Spain as:

- TransportExchange (www.transportexchange.com)
- FreeCargo (www.freecargo.co.uk) and,
- Eurotrans (www.eurotrans.com).

An interesting possibility to extend the use of cargo bags would be to use mobile Internet access via WAP or other protocols. Thus, the carriers, who spend most of their time on the road, where Internet connection is still conventionally difficult, would have all the benefits of virtual exchange through their mobile phones. Go directly to a web server using protocols for mobile access, either through consultations to the central server through SMS short messages, the carriers would enjoy the opportunity to continue using the service without having to sit at the computer. Yet none of the Spanish stock exchanges offer this valuable opportunity, although there is no doubt that that he did introduce a considerable differential advantage over competitors. Another logical step to be expected over the next evolution of the services offered by the stock would load the possibility to cross information between them, so that users could benefit from information on cargoes and vehicles of any stock, but were subscribe to a single service.

Currently, the high fragmentation of the supply diminishes the effectiveness of the bags, to the extent that there are many more bags, the smaller its market share (the number of subscribers that count) and therefore lower the available supply.

6.7.2.3 Tracking through courier companies

If electronic commerce finishes off in this country and around the world and comes to fill the exaggerated expectations that is awakening among companies and users, without a doubt one of the economic sectors that would benefit most will be the messaging and distribution goods, whether by land, sea, air or rail. While not invent the method to send the products bought via the Internet through a modem, will remain the problem of physical distribution.

Given the universality of the Internet, the buyer may be in any position of the balloon, while the selling company faces the obligation to convey the article paid, but at the same time without additional cost. To complicate matters further, many companies have embarked on the adventure of e-commerce stores have not even own, so that the product must pass directly from the supplier warehouse to the home of his client. Ultimately, the package delivery company which faces the logistical challenge of collecting the product in multiple locations and deliver it to turn in multiple destinations, thus raised to the link between the virtual and the real world.

In this situation it may be important, especially for valuable goods or urgent present tense knowing where they are, when they left and how long is expected to slow in coming. Internet is an invaluable tool to provide this information universally. Simply connect to the website of the package delivery company and enter the reference number of the goods sent to obtain these or other data, according to the company offering the service.

Some companies such as UPS, also provide this service via email, so it is not necessary to use a browser. Simply send an email with the shipment tracking number to the address provided for that purpose, to automatically receive an email with the information about the package in question. Thus, the possibilities are broader access to this service because it is very common to have mobile phones sending and retrieving email messages, and no phone with Internet browsing capability, still based on emerging Service immature technologies. This tracking service is operational only for the person who sent the package, although expected, will pool their addition to purchases made through e-commerce servers, so that customers anxious to know at all times where your merchandise. In Spain, most of the major distribution companies already incorporate this service, although there is some dispersion in the amount of information provided by each and the speed of updating it. Among the best known, include:

- UPS (www.ups.es),
- DHL (www.dhl.es),
- Post (www.correos.es),
- SEUR (www.seur.es) and
- AZKAR (www.azkar.es).

Access to information is confidential package in transit, usually protected by passwords or codes identifying customer / commodity.

6.8 Research and development: Intermodal transport in Spain

There are three areas of action in the field of transport innovation:

- Research and Development (R&D) and Research, Development and Innovation (R&D+i), as part of associated National R&D Programs.
- Pilot programs in which the Ministry of Public Works and Transport offers financial and technical backing for action in certain priority fields which may have significant effects for demonstration and dissemination.
- Drafting and startup of specific projects in areas not covered by the sector plans, and where significant deficiencies are noted in the transport system, such as in nonmotorised mobility.

For the period 2005-2008, the main lines of these actions were addressed to consolidating a suitable framework for innovation in transport via the following:

- Creation of a specific transport R&D management system, framed within the National R&D Plan, through an Integrated Management Unit for Research in Transport in the Centre for Studies and Experimentation in Public Works (CEDEX).
- Design of a strategy to foment non-motorised modes.

- The creation of tools facilitating management of the PEIT, and the identification of future priority lines for innovation, such as the observatory to monitor the transport system, and the national demand forecast model.

On the basis of the objectives and strategic options defined in the PEIT 2020 Scenario, the Ministry of Public Works and Transport infrastructures and services policy will in the coming years be adjusted to the following guidelines for intermodality action:

a) The transport system is conceived as a network of networks in terms of both the infrastructures and the services they carry, and requires an intermodal view which must be shared and developed according to the levels of competence and responsibility of each of the players –the Autonomous Communities, Municipalities and Operators– as well as by the Ministry. Integration of the various modes must take account of all areas of action: the physical connection, service coordination, charges, management and planning.

b) This vision which, avoiding the introduction of sudden procedural shifts, allows for continuity with the traditional working procedure according to modal networks, means dealing particularly with the points or nodes where they are located, and provides objective mainstreaming elements around which to define, agree and, where necessary, resolve proposals, initiatives and actions by different players in a homogeneous way.

c) Thus planning, as a coherent meeting point in establishing the current and future form of the system and its operation, must at least define the following aspects:

- The creation of a general scheme of development objectives and policies, fomenting intermodality, defining the basic intermodal network and interchange nodes.
- The conditioning of clearance and funding for modal projects upon the outcome of a meticulous analysis of their efficacy and intermodal efficiency in relation to that general scheme.
- The inclusion and consolidation of this approach as a criterion and universal working procedure on the Transport Sector Conference agenda.
- The provision of the tools required, and most particularly a National Transport Model available to the public and as reference for studies and prospecting.

d) Application of the set of guidelines, and implementation of sector plans and programs must address the progressive application of this strategic principle of intermodality.

e) The Operators, who have the full capacity to make proposals in this area to their monitoring and control bodies and whose proposals will, irrespective of their specific marketing criteria, be assessed in terms of the capacity to coordinate and enhance service levels through intermodality.

6.8.1 Program of research, development and innovation in transport

6.8.1.1 Objectives

Technological development is a powerful tool for enhancing the efficiency of all economic activity and to strengthen the competitiveness of agents operating in the markets where such activities are carried on. Technological capacity determines the prosperity of nations far more than the abundance and quality of the classic factors of production.

The transport sector has remained relatively on one side of the usual notion of sector technological development. Action by the sector Ministry (Public Works and Transport) in these fields, which is indispensable, was initially non-existent and then very timorous. It was however clear that the ministerial departments with general powers in the field of research lacked by definition the technical resources necessary to identify in detail the projects of greatest utility for innovation in Spanish transport, and the budgetary means to promote them. There was in the past a degree of coordination in some areas of transport related research, specifically in relation to the Information Society and Intelligent Transport Systems, limited to announcements from the Ministry of Public Works and Transport, and the "PROFIT" actions of the Ministry of Science and Technology.

While some industries which should strictly be classified as "ancillary to transport" (motor vehicles, aeronautics ...) have focused technology on a large scale, in the transport sector, considered a service provider system, there has been a considerable lacuna in the area of technological activity and qualification. Even in the most developed countries, it not easy at present to physically identify the «technological transport system» i.e. the inter-related constellation of centres for research and technological development, whether of the State, or academic, professional or entrepreneurial, which is where the technological advances of such an important sector are bred.

This situation is also seen in the consideration usually given the transport sector in technological development planning. Where national R&D+i plans or programs incorporate a section or area dedicated generically to “transport”, the budget allocation is usually of little substance compared with what goes to the chain of industrial sectors supplying material elements for the provision of transport services. On the other hand, the varied productive and technological activities which, one way or another, converge in the final production of transport, come under the authorities of various departments or administrative areas, most of which do not include guarantee of the social availability of efficient transport services among their objectives or responsibilities.

The transport sector’s R&D+i policy must be based on an acknowledgement that it is possible to correct the essential problem of the dislocation of the transport sector, which weighs heavy upon the sector’s efficiency. The panorama of its technological research and development system is no more than one further consequence of that fundamental problem, and can be corrected only by resolving its causal factors.

The design of the new Strategic Infrastructures and Transport Plan is therefore the occasion for dealing with these deficiencies, by assigning close to 1.5% of expenditure to the promotion of R&D+i in the sector, and setting up an adequate administrative structure for the management of these actions to aid research, and the coordination and dissemination of results, via an Integrated Management Unit for Transport Research in the CEDEX.

This line of thinking brings up the establishment of R&D+i priorities in the transport sector, to be implemented via four-year Transport R&D+i Sector Programs which are in line with national research plans and integrated into them. The current outlook of the National R&D Plan for the transport sector does, up to a point, coincide with the approaches described above, or at least does not contradict them. However, both the structuring of the many planned activities, and the orientation proposed for some of them specifically, do diverge from the integrated perspective of the “transport system” advocated here.

Based on the slant already referred to of the current National Plan, the possibility arises of fixing certain complementary priorities, along with R&D+i management systems in the transport sector, which will help to strengthen the structuring and integration of the sectors' drive, particularly in areas which prove to be of greater interest for sector policy at the national level.

The aspects of efficiency and the optimisation of transport infrastructures and services are those which, at this time, require more attention, since they are less decisively dealt with in the current National Plan. The impact and improvement of the environmental compatibility of transport are particularly taken into account, above all in the field of biodiversity and the territorial integration of infrastructures; as to improved efficiency and energy consumption in transport, and the reduction of pollutant emissions –subjects of unquestionable importance in transport planning– this sector program will seek maximum complementarities with other sections of the National R&D+i Plan, where these factors are dealt with very broadly and in great detail. Beyond that, it should be pointed out that the best contribution the transport sector can make to environmental equilibrium is in the optimisation of use of its existing infrastructures and in enhancing the efficiency and competitiveness of the services offered by transport modes whose environmental impact is less.

6.8.1.2 Management of the transport sector R&D+i program

Configuration of the management, following the pattern of the National R&D Plan, seeks to overcome the weaknesses pointed out above, and enhance the links between research and the transport policy objectives defined in the PEIT.

The Sector R&D+i Program is four-yearly, and the first will be defined in 2005, taking in the period 2005-2008, and applied first in 2006. The lines of research initially proposed will be set out in the sector program, and then every four years.

The monitoring system will have to be strengthened and, in each project, provide for an assessment of the end report presented. This concluding evaluation must analyse the degree to which objectives set were attained, the disclosure of the final results, and the interest of proposed future lines of research.

Management of the Sector Program will be charged to the funds assigned to it and will include specific studies making it possible to identify new needs, offer backup to all the projects in progress and facilitate the relation between research teams and the publication of results, through activities like the drafting of prospective sector studies, demonstration projects, national and international disclosure of results, and coordination with the European Union's Framework Program for R&D.

6.8.1.3 Indicative classification of areas of the Transport Sector R&D+i Program

Throughout the many projects which have gone into the preparation of the transport chapters in National R&D+i Plans, a number of classifications have been created, for operational ends, for activities in transport sector innovation, research and technological development. The classification used here is not just in line with PEIT priorities, but also fits reasonably into the structure of the chapter on transport in the National Plan itself.

Definition of the lines of action in R&D+i for the Strategic Infrastructures and Transport Plan (PEIT) have in the first instance dealt with transport research from an integrated viewpoint, not dividing subjects up according to the different modes of transport (road, rail, sea, air) or the areas of jurisdiction of various bodies (the Ministry of Public Works and Transport, the Ministry of the Interior, the Autonomous Communities).

The following lines of research were grouped into four headings or main chapters:

A. Enhanced transport safety

Safe transport is one of the PEIT's main priorities, and research must include not just accident prevention (active safety) but also the alleviation of the consequences (passive safety). Moreover, a further two sections are established to deal with the specificities of goods transport and studies of road accidents, by far the most dangerous mode and requiring the development of different sets of measures to cut the accident rate.

A.1 ACCIDENT PREVENTION

- Secure infrastructure design
- Automatic infringement control systems
- Vulnerable user protection
- Enhanced conventional rail network safety
- Harmonisation of the man-machine interface

- Safety-enhancing equipment, devices and systems
- Tunnel security
- Emergency situation protocols; simulator use

A.2 REDUCED ACCIDENT DAMAGE

- Accident notification and location systems
- Rescue and evacuation systems
- Passive security systems in infrastructures and vehicles
- Risk-reduction in infrastructure construction and maintenance

A.3 GOODS TRANSPORT SAFETY

- Intermodal transport safety
- Special transport
- Transport of dangerous goods
- Enhanced maritime safety on vessels, and land backup

A.4 ROUTE ACCIDENT STUDIES

- Data Base design, management and updating
- Study of Safety-Speed relations
- Simulation of accidents and their effects
- Studies of user behaviour and its modification
- Route Safety cost-efficiency analysis and audits

B. Increased transport system efficiency

Increased transport efficiency and integrated management of the system mean dealing with the development of services in this sector from a standpoint of the enhanced productivity and competitiveness of this activity. Thus four divisions have been drawn, referring to the following: transport service management; traffic management (not just road, but including rail and air traffic); intermodal transport and, finally, transport planning studies, which are fundamental to ensuring an optimal allocation of resources and the long-term reorganisation of the sector.

B.1 TRANSPORT SERVICE MANAGEMENT

- Fleet management and logistic applications

- Transport centre management
- Reservation systems and availability of resources, and their opening up to users
- Electronic exchange of information and management data
- Transport system dynamic simulation models
- Geographical data and vehicle location systems
- New IT-based products and services

B.2 TRAFFIC MANAGEMENT

- Information systems for operators, drivers and users
- Computerised systems and expert traffic management and regulation systems
- Interoperability of European high-speed rail systems (the European rail traffic management system - ERTMS) and their associated technologies and regulations, to increase European air space capacity
- Automatic vehicle guidance
- Vehicle-infrastructure and vehicle-vehicle communication and control systems
- Vehicle positioning, navigation and monitoring systems
- Development of automatic guidance systems for takeoff, landing and ground taxiing, in all weather conditions
- Automatic incident detection systems
- Traffic data base applications and their management
- Application of the Galileo System to traffic management
- Electronic toll-collection

B.3 INTERMODAL TRANSPORT

- Intermodal interface systems
- Intermodal terminal management
- Intermodal coordination of high-speed transport, focused particularly on airports
- Small high-speed interchanges
- Rolling stock for bimodal or multimode systems
- Multimode goods transport
- Development of telematic and control systems for intelligent traffic distribution in different modes of transport
- Development of more effective cargo-handling procedures/facilities in ports
- Automatic goods identification systems.

B.4 TRANSPORT PLANNING STUDIES

- Infrastructure Planning and Programming techniques
- Information systems: Data recovery, creation and management of data- and metadata bases
- Statistical procedures for data analysis and extrapolation
- Traffic prediction methods
- Studies of the mobility of persons and goods
- New procedures for the evaluation of actions

C. New infrastructure and vehicle technologies

The lines of work in the new technologies are designed to enhance the efficiency of the production (planning and construction) and the operation (upgrading and maintenance) of transport infrastructures. This point does not include innovations in the various types of transport vehicles or in fuels, since this aspect fits adequately into the R&D+i activities of other industrial sectors.

C.1 DESIGN AND CONSTRUCTION PHASE

- Calculating systems, tools and models
- New infrastructure construction designs and systems
- Waste and recycled material use in infrastructure construction
- Full- or reduced-scale experimentation

C.2 OPERATING PHASE

- Infrastructure maintenance, conservation and repair
- New techniques for the inspection and auscultation of ways, structures and works
- Development of in-service performance models, and performance-based specifications (functional requisites).
- Life-cycle-based analysis and design methods.
- IT systems, and expert systems for infrastructure management
- Sea traffic control systems in high-density areas.
- Adjustment to new risk-assessment standards, environmental conformity and the functionality of existing infrastructures

C.3 SINGULAR INFRASTRUCTURES

- Specific high-speed rail technologies
- Port terminals and services for short haul and small cargos
- Analysis and management of natural risks and disasters in infrastructures Rail interoperability

D. An enhanced socio-economic and institutional environment

Finally, the relation between transport activities and the environment are dealt with, whether the socio-economic, legal or institutional aspects. Society has been discovering that increased mobility has brought the consequences of negative effects on the environment, cities, regions or resources. In response to these problems, a set of lines of research have been brought together which fit within the areas dealing with external transport elements, the financial and economic aspects of transport, and the regulatory framework, all of great influence in the practical pursuit of the activity of this sector. A section on environmental studies has not been considered necessary, since these lines are dealt with in other National Plan programs, and this would produce duplication. In any event, the final definition of the lines will be set in the Sector R&D+i Program.

D.1 STUDIES OF FACTORS EXTERNAL TO TRANSPORT

- Urban effects: noise, congestion, spatial segregation
- Territorial effects: territorial fragmentation, the landscape integration of infrastructures, conservation of biodiversity.
- Global effects: carbon emissions, other pollutants, the greenhouse effect
- External social factors: accident costs, mobility discrimination.
- Protecting the cultural heritage.

D.2 ECONOMIC STUDIES

- Economic analysis: costs, rates, prices and efficiency
- Financing systems: public, private and mixed models
- Equal competition conditions
- Transport infrastructure socio-economic impact studies
- Studies of costs arising from infrastructure failure

D.3 REGULATION

- Development and updating of the legal framework
- Deregulation and privatisation.
- Creation and development of the Rail Regulator
- Assimilation of new technologies in the legislation
- Effects of Community Transport Policy

6.8.2 Conclusion

Intermodal transport receives practically no public subsidy in Spain; it is hardly mentioned in political discourse, apart from the Petra plan for supporting road transport, which makes a minor mention of intermodal transport. To a certain extent, it benefits from the aids provided by neighbouring countries.

Rail intermodal transport concerns mainly containers and a limited number of swap bodies, but not accompanied lorries of the “rolling road” type. The business unit in charge of freight within the rail company RENFE has recently fused with the unit in charge of intermodal transport. Within a total traffic of 26 million tonnes, intermodal transport represents about 30%. A third of this traffic is domestic, entirely within Spain; a third is international European, and a third relates to maritime ports. The network connects the main towns and maritime ports. Apart from the historic operator, there is Combiberia (with participation by Novatrans and Kombiverkehr) and Transfesa (which brings together RENFE, SNCF and private capital). Traffic development is limited by the pinch points outside terminals in the major cities.

A recent study by CETMO analysed intermodal transport within a ‘strengths, weaknesses, opportunities and threats’ framework.

The weaknesses are not negligible:

- operations are too segmented;
- tariffs have increased more than inflation, unlike road transport;
- investment decisions are inflexible;
- the average commercial speed is lower than that of road, and even of sea transport;
- the main terminals are saturated;

- the French network, which gives access to the rest of Europe, has no spare freight paths;
- there are many strikes on the French network;
- the responsibility for this traffic is divided between national networks;
- the length and weight of rail convoys in Spain are less than the European average (respectively 400m and 800 tonnes, against 750m and 1200 tonnes in France). Changing to these norms would reduce costs by 30%.

Among the threats can be listed:

- price competition from door-to-door road transport;
- priority given by the rail network to passenger transport (notably in the suburbs);
- the scarcity of land at affordable prices for constructing new terminals, and the distance from city centers which stems from that;
- the large number of actors, which complicates any new initiative.
- The strengths of the system cannot be ignored:
- a possible increase in the share of the market for intermodal transport;
- the service quality plan that has been introduced, which could bear fruit.

Finally, the opportunities are as follows:

- intermodal transport has less impact on the environment than its main competitor, roads;
- rail transport is growing by 1% to 2% faster than Spanish GDP;
- road transport costs would increase significantly if the internationalisation of external costs, promoted by European documents, comes into effect;
- the costs and prices of road transport are likely to increase under the influence of a rise in salaries;
- road is subject to a growing pressure to take more account of the environment;
- European policy is seeking alternatives to road;
- the liberalisation and interoperability of railways are likely to strengthen its competitiveness;
- the Sines - Madrid - Paris line might be reserved for freight and is TENs - listed.

Though the operation of the terminals must be improved by creating new ones, and the characteristics of convoys must be harmonised with the rest of the European network, the problem of the larger Spanish gauge will constitute an supplementary and long-lasting obstacle.

7. EUROPEAN COMMUNITY TRANSPORT LAW

Transport is one of the Community's foremost common policies. It is governed by Title V (Articles 70 to 80) of the Treaty establishing the European Community. Since the Rome Treaty's entry into force in 1958, this policy has been focused on eliminating borders between Member States and to therefore contribute to the free movement of individuals and of goods. Its principal aims are to complete the internal market, ensure sustainable development, extend transport networks throughout Europe, maximize use of space, enhance safety and promote international cooperation. The Single Market signaled a veritable turning point in the common policy in the area of transport. Since the 2001 White Paper, which was revised in 2006, this policy area has been oriented towards harmoniously and simultaneously developing the different modes of transport, in particular with co-modality, which is a way of making use of each means of transport (ground, waterborne or aerial) to its best effect.

The Framework Programme (FP) is the European Union's main instrument for funding research and development. FPs have been implemented since 1984 and cover a period of five years with the last year of one FP and the first year of the following FP overlapping. The current FP is FP7, which will be running up to the end of 2013. In the 7th Framework Programme, the Commission favours large projects to increase the involvement of industry, in contrast to earlier programmes which where more research-driven. It has been proposed for FP7 to run for seven years. It will be fully operational as of 1 January 2007 and will expire in 2013. It is designed to build on the achievements of its predecessor towards the creation of the European Research Area, and carry it further towards the development of the knowledge economy and society in Europe.

7.1 COMMON TRANSPORT POLICY

The promotion of what is referred to as intermodal transport logistics is a key element of European transport policy. It involves the creation of technical, legal and economic framework conditions as well as innovative concepts relating to logistics for the optimum integration of the different modes of transport for a “door-to-door” service.

1. An efficient transport system is an essential prerequisite for the European Union's competitiveness. With the projected growth of international trade, the possible extension of the Union to the Central and Eastern European countries and enhanced cooperation with the Mediterranean countries, the role of transport will become even more important.

2. Since 1970 European freight transport has increased by about 70 %. Annual growth of about 2 % is expected for the next two decades. Present figures put the costs of traffic congestion at 2 % of the EU GDP. Accidents, air pollution and noise amount to a further 2 %. These costs undermine European competitiveness, when transport demand requires flexibility, reliability and cost-effectiveness.

3. Unless the transport sector considers mode-independent service requirements and utilizes spare capacities in other modes, road transport is likely further to increase its present market share of 72 % (from almost 50 % in 1970). The share of rail transport has since 1970 decreased from about 32 % to less than 15 % in 1995. This decline is likely to continue if present trends persist.

4. In order to achieve socio-economic and environmental sustainability, the efficient and balanced use of existing capacities throughout the European transport system has become a key challenge.

5. The policy instruments used for a "business as usual" approach cannot solve the future problems associated with transport. The present approach must therefore be changed into a systems approach.

6. The promotion of Intermodality is a policy tool enabling a systems approach to transport. Transport services are offered as mode-independent door-to-door connections based upon a range of viable modal transport alternatives by making a new, efficient use of the transport system, reducing transport costs and allowing the generation of added value.

7. A number of obstacles have been identified which prevent the extensive use of intermodal transport. These include the lack of a coherent network of modes and interconnections, the lack of technical interoperability between and within modes, a variety of regulations and standards for transport means, data-interchange and procedures. There are uneven levels of performance and service quality between modes,

different levels of liability and a lack of information about intermodal services. As a result, mode-independent door-to-door transport is underdeveloped.

8. Implementing a European intermodal transport system requires coordinated development of transport policy on European, national and regional level. Four key strategies will provide the necessary impetus to the development of intermodal transport in the overall context of the Common Transport Policy.

Key issues of intermodality

- A European strategy on infrastructure: trans-European transport networks and nodes
- The Single transport market: harmonization of regulation and competition rules
- Identification and elimination of obstacles to intermodality and the associated friction costs
- Implementing the Information Society in the transport sector

9. Since intermodal transport is more data-intensive than conventional transport, the Information Society’s role in transport is of crucial importance. Computer Aided Transport CAT - the use of information and communication technologies - is key to efficient and customer oriented transport services. Open and flexible information and decision support systems are changing the way transport is organised and managed and will enhance present and create future market opportunities. In addition the use of the information infrastructures and the development of additional specific capacities for intermodal operations will increase the attractiveness of the new approach.

10. Intermodality does not aim or relate to a specific modal split, but addresses the integration of modes at three levels:

- infrastructure and transport means ("hardware"),
- operations and the use of infrastructure (especially terminals), and
- services and regulation (from a modal-based to a mode-independent framework).

11. The Commission will take the necessary initiatives where regulatory or legal issues are concerned. While respecting the principle of subsidiarity, the Commission will also address areas where intermodality depends on coordination at European level.

Key actions towards intermodality

Integrated infrastructure and transport means:

- Intensify intermodal design of the trans-European transport networks
- Enhance design and functions of intermodal transfer points
- Harmonise standards for transport means

Interoperable and interconnected operations:

- Integration of freight freeways in an intermodal context
- The Single transport market: harmonization of regulation and competition rules
- Development of common charging and pricing principles
- Harmonise competition rules and state aid regimes on an intermodal basis

Mode-independent services and regulations:

- Harmonization and standardization of procedures and EDI
- Intermodal liability
- Research and demonstration
- Benchmarking
- Intermodal statistics

12. Together with other policies already proposed by the Commission, the actions proposed in this communication are aimed at eliminating the current barriers to the development of intermodal door-to-door transport, and thereby promote a greater use of environmentally friendly modes of transport with spare capacity. By improving the potential of rail and waterborne transport and by offering, where appropriate, effective alternatives to unimodal road journeys, intermodality will help to overcome congested road networks. Performance improvements in railways, the full internalization of external costs and the promotion of intermodality are part of an overall strategy for sustainable mobility.

7.2 LEGISLATIVE FRAMEWORK

European Union objective is to develop a framework for an optimal integration of different modes so as to enable an efficient and cost-effective use of the transport system through seamless, customer-oriented door-to-door services whilst favoring competition between transport operators.

The Commission has proposed 60 or so measures to develop a transport system capable of shifting the balance between modes of transport, revitalising the railways, promoting transport by sea and inland waterway and controlling the growth in air transport. In this way, the White Paper fits in with the sustainable development strategy adopted by the European Council in Gothenburg in June 2001.

The European Community found it difficult to implement the common transport policy provided for by the Treaty of Rome. The Treaty of Maastricht therefore reinforced the political, institutional and budgetary foundations for transport policy, inter alia by introducing the concept of the trans-European network (TEN).

The Commission's first White Paper on the future development of the common transport policy, published in December 1992, put the accent on opening up the transport market. Ten years later, road cabotage has become a reality, air safety standards in the European Union are now the best in the world and personal mobility has increased from 17 km a day in 1970 to 35 km in 1998. In this context, the research framework programmes have been developing the most modern techniques to meet two major challenges: the trans-European high-speed rail network and the Galileo satellite navigation programme.

However, the more or less rapid implementation of Community decisions according to modes of transport explains the existence of certain difficulties, such as:

- unequal growth in the different modes of transport. Road now takes 44% of the goods transport market compared with 8% for rail and 4% for inland waterways. On the passenger transport market, road accounts for 79%, air for 5% and rail for 6%;
- congestion on the main road and rail routes, in cities and at certain airports;
- harmful effects on the environment and public health and poor road safety.

7.2.1 Road

- Objectives: To improve quality, apply existing regulations more effectively by tightening up controls and penalties.

- Figures: For carriage of goods and passengers, road transport dominates as it carries 44% of freight and 79% of passenger traffic. Between 1970 and 2000, the number of cars in the European Union trebled from 62.5 million to nearly 175 million.

- Problems: Road haulage is one of the sectors targeted because the forecasts for 2010 point to a 50% increase in freight transport. Despite their capacity to carry goods all over the European Union with unequalled flexibility and at an acceptable price, some small haulage companies are finding it difficult to stay profitable. Congestion is increasing even on the major roads and road transport alone accounts for 84% of CO2 emissions attributable to transport.

- Measures proposed: The Commission has proposed:

- to harmonise driving times, with an average working week of not more than 48 hours (except for self-employed drivers);
- to harmonise the national weekend bans on lorries;
- to introduce a driver attestation making it possible to check that the driver is lawfully employed;
- to develop vocational training;
- to promote uniform road transport legislation;
- to harmonise penalties and the conditions for immobilising vehicles;
- to increase the number of checks;
- to encourage exchanges of information;
- to improve road safety and halve the number of road deaths by 2010;
- to harmonise fuel taxes for commercial road users in order to reduce distortion of competition on the liberalised road transport market.

7.2.2 Rail

- Objectives: To revitalize the railways by creating an integrated, efficient, competitive and safe railway area and to set up a network dedicated to freight services.

- Figures: Between 1970 and 1998 the share of the goods market carried by rail in Europe fell from 21% to 8.4%, whereas it is still 40% in the USA. At the same time, passenger traffic by rail increased from 217 billion passenger/Kilometers in 1970 to 290 billion in 1998. In this context, 600 Km of railway lines are closed each year.

- Problems: The White Paper points to the lack of infrastructure suitable for modern services, the lack of interoperability between networks and systems, the constant search for innovative technologies and, finally, the shaky reliability of the service, which is failing to meet customers' expectations. However, the success of new high-speed rail services has resulted in a significant increase in long-distance passenger transport.ff

- Measures proposed: The European Commission has adopted a second " railway package " consisting of five liberalisation and technical harmonisation measures intended for revitalising the railways by rapidly constructing an integrated European railway area. These five new proposals set out:

- to develop a common approach to rail safety with the objective of gradually integrating the national safety systems;
- to bolster the measures of interoperability in order to operate transfrontier services and cut costs on the high-speed network;
- to set up an effective steering body - the European Railway Agency - responsible for safety and interoperability;
- to extend and speed up opening of the rail freight market in order to open up the national freight markets;
- to join the Intergovernmental Organization for International Carriage by Rail (OTIF).

This "railway package" will have to be backed up by other measures announced in the White Paper, particularly:

- ensuring high-quality rail services;
- removing barriers to entry to the rail freight market;
- improving the environmental performance of rail freight services;
- gradually setting up a dedicated rail freight network;
- progressively opening up the market in passenger services by rail;
- improving rail passengers' rights.

7.2.3 Maritime

- Objectives: To develop the infrastructure, simplify the regulatory framework by creating one-stop offices and integrate the social legislation in order to build veritable "motorways of the sea".

- Figures: Since the beginning of the 1980s, the European Union has lost 40% of its seamen. For all that, ships carry 70% of all trade between the Union and the rest of the world. Each year, some two billion tonnes of goods pass through European ports.

- Problems: Transport by sea and transport by inland waterway are a truly competitive alternative to transport by land. They are reliable, economical, clean and quiet. However, their capacity remains underused.

Better use could be made of the inland waterways in particular. In this context, a number of infrastructure problems remain, such as bottlenecks, inappropriate gauges, bridge heights, operation of locks, lack of transhipment equipment, etc.

- Measures proposed: Transport by sea and transport by inland waterway are a key part of intermodality, they allow a way round bottlenecks between France and Spain in the Pyrenees or between Italy and the rest of Europe in the Alps, as well as between France and the United Kingdom and, looking ahead, between Germany and Poland.

The Commission has proposed a new legislative framework for ports which is designed:

- to lay down new, clearer rules on pilotage, cargo-handling, stevedoring, etc.;
- to simplify the rules governing operation of ports themselves and bring together all the links in the logistics chain (consignors, shipowners, carriers, etc.) in a one-stop shop.
- On the inland waterways, the objectives are:
- to eliminate bottlenecks;
- to standardise technical specifications;
- to harmonise pilots' certificates and the rules on rest times;
- to develop navigational aid systems.

7.2.4 Combined transport

- Objectives: To shift the balance between modes of transport by means of a pro-active policy to promote intermodality and transport by rail, sea and inland waterway. In this connection, one of the major initiatives is the " Marco Polo " Community support programme to replace the current PACT (Pilot Action for Combined Transport) programme.

- Figures: The PACT programme launched 167 projects between 1992 and 2000. The new "Marco Polo" intermodality programme has an annual budget of 115 million euros for the period between 2003-2007.

-Problems: The balance between modes of transport must cope with the fact that there is no close connection between sea, inland waterways and rail.

- Measures proposed: The "Marco Polo" intermodality programme is open to all appropriate proposals to shift freight from road to other more environmentally friendly modes. The aim is to turn intermodality into a competitive, economically viable reality, particularly by promoting motorways of the sea.

8. IMPACT, COST AND BENEFITS OF STRATEGIES AND MEASURES PROMOTING INTERMODAL TRANSPORT

8.1 BENEFITS OF INTERMODAL SUPPORT MEASURES

There are very few ex post evaluations of measures in intermodal transport, and especially of governmental support measures, and therefore it is difficult to say much about the costs/benefits of measures of this kind. However, I briefly discuss this matter based on ex post evaluations made in the European Union.

The following benefits can be expected from measures and framework conditions supporting intermodal transport.

Benefits due to support of intermodal transport itself:

- improvement in efficiency and quality of intermodal transport (best practices from Spain achieved significant improvement in the quality of intermodal services for shippers and trains);
- increasing awareness on intermodal options (e.g. by the Marco Polo programme and European research projects);
- improvement of road access to seaport and inland terminals;
- improvement of cooperation in the intermodal transport chain;
- reduction of terminal costs and thereby overall intermodal transport costs;
- improvement of security in intermodal chains.

These improvements have led to a better position of intermodal freight transport in the freight market and therefore also to a modal shift. Benefits due to modal shift:

- better use of the capacity of the whole transport system;
- relief from road freight transport on motorways and highways (e.g. with intermodal transport measures, Switzerland significantly reduced road transit transport and thus environmental and social costs);
- reduction of environmental burdens like pollution and noise (e.g. best practice from Japan shows that new intermodal solutions can result in a significant reduction of CO_2 emission);

- improvement of safety.

8.2 IMPACTS OF INTERMODAL SUPPORTING MEASURES

Intermodality is not intended to impose a particular mode option, but enables better use to be made of the railways, inland waterways and transport by sea, which individually cannot provide a door-to-door service. Intermodality has been added to the other transport policies conducted by the European Union, more particularly with a view to:

- liberalising the transport market;
- developing the trans-European networks (TEN);
- promoting fair, efficient pricing;
- bringing the information society to the transport industry.

As things now stand the use of intermodal goods transport faces a certain number of hurdles. A change of mode during a journey is more a change in system than a simple transhipment operation. The resultant friction costs have an impact on the competitiveness of intermodal transport. These friction costs result in:

- higher prices;
- longer journeys, more delays or less-reliable deadlines;
- lower availability of quality services;
- restrictions on the type of goods;
- a greater risk of cargo damage;
- more complex administrative procedures.

The inability to interconnect results in friction costs at the following levels:

Infrastructure and transport equipment

- the lack of consistent networks and interconnections (missing infrastructure sections, for example), forces transfer costs onto the operators;
- each mode within the current system is financed and managed separately. The responsibility for strengthening the links between those modes is thus difficult to establish;
- the inability to operate between modes, such as differing railway signalling systems, causes problems;

- the differing sizes of load-carrying unit between one mode and another are not harmonised;

Operations and infrastructure use, and in particular that of terminals

- certain services such as vehicle identification or productive information systems are unavailable in intermodal situations;
- the various transport modes give unequal performance and service quality;
- commercial information and practices are not always coordinated among the various modes;
- terminals cannot always adapt to train and ship timetables that are operated round the clock, while the working hours of drivers and crews are not always suited to intermodal operations;
- the timetables for the various modes are not harmonised;

Services and regulations aimed at the modes

- the absence of harmonised electronic communication systems among the various operators within the intermodal sequence prevents adequate scheduling;
- where cargoes are damaged the responsibility is difficult to establish since the various transport modes involved are governed by different international conventions;
- administrative bottlenecks impair the competitiveness of intermodal transport.

Transport modes must be integrated at these different levels. Faced with this situation the Commission advocates a certain number of approaches towards promoting intermodal transport in Europe.

The aim of integrated infrastructures and means of transport is to have a network of infrastructures and transfer points that is consistent at European level in order to ensure that the various modes can interoperate and interconnect. In order to do this the Commission:

- wishes to boost the intermodal configuration of the TEN;
- supports the provision of logistical services that have added-value potential at the transfer points;
- is guiding the process of harmonising the load-carrying units (dimensions and weights).

The measures put forward in order to improve operation or interoperability or interconnectability are as follows:

- analysing the market in order to integrate transport and logistics more closely;
- extending the PACT programme (new proposal, see Marco Polo programme);
- creating trans-European rail-freight freeways offering open access, and incorporating these into an intermodal environment;
- drawing up common pricing principles and establishing charges for the various modes of transport;
- amending Regulation (EEC) No 1107/70 (new proposal COM (2000) 0007 (2000) 0007 final) on aid granted to combined transport, taking account of the need to improve the competitiveness of this sector;
- defining the approaches towards granting state aid to intermodal transport;
- applying the rules of competition to intermodal freight carriage;
- coordinating the intermodal timetables by creating an electronic clearing house.

In order to achieve intermodality it is necessary to have services and regulations that are common to all modes. In order to achieve that, the Commission is encouraging the following:

- providing the background for the development of intermodal real-time electronic data processing systems;
- using communication structures such as satellites or the GSM network in order to monitor and locate loads within the various transport modes;
- laying down appropriate standardisation criteria for the paperless transport procedures and documents, and more particularly customs procedures;
- promoting a voluntary intermodal responsibility system.

A certain number of activities are also to be promoted with regard to:

- research and innovation via the INTERACT research network and the framework programmes;
- assessment and calibration of performance levels by preparing methodologies and setting up a European intermodal reference centre for goods transport;
- cooperation among the Member States;
- preparing concepts for intermodal statistics.

Finally, the Commission underscores the necessary coordination between intermodality and the activities carried out within the information society, regional development and inclusion of the SMBs (Small and Medium-size Business) and of the environment.

8.3 COSTS OF INTERMODAL TRANSPORT

Cost reduction is, for intermodal transport, a must. Due to its present cost structure, intermodal transport often cannot face road transport competition and, just to survive, it strongly depends on public support, through direct subsidies to intermodal operators, or through a help to railway companies, to infrastructure administrators or otherwise. In exception to its general principles which give central confidence to market mechanisms, European Commission agrees with these practices, since they contribute to develop an alternative solution to all-road freight transport, according to their concern for sustainable mobility.

This paragraph consists in establishing, first, an acute measure of all involved costs, including both direct and external elements.

Those measurements confirm that direct costs are usually higher for intermodal transport than for road. Under mere market prices, intermodal transport would have today little room in Europe. Within intermodal total direct costs, the importance of terminal handling, of local haulage operations and of organisational and marketing extra costs are underlined, i.e. all costs coming in addition to long distance rail or waterway haulage. This means that efforts to reduce costs should not only concern long distance transport, but also all other items, which could make an all the more important progress as they have not been till now carefully examined under this respect.

Another approach deals with external costs, the current belief being that if these could be internalised into market prices, through an adequate fiscal and pricing system, the terms of competition would be transformed, the behaviour of shippers would be modified and modal split of freight traffic would find a new, preferable, balance. The point is that external costs are not as important and not as uneven as one often thinks. The average ratio of external cost related to total cost is about 27 % for road transport. But it is still about 17 % for intermodal solutions, which is not as environmental friendly as expected. The advantage for intermodal transport, under the very strong assumption of internalising external costs, would therefore not be strong enough to spark a massive modal shift off.

All these results show that the expansion of intermodal transport cannot only proceed from a change of fiscal and infrastructure pricing practices. A strong, internal effort of direct cost reduction is necessary, which can only result from technological, organisational and social progress, in a complex and sometimes opaque system, involving many actors whose short term interests are not always convergent. At medium range, a substantial result can be obtained, which would make intermodal and road costs closer, with even a slight advantage to intermodal solutions. Competition would be better balanced. But costs considerations should not keep quality of service matters in oblivion, as many shippers, in a lean production management scheme, also consider flexibility, reliability, tracing and lead time as modal choice criterion, besides price.

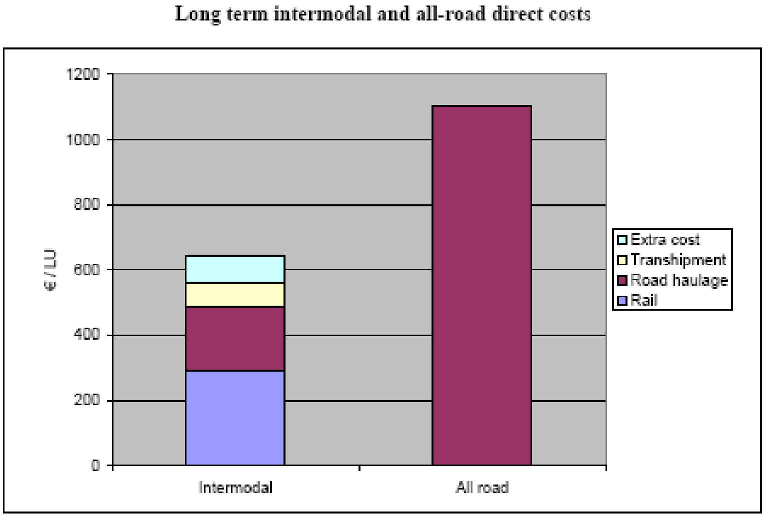


Figure 39 – Intermodal – road direct costs (ReCorDit)

On the long run, perspectives are more uncertain, but room for maneuver is also wider. Road transport can make further progress (due to technology, to regulation of size of vehicle, to information technology and logistics management, etc.), but several constraints might also get stronger, due to congestion, energy and infrastructure pricing, working conditions regulations and manpower shortage, etc., so that long range tendency is not necessarily cost decrease, as it has always been. On the contrary, radical changes in railways can occur, if a dedicated network is set up for freight traffic, at least on major trunk lines, enabling the type of operation one can observe the success of in such countries as the United States, Canada or even Russia. In such conditions, rail and intermodal direct costs can be dramatically reduced, and allow a self supported competitive growth. But this presupposes a huge investment effort, European and national budgets were, till now, unable to achieve. Maybe, the White Paper concerns will give such a challenge, in coming years, a stronger political relevance.

But ways of progress are certainly possible, that require unprecedented efforts. As the title of the White Paper says, it is time for choice…

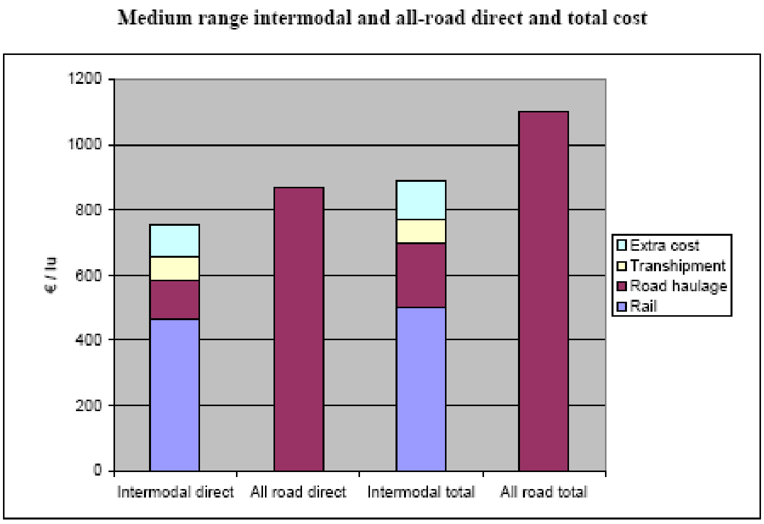


Figure 40 – Medium range intermodal – road direct costs and total cost (ReCorDit)

8.4 RESULTS FROM EUROPEAN EVALUATIONS

The ex post evaluation of the PACT programme (AEA 2000) has shown a significant modal shift from road to intermodal transport with, at the same time, a relatively small budget for supporting measures. Between 1996 and 1998 a modal shift of 6.5 billion tonnes-kilometres could be reached and related decreases in emissions and energy consumption.

For the Marco Polo II programme (2007-2013) supporting intermodal transport, a modal shift of 144.1 billion tonnes-kilometres with European Union subsidies of 820 M Euros is expected (ECORYS 2004). The most promising parts of the analysis results in Marco Polo II having a positive impact on reducing externalities of 4.98 billion Euros. Effectiveness ratios of 176 tonnes-kilometres shift per Euro subsidy and 6.07 external benefits per Euro are aimed at.

In addition, the supporting measures proposed in ISIC (Integrated Services in Intermodal Chains) will lead to a major modal shift and reduction of external costs (ISIC 2005). It is expected that 6351 million tonnes-kilometres can be moved from road to intermodal transport. Some of the actions achieve B/C ratios between 2 and 8.

German cost-benefit analysis of intermodal terminals shows that it is primary private costs that will be reduced with the development of new terminals. Only 10% of the benefits can be connected with transport network effects and environmental costs. However, best practise from Switzerland shows that measures in intermodal transport can reduce road transport and, consequently, environmental and social costs.

Best practice from Japan presented, shows that new intermodal solutions can give a significant reduction of CO_2 emissions The reduction from some projects in the pilot program for developing environmentally-friendly freight distribution systems is 60-90% according to results presented at web-sites from Ministry of Land, Infrastructure and Transport in Japan.

9. CONCLUSIONS AND RECOMMENDATIONS

During recent decades, there has been very substantial growth in the freight transport sector. Freight transport is increasing faster than the economic growth and passenger transport. Road freight transport demand, in particular, is increasing faster than supply and is causing environmental and social problems. Increasing congestion is also affecting the efficient and reliable freight distribution which is required by the economy. Therefore intermodality is needed so that better use can be made of alternative modes that have accessible spare capacity, such as rail, inland waterways and short-sea shipping.

In this context, increasing the commercial use of effective intermodal operations is one of the main objectives of transport policies. National governments, but also international organizations, are putting more and more emphasis on having better modal integration. Despite measures supporting and promoting intermodal transport, however, statistics seem to be indicating contrary trends, namely a continuous decline of the freight rail modal share and the important development of roads, even though in some corridors, road traffic seems to be nearing its limits.

Existing infrastructural, technical, operational barriers, etc., hindering the big breakthrough in intermodal transport can be summarized as follows:

- the poor performance of the railway with regard to reliability and quality of service (different traction systems, signalling systems, etc.);
- the lack of integrated commercial services throughout the international logistics chain;
- the structural weakness of intermodal terminals with regard to capacity, accessibility and organization;
- the lack of security on terminals and network along the entire supply chain;
- the lack of a well-functioning system of reservation of potential slots across national borders linked to the priority systematically given to passenger trains;
- investments for infrastructure are underway but many projects are unlikely to materialize for a number of years;
- a low degree of cooperation between the different actors in the logistics chain;
- the lack of ex post evaluation of projects and measures taken to supply the strategy and the action plans to set-up.

However, measures to support and promote intermodal transport should be continued because a more balanced modal split is the required condition for increasing the efficiency of the freight transport system and for contributing to sustainable freight transport with fewer pollutant emissions and more safety. Measures supporting and promoting intermodal transport can lead to a modal shift from pure road transport to intermodal transport chains and render the transport system more sustainable.

It is therefore recommend the following measures to be taken by governments in support of intermodal transport:

Intermodal transport has to be considered in international, national and regional transport policies.

Because of the contribution to a more sustainable freight transport, intermodal transport should be given more consideration and be supported in international, national and regional transport policies and strategies. Because intermodal transport is usually also international transport, transnational cooperation and agreements can make sense relating to terminal design and operation (e.g. bilateral agreements, European programmes, etc.);

Locations of intermodal terminals have to be secured in national transport plans.

Because of the long planning and realisation process and the need for extending existing locations of intermodal seaports, inland waterway and rail/road terminals should be integrated and secured in national transport plans. This should be based on capacity need and location evaluation studies because the market and competition itself cannot guarantee an optimal terminal density from a political economics point of view. Special emphasis has to be given to terminals connecting more than two modes (e.g. trimodal terminals) and which can provide a real modal choice for intermodal transport users;

Access to terminals has to be secured by infrastructural and operational measures (road, rail and inland waterway services).

Important railway, inland waterway and terminal access road connections have to be integrated in national transport plans;

National authorities have to co-fund intermodal terminals when this is necessary.

Owing to the existing and foreseeable trans-shipment capacity restraints and the limited interest of investors in building intermodal terminals, the national authorities have to co-fund the planning and realisation of intermodal terminals. This should be done based on clear requirements and conditions to avoid overcapacity and windfall gains. Private Public Partnership (PPP) could be of interest;

Subsidies for intermodal operations in the starting phase.

Only in specific cases should subsidies for intermodal operation (railways, inland waterways, etc.) be foreseen and restricted in relation to time. Such subsidies can make sense, for example, in the starting phase of new intermodal services;

The performance of each mode should be improved.

This is especially important for rail, with regard to reliability and quality of service, but also for other modes including road pre and end haulage;

Further international standardization.

To improve the interoperability in intermodal transport, further international standardisation by ISO and CEN is needed. In intermodal transport, standardisation needs have been identified relating to intermodal equipment (e.g. information and communication systems, loading units) infrastructure (e.g. terminal design) and processes and services (e.g. responsibilities, quality and performance). Standardisation is not directly a task of national authorities, but national authorities could initiate standardization processes along with national standardisation organisations;

Harmonizing of framework conditions.

Because intermodal transport often crosses borders between countries, it is appropriate to harmonize the differences in national and intermodal framework conditions (weight limits, supporting measures, etc.);

The communication situation in intermodal transport should be improved.

There is a need for standardized communication systems in intermodal transport;

Co-funding of research and development.

Technical innovations can improve the efficiency and quality of intermodal transport chains by reducing technical and operational barriers. Innovations face various hindrances during the market implementation phase. Co-funding of research and development by the state can reduce these hindrances in the start-up phase of new technologies;

Creation of intermodal development centres.

Another important possibility for promoting intermodal transport is the creation of intermodal development centres suitable in corridors or at hinterland connections where the intermodal share today is low and a potential for modal shift can be expected. National and regional authorities can co-fund such activities, but only if they fulfill the requirements and conditions set by the national transport authorities;

Improvement of intermodal transport statistics.

If we are to have a better view of intermodal transport and improved planning and monitoring, there is a need to improve intermodal transport statistics. Compared to road or rail transport, the quality of intermodal statistics is generally poor, and any improvement needs an international approach which should be initiated by the states with high intermodal volumes;

Monitor and control effects of measures.

If national authorities create a supporting strategy for intermodal transport it is inevitable that they monitor and control the effects and success of these strategies. Based on a comprehensive evaluation, suitable corrections and adaptations of the strategy have to be implemented;

Access to seaports for landlocked countries.

For landlocked countries, access to seaports has to be secured by railway shuttle or inland waterway services from important seaports to inland terminals. Furthermore, there is a need for intermodal land transport services to important economic areas.

9.1 GOVERNMENTAL ACCOMPANYING MEASURES IN SUPPORT OF INTERMODAL TRANSPORT

Governmental accompanying measures do not directly affect intermodal transport, but they do indirectly influence the use of it.

The measures described in this paragraph constitute some recommendations. Further measures could not be studied in detail in this project, as the evaluation period of the impact of implementation in several countries is too long, a few years at best.

However, the best practice summaries included about several of these measures demonstrate that they are able to impact intermodal transport positively. It would be worthwhile conducting a follow-up study about the impact of these measures over several years, in order to develop even more efficient strategies for modal shift. These impacts are:

- heavy goods vehicle (HGV) fees;
- road freight transport regulation on driving hours, weight, etc;
- road freight transport management (slot management, reservation systems, information systems, etc.).

Not only would these measures support the use of intermodal transport, they would also increase efficiency and improve safety.

Because of the increasing problems in road freight transport, it is important to consider intermodal alternatives using the most suitable combinations of different modes of transport. It is the role of public authorities to support intermodal transport and to provide the suitable framework conditions while taking into account the public interest and requirements of the industry.

9.2 FUTURE DEVELOPMENT OF INTERMODAL TRANSPORT

Intermodal Freight is the future of the transportation that promises a seamless intermodal transportation system that is efficient, safe, flexible and environmentally sound, and meets the needs of the travelers and industry alike.

There are several important reasons why governments need to be actively involved in advanced Intermodal freight transportation. The availability of quality-focused, cost-effective intermodal freight transportation services can affect how well the firms in a region can compete economically in the battlefield of regional and global economic competition. Thus, jobs, incomes, and growth all depend significantly on logistics capabilities. Governments have an interest in promoting intermodal freight transportation expertise: in stimulating the development of up to date interrnodal freight transportation services providers; and in reducing regulatory and other barriers to the ability of providers to offer attractive services. Intermodal freight transportation services and the fees paid by service providers for facilities, transportation, and information services, and taxes can be important sources of revenues to governments. Actions in the intermodal freight transportation domain can have important environmental, health, and safety consequences and these are important concerns of governments. Often, governments are the major providers of transportation infrastructure that supports the provision of inter-modal freight transportation services, such as air and ocean cargo facilities, intermodal transfer terminals, and others.

For some modes, the levels of congestion and delays in transportation and terminals are an important issue. Therefore, governments are actively involved in planning, investment, pricing, and/or operational decisions that influence the provision of capacity and the pricing and time dependent availability of facilities and services.

Often, the logistics services sector is a sector with many small and medium-sized enterprises.

In many countries, governments are concerned with viability and survival of such enterprises, and want to ensure this survival through providing awareness programs, educational and resource-expansion export.

Although freight transportation has benefited from improvements in information and equipment technologies over the past years, the progress linking the evolving information and transportation systems has been slowed by lack of network infrastructure, and lack of expertise in some sectors that participate on this.

From this picture of contrasts, the conclusion might be that intermodal transport is only one particular answer among very many others to the questions that public authorities and economic actors ask themselves about the future of transport.

Intermodal transport, whether it marries road freight to the maritime mode, rail freight or waterborne transport, cannot be introduced under any conditions or in any place. On the contrary, efforts to encourage it must concentrate on those cases where it has the best chance of demonstrating its technical and commercial effectiveness and its benefits, socio-economic if not financial.

Intermodal solutions are more efficient on axes with heavy traffic, over long distances. Though intellectually seductive, the various “hub and spokes” formulae, that aim to massify low-volume traffic flows by making them transit a single central sorting point, have been abandoned. It is through “industrialised” shuttles which associate productivity with service quality (providing that they own suitable rail freight paths) that rail – road transport can develop today.

Construction, access and infrastructure tariff regime, fiscal policy, labour regulation, technical standardisation and interoperability, the regulation of emissions and noise and other nuisances: the public authorities have to operate a vast range of instruments in order to contribute, with the private actors, to the development of an intermodal solution which associates the special characteristics of each one of the various transport techniques

10. REFERENCES

AEA "Evaluation of the Implementation of Council Regulation 2196/98 (PACT)", November 2000

ADEME «Transport combiné de marchandises – Aides aux transporteurs et chargeurs», PDF files available at http://www.ademe.fr, 2006

AIPCR - ACTES DU SEMINAIRE INTERNATIONAL AIPCR C 2-4 DE OUAGADOUGOU «Systèmes de transport de marchandises en Afrique de l'Ouest», Burkina Faso, 2005 : GUIEBO M.T., CEA-ONU, «Systèmes de transport en Afrique»; KOÏMBONGO E. «Les priorités du NEPAD»; HAÏNIKOYE A. «La politique et le système de transport en vigueur dans l'espace CEDEAO»; KOÏTA Y. «La situation générale des opérations de transports sur les corridors de la CEDEAO»; GUISSOU H. «La politique et le système de transports routiers de marchandises au sein de l'UEMOA»; CISSE H. «La création de ports secs au Mali», 2005. PDF files available at: http://www.piarc.org

AGTC "European Agreement on Important International Combined Transport Lines and related Installation", 2005.

ANDREW FOXCROFT: Domestic box gains, in Containerisation International, April 1999, p. 97

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL "On intermodal loading units" Brussels, 30.4.2004 COM(2004) 361 final 2003/0056 (COD)

DTPE «Le développement du transport intermodal de marchandises dans les pays emergent», MINEFI, Direction Générale du Trésor et de la Politique Economique (DGTPE), Paris, juin 2005.

EC Communication on "Intermodality and intermodal freight transport in the EU" doc. COM (97) 243

ECMT "Trends in the Transport sector 1970-2004", ECMT, 2006.

ECORYS ET AL. "Integrated Services in the Intermodal Chain". Report Task G on Socio economic CBA for the ISIC actions, 2005.

ECORYS “Ex ante Evaluation Marco Polo II (2007-2013)”. Final Report, 2004.

EUROPEAN COMMISSION “European Transport Policy for 2010: Time to decide. Brussels (White Paper)”. European Commission, 12.09.2001.

EUROPEAN COMMISSION «Freight logistics in Europe – the key to sustainable mobility» European Commission COM (2006) 336, 2006.

EUROPEAN COMMISSION «Keep Europe moving – sustainable mobility for our continent», mid-term review of the European Commission´s 2001 White Paper COM (2006) 314, 2006.

Freight Containers - ISO Standards Handbook, 2nd edition, ISO Central Secreteriat, Genève 1999

GILLE A. «La Co-modalité outil du développement durable», Revue Transport n° 436, p.73-82, mars-avril 2006.

INTERNATIONAL STANDARDS: ISO 646, ISO 1496 and ISO 6346. Draft European Standard: Swap bodies for combined transport - Stackable swap body type C 745-S16 - Dimensions, design requirements and testing Doc. CEN/TC 119 N 135

“INTEROPERABILITY IN INTERMODAL FREIGHT TRANSPORT“, report on standardisation prepared for the 2nd EU-USA Workshop on Intermodal Freight Transport, 22 September 1998.

IQ «Intermodal Quality», Project Summary, European Commission, 1998.

IRE / RAPP TRANS AG “Assessment of quality factors in freight transport.” ASTRA Contract 2002/011. Lugano/Zurich, Switzerland. 2005.

ISIC “Integrated Services in the Intermodal Chain”. Summary Report, European Commission, November 2005.

LEMPER, BURKHARD “Containerschiffahrt und Welthandel - Eine Symbiose”, Institut für Seeverkehrswirt-schaft und Logistik, Germany, 2003.

LOGIQ «Intermodal Decision: The decision making process in intermodal transport», European Commission, 1999.

OECD «Logistics Developments Supported by ICT&ITS in the Asia-Pacific Region», Asian Task Force 2003.

PIARC TECHNICAL COMMITTEE ON FREIGHT TRANSPORT AND INTERMODALITY "Freight Modal Split." Reference 19.02.B, PIARC, Paris, 2005.

PROMIT "Promoting Innovative Intermodal Freight Transport", EU-Project in the 6th Public Framework Programme, www.promit-project.net, 2006.

PUBLIC PLANNING & POLICY STUDIES, INC., IMANISHI Y. «Best Practices of HGV transport measures in Japan», summarizing paper, 2006

RAMBØLL AS «Public measures supporting more efficient freight terminals and intermodal transport – international experiences», report in Norwegian, Oslo, 2006.

RAPP AG "Today's and future freight transport chains: Analysis and standardisation needs". (Report in German), VSS 1999/255, Switzerland. October 2002.

RAPP TRANS AG "Evaluation des Bestellverfahrens im Kombinierten Verkehr", Bundesamt für Verkehr, Switzerland, 2006.

RAPP TRANS AG "Pre- and End haulage in Intermodal Transport." SVI Report 1999/329, Switzerland, 2000.

RAPP TRANS AG ET AL. "Integrated Services in the Intermodal Chain; Report on task D: Improving Intermodal Terminals", 28th November 2005.

RAPP TRANS AG / ETH IVT "Design of terminals for unaccompanied combined transport" (report in German), Switzerland, June 2005.

SPIN "Scanning the potential of intermodal transport: Actors and factors in transport mode decisions in supply chains", European Commission, 1st January 2002.

THE WORLD BANK "A RAILWAY CONCESSIONING TOOLKIT – APPLICATION TO AFRICAN NETWORKS", THE WORLD BANK SUB-SAHARAN TRANSPORT POLICY PROGRAM, 2003

TML c.s. (2005) ASSESS: Assessment of the Contribution of the TEN and other Transport Policy Measures tot the midterm implementation of the White Paper on the European Transport Policy for 2010, TRAIL and RUPS: „Continental Loading units for intermodal transport“, Schiedam, August 1998

TRILOG “Intermodal Transport in Europe”, HENSTRA Dirk (TNO Inro), WOXENIUS Johan (Chalmers University of Technology), Deliverable of TRILOG Europe Tasks 4.1, 4.2, 4.3,1999.

UNECE, ECMT, EUROPEAN COMMISSION – CEE-ONU, CEMT, COMMISSION EUROPÉENNE “Terminology of combined transport - Terminologie en transports combiné” New York & Genève, 2001.

United Nations Economic and Social Council, Economic Commission for Europe, Committee for Trade, Industry and Enterprise Development, Working Party on Technical Harmonisation and Standardisation Policies, Report on the 8th Session, Geneva 18-20 May 1998

White paper - European Transport Policy: Time to Decide, European Commission, Luxembourg: Office for Official Publications of the European Communities, 2001, 119 pp., ISBN 92-894-0341-1

WOLFRAM BLÄSIUS: Neue palettenbreite Seecontainer für die EU-weite Küstenschiffahrt, in: Der Containerverkehr, Frankfurt am Main/Neu-Isenburg, JAN/FEB 1999, p.7.

ZLU ET AL. “Study on freight integrators”, 2003

10.1 Internet references

www.cordis.europe.eu

www.eirac.net

www.uirr.com

www.trb.org

www.bmvbs.de

http://europa.eu/legislation_summaries/other/l24179_es.htm

http://ec.europa.eu/transport/strategies/studies/strategies_en.htm

http://www.idg.es/iworld/articulo.asp?id=100540

http://www.transport-research.info/web/common/search.cfm

http://www.fomento.es/mfom/lang_castellano/_especiales/peit/default.htm

http://ec.europa.eu/transport/marcopolo/home/home_en.htm

http://www.recordit.org/deliverables.asp

http://www.adif.es/es_ES/infraestructuras/terminales/terminales.shtml

¡Error! Referencia de hipervínculo no válida.]

www.grimaldilogistica.com

Short Sea Shipping, 2000-2003. Oficina Estadística de la Unión Europea (EUROSTAT). http://epp.eurostat.cec.eu.int

http://cordis.europa.eu/fp5/

http://cordis.europa.eu/fp6/dc/index.cfm?fuseaction=UserSite.FP6HomePage

http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.FP7CallsPage