



# DIOMIS


## 2005 / 2015 Report on Intermodal Rolling Stock in Europe



**Developing Infrastructure & Operating Models for Intermodal Shift**

February 2009





Developing Infrastructure and Operating Models for Intermodal Shift

## **2005 / 2015 Report on Intermodal Rolling Stock in Europe**

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## PREFACE

The ***Agenda 2015 for Combined Transport in Europe***, published in January 2008, was the epitome of the analytic work with an eye to the future carried out in the first phase of the UIC DIOMIS project (Developing Infrastructure and Operating Models for Intermodal Shift).

Beyond creating a set of tools in the form of the Agenda 2015, our interactions with the Combined Transport (CT) sector while carrying out the work for the various DIOMIS modules led to a growing realisation that the current and future bottlenecks identified by the ***Capacity Reserve Study for Combined Transport in 2015*** and confirmed by DIOMIS did not only concern railway infrastructure or CT terminals.

Indeed, the growing threat of a new and sizeable bottleneck was an obvious and increasing source of apprehension among our stakeholders and partners: the future availability of CT wagons sufficient in number and quality had become a cause for concern. We therefore decided to include a module focusing on wagons in the second phase of DIOMIS.

We are delighted to present the results and conclusions of this investigation in this ***Report on Intermodal Rolling Stock in Europe 2005/2015***. It shows that substantial efforts will also be needed in this field so that CT may respond to the projected demand.

As we have already stated in other documents, the present economic downturn resulting from the ongoing financial crunch will undoubtedly have affected the growth of CT in the last quarter of 2008, and shall have even more impact in 2009 – goods that are not produced cannot be transported. However, sometime in the course of 2009/2010 the financial world is bound to come to its senses. The general public will regain confidence, orders will be made again and the world economy will start to recover. CT will be there to respond to the demands arising from these new circumstances.



We have no compunction about repeating ourselves. It would indeed be a grave, even fatal mistake for CT stakeholders and decision-makers to use the current economic slump as an excuse to avoid taking action where action is now needed in order to meet the future capacity needs of rail freight and of CT in particular. Nothing will ever be the same again, and, when the storm eventually subsides, it will not be business as usual: the need for modal shift and for competitive, environmentally-friendly freight transport will not disappear. We can at best use the current economic slump as a short additional breathing space, to then be better prepared and take the necessary action in order to anticipate the capacity constraints expected by DIOMIS for 2015/2020. Considering the lead times, now is the time for action, however much this may seem an unnatural reaction in the present economic circumstances.

We hope our work will help the reader share our sense of urgency, and we look forward to cooperating with all the stakeholders in order to reach this shared goal.

**Eric Peetermans**  
**Chairman of the UIC Combined**  
**Transport Group**

**Oliver Sellnick**  
**Director Railway Undertakings, UIC**

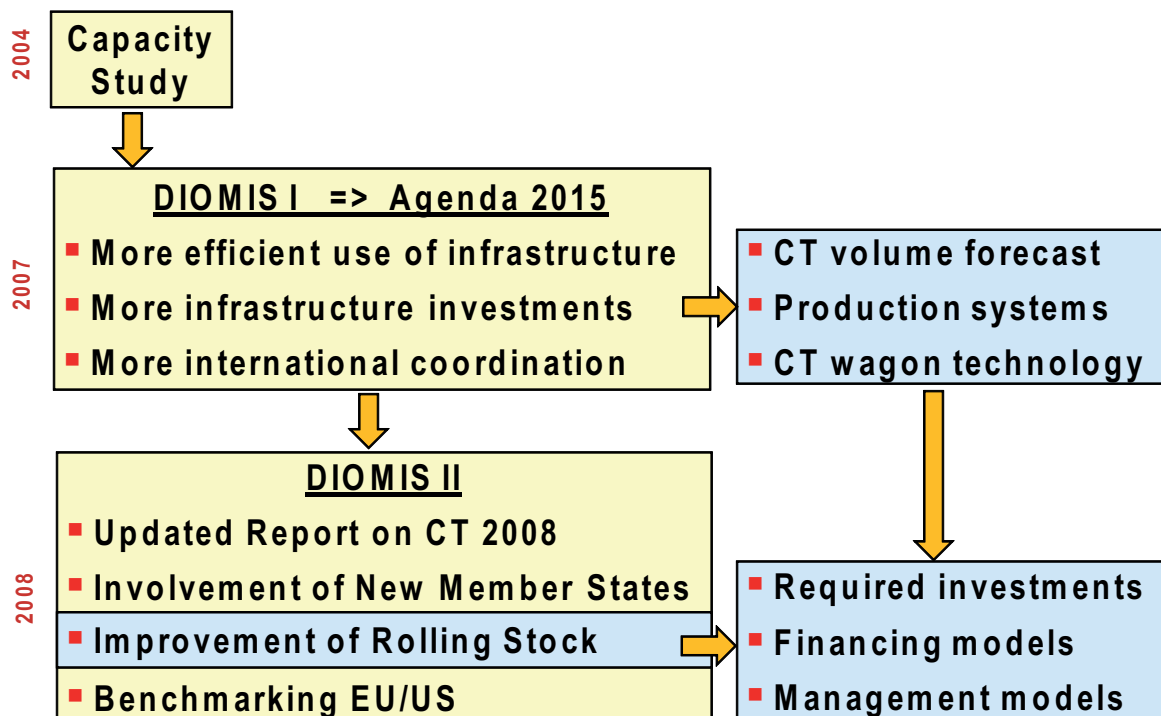




# 1. PROBLEM AND OBJECTIVE

The Capacity Study published in 2004 brought to light the fact that capacity bottlenecks would affect both rail networks and intermodal terminals in Europe even if all the planned infrastructure enlargement projects were implemented by 2015. It recommended that the analysis of Combined Transport (CT) in Europe as part of the DIOMIS I study (Developing Infrastructure and Operating Models for Intermodal Shift) continue. In late 2007 this work was completed and summarised in the **Agenda 2015 for Combined Transport in Europe**. The Agenda 2015 recommends a more efficient use of infrastructure, more infrastructure investments and more international coordination in order to synchronise improvement plans (see **Figure 1**).

Figure 1 DIOMIS objectives in terms of rolling stock





Three points in the Agenda are of particular relevance for the development of rolling stock:

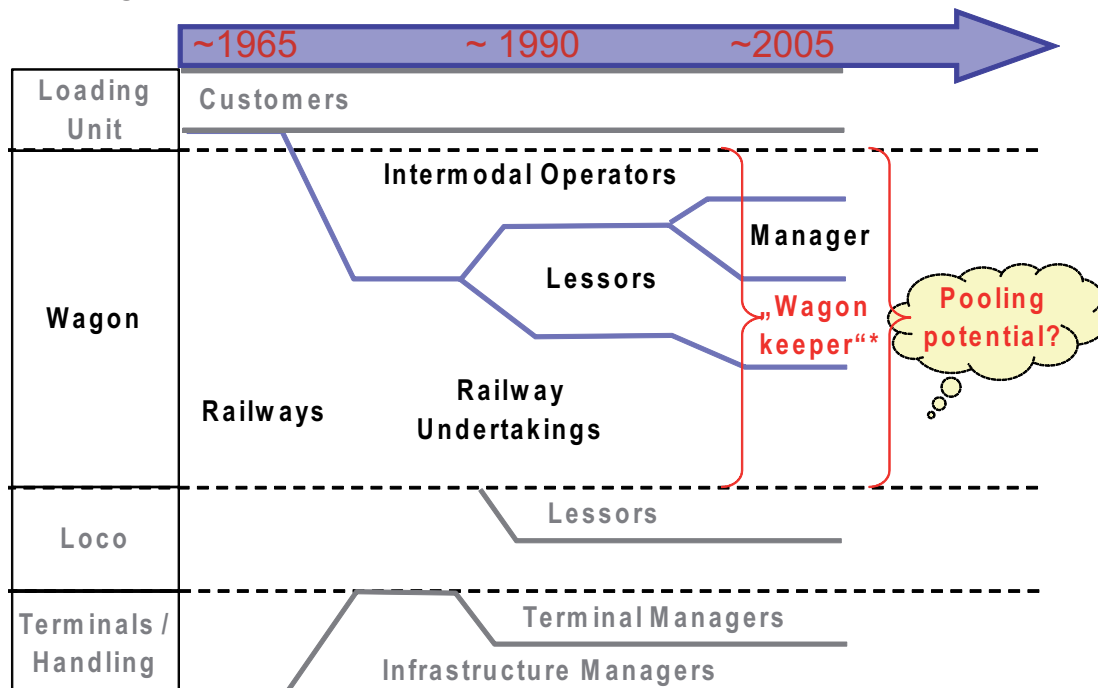
- The new forecast of CT volumes by 2015;
- The relevant rail freight production systems (e.g. shuttle and gateway systems) for an efficient deployment of services, and
- Wagon technology: the analysis of efficient wagon types with regard to optimum use of infrastructure and train parameters, e.g. weight and length-efficient wagons. See DIOMIS report on **Assessing New Technologies in the Wagon Field**).

In early 2007, when the DIOMIS II work programme was adopted by the International Union of Railways (UIC) we made the following observations:


- Investment in CT wagons had been stagnating up to 2006
- Manufacturers were increasingly reluctant to invest in research and development or wagon design and testing without strong commitment from a customer
- With the liberalisation of the rail sector additional players (intermodal operators, lessors, “managers”) were entering the market as (potential) customers
- Too, rail liberalisation was enforcing new roles (“wagon keepers” for example)

Consequently, the questions were whether there was a chance of achieving the projected CT volumes, and what could be done.

**Figure 2 Development of asset ownership and stakeholders**



\* Owner or long-term user according to GCU



The present report on rolling stock, carried out as part of DIOMIS II by KombiConsult, represents another step forward.

Since the liberalisation of the European railway sector the market has been the scene of a shift from integrated railways to specialised undertakings and business units (see **Figure 2**). Knowledge about growth potential and the shortfall of resources is divided between various companies. In addition, the period between identifying a capacity or technical requirement and responding to it is too long (an example being the oft-lamented lack of wagons in 2007).

The railway industry faces the challenge posed by the need for huge and long-term (~ 25-30 years) investments, and the short-term nature of transport contracts (~ 1 year). The combination of the two creates financial barriers, in particular for small and medium businesses.

In addition, regulatory changes at EU and multinational levels create new roles, responsibilities and issues (wagon noise for example).

The objective of the recent DIOMIS II report was therefore to provide guidance from the rolling stock point of view for the planned modal shift, by addressing the following issues:

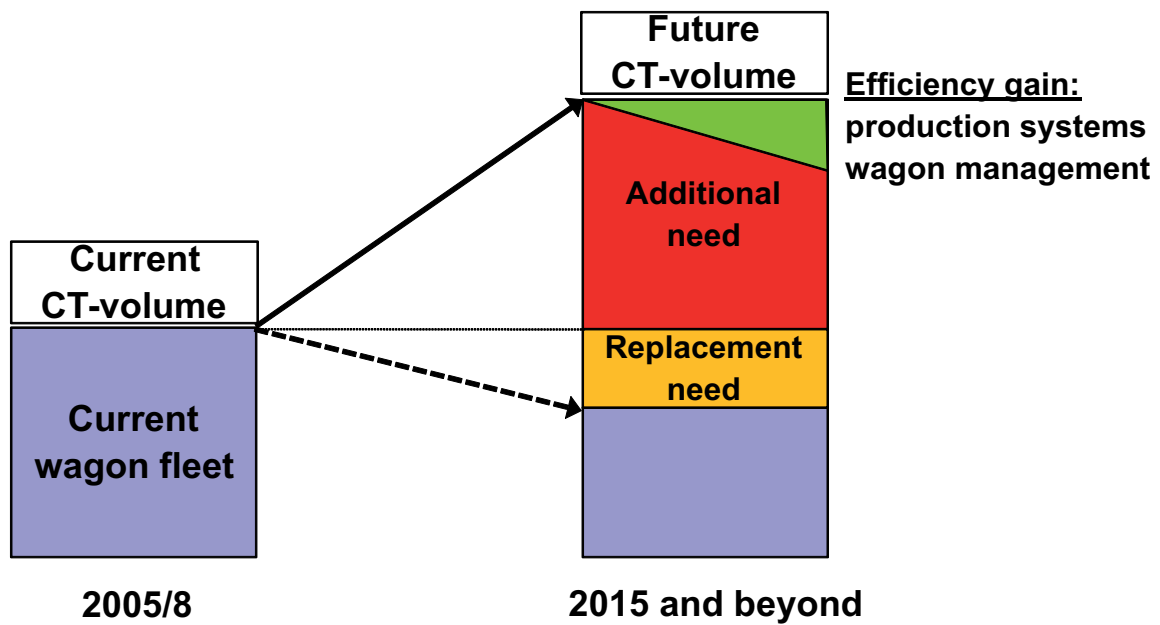
- What investments are required?
- In what time frame?
- What are the appropriate financing and management models?

This analysis focused on normal gauge wagons used in continental Europe.

The methodology applied was pragmatic and transparent, in order to be validated by stakeholders within and without the scope of the project (see **Figure 3**). We analysed the fleet of wagons used to transport the current quantities of freight: in 2005, for comparison with the growth scenario of the Agenda 2015, and in recent years (2007/8) where data was available.

The development of the current fleet, its aging and replacement, as well as future demand according to the growth path set out in the Agenda 2015 are decisive factors in determining future wagon demand.

Figure 3 Methodology for working out investment need





## **2. CURRENT FLEET**

### **2.1 Introduction**

Combined Transport on rail requires a sufficient number of suitable wagons. There is already a lack of appropriate wagons, even though wagons specifically designed for CT have been manufactured in vast quantities in recent years. In addition to wagons of this type, many other flat wagons are used for CT, mostly in Southern and Eastern Europe, as a result of the lack of special wagons. This report shall determine the current stock of wagons available for CT services and the need for further development.

The following figures come from the INTERUNIT Technical Committee wagon list, last updated in mid-2006, as well as internet research and interviews with the major owners, lessors and manufacturers of CT wagons carried out in the summer of 2008.

First of all we had to determine the current stock of wagons. Wagons for services in Spain, Portugal and Britain were not taken into account as they only ran inside these countries, for reasons of track gauge and structure clearance. Moreover, we only included wagons used for unaccompanied services, since the number of wagons needed for accompanied services (RoLa) was very much determined by political framework conditions.

### **2.2 Wagons specifically designed for CT**

While the first CT services were operated with normal flat wagons, the increasing demand for CT services led to the development of wagons specifically designed for this type of service. Nowadays the 60-foot wagon for containers (and swap bodies) is the most common CT wagon type (~ 50%). In addition, a wide variety of wagon types have been developed to match the variety of loading units in terms of length and weight. As well as the 60-foot wagon, two wagons types are becoming increasingly popular: 6-axle articulated wagons



with a loading length of up to 104 feet for swap bodies and 80 or 90 feet for containers, as well as single or double pocket wagons for semi-trailers and swap bodies. An overview of these wagons' quantities is presented in **Table 1**.

**a) 60-foot wagons**

The 60-foot wagon with two Y25 bogies has become the standard CT wagon in Europe as it is suitable for all kinds of containers (and swap bodies) without too much loss of loading space. Half of all wagons used for CT services belong to this category. It has thus become a standard product for all wagon manufacturers.

**b) 6-axle wagons**

6-axle wagons for containers and swap bodies are becoming increasingly popular, as they enable better utilisation of train length than 60-foot wagons in transporting 40 and 45-foot containers and swap bodies. The first 6-axle wagons were 104-foot wagons specifically designed for transporting swap bodies. Due to a significant increase in maritime container services in recent years, there has been an increase in the number of shorter 90-foot wagons and, lately, even 80-foot wagons. The major disadvantage of these wagons is that the loading scheme requires loading units in the inner places not to exceed a certain weight, because of the maximum axle load of the middle bogie. This problem is of particular relevance for container services as the weight of containers is increasing. The 80-foot wagons available to date are only suitable for 20- or 40-foot maritime containers.

**c) Pocket wagons**

The other major wagon type is the pocket wagon. The first pocket wagons were 4-axle wagons with a single pocket for one semi-trailer. Almost all new pocket wagons are 6-axle wagons with two pockets, which enable improved utilisation of train length. Nevertheless, the choice of pocket wagons appears to be a matter of "philosophy", as some intermodal operators (HUPAC for example) favour single pocket wagons because of the flexibility they provide in loading several types of swap bodies, the easy replacement of train sets and the easy handling in workshops, while others (e.g. Kombiverkehr) would advocate the use of articulated wagons. In any case, both wagon types in their most recent models, T3000 for Kombiverkehr and T5 for Hupac, provide the same loading capacity for mega-semi-trailers.

**d) Other wagons**

The first wagons used for CT services were 2-axle wagons with a loading length of 40 or 45 feet. Most of these wagons had been rebuilt from other flat wagons or covered wagons.

A significant number of them are still in service nowadays. In addition, a small number of low floor wagons transport high cube containers and swap bodies on rail lines with lower loading profiles. At last, there are a certain number of 45- und 52-foot 4-axle wagons, mostly rebuilt from other flat wagons as well.

*Table 1 Total number of normal gauge wagons used exclusively for unaccompanied CT services, by wagon types in service in 2007*

Category	Type of wagon	# of Wagon	TEU/ Wagon	# of TEU	Share [%]
(a)	60-feet 4-axle	28.000	3	84.000	50,3
(b)	80-/90-feet 6-axle	5.300	4	21.200	13,2
	104-feet 6-axle	3.300	4	13.200	8,2
(c)	4-axle pocket	1.500	2	3.000	1,9
	6-axle double pocket	1.700	4	6.800	4,2
	2-axle	7.800	2	15.600	9,7
(d)	other 4-axle	6.500	2	13.000	8,1
	low-floor	1.900	2	3.800	2,4
<b>Total</b>		<b>56.000</b>	<b>Ø 2,9</b>	<b>160.600</b>	<b>100,0</b>

*Source: KombiConsult research and estimates*

In total there are 56,000 wagons specifically designed for CT in Europe, excluding wagons used for broad gauge services and services in Great Britain. They provide a total loading capacity of 160,600 TEU.

### 2.3 Standard wagons that can also be used for CT services

In addition to wagons specifically designed for CT, almost every flat wagon can also be used to carry containers. Precise figures for these wagons are not available. Many of these wagons are over 30 years old. A significant number of these are out of service, although they are still listed in statistics. They are often used to provide spare parts for other wagons, or are simply parked on sidings. An overview of the figures is presented in **Table 2**.

The use of these wagons for CT involves some disadvantages. Their tare weight is higher than the weight of comparable wagons specifically designed for CT, consequently they can only carry approximately 5 tonnes less per pay load. In addition, they are at a disadvantage in terms of loading and unloading procedures, although some of these wagons are equipped with pins for containers. The use of these wagons for CT is very rare in Western and Central Europe but still common in Southern and Eastern Europe, as well as on some port hinterland transport services.

There are roughly 20,000 “R” and “K” type wagons with 2 axles and mostly 40 feet of loading length, 15,000 wagons with 4 axles and 40 or 45 feet of loading length and around 30,000 wagons with 4 axles and 60 feet of loading length. In addition to the above mentioned disadvantages, the use of these wagons for CT services is further limited by demand for them on other freight services.

**Table 2** *Total number of standard normal gauge wagons that can also be used for unaccompanied CT services, by wagon types in service in 2007*

Type of wagon	# of Wagon	TEU/ Wagon	# of TEU	Share [%]
2-axle (40-feet)	20.000	2	40.000	25,0
4-axle (40/45-feet)	15.000	2	30.000	18,8
4-axle (60-feet)	30.000	3	90.000	56,2
<b>Total</b>	<b>65.000</b>	<b>Ø 2,4</b>	<b>160.000</b>	<b>100,0</b>

*Source: KombiConsult research and estimates*

Around 65,000 standard wagons, providing the capacity to carry around 160,000 TEU, may in part be used for CT services.



## 3. INVESTMENT NEEDED

### 3.1 Projection of future need

The future need in terms of wagons is determined by the present fleet, the projected (future) volume and the following parameters, which are presented in detail in the following sections:

- Orders and options
- Replacement need
- Operational parameters
  - Round trip schedules
  - Maximum train length and weight
  - Maintenance reserve
  - Utilisation of maximum wagon parameters

### 3.2 Orders and options

Due current demand in wagons for CT, many wagons have already been ordered, mostly by wagon lessors, who account for over half of all pending orders and options. Contrary to the past, wagon lessors now order wagons for CT without being certain of having a lessee. This is a viable approach, as in early 2008 demand for CT wagons exceeded supply, and all new wagons could easily find a lessee. However, major operators intend to reduce the leasing rate in their fleet from around 30 % at present to around 20 % in the future, and at the same time intend to increase their own fleet size constantly. This shows they are confident in intermodal business and want to control assets on their own.

The pending orders and options for CT wagons are concentrated on three wagon types: 60-foot wagons, 80- and 90-foot wagons and double pocket wagons. A quantitative overview is presented in **Table 3**.



**a) 60-foot wagons**

As well as being the wagon type with the highest numbers in stock, the 60-foot wagon is also popular in terms of pending orders and options, as it accounts for over half of them. The reasons are its flexibility and high availability compared to other wagon types. Indeed, all manufacturers are able to offer this wagon type and as a result it is available at a more reasonable price than others.

**b) 6-axle wagons**

The second most ordered wagon type is the 6-axle wagon for containers and swap bodies with 80 or 90 feet of loading length. The 90-foot wagon is still much more requested than the 80-foot wagon as it provides more flexibility in operations, and in particular because it can carry swap bodies as well as maritime containers. 80-foot wagons themselves are only equipped to carry maritime containers. No 104-foot wagons have been ordered in recent years as they are more suitable for swap bodies than for maritime containers – the greatest increase in demand has been for the transport of maritime containers and semi-trailers.

**c) Pocket wagons**

The wagon type that is least manufactured at present is the 6-axle double pocket wagon. However, due to an increasing number of semi-trailers among loading units in continental CT services the demand for pocket wagons is constantly increasing. As double pocket wagons offer a better utilisation of train length, almost all pocket wagons manufactured nowadays are of this type.

**d) Other wagons**

There are almost no orders for wagon types other than the three mentioned above. On one hand this is because the existing rolling stock provides a broad variety of different wagons for different loading units, thus satisfying the demand for wagons that can carry special loading units. On the other hand the increase in demand for CT services is almost entirely due to an increase in the number of maritime containers and semi-trailers. There is therefore no additional demand for wagon types other than those mentioned above at present. Moreover, as the above mentioned wagon types are ordered in great quantities they can be procured at a reasonable price, whereas other wagon types would only be manufactured in small numbers. This leads to higher unit prices, which makes procuring these wagon types less economically viable.

In addition to new wagons being procured, old wagons are still being made into CT wagons. Old flat wagons in particular are being made into 60-foot CT wagons, but no figures are available on how many wagons have actually been rebuilt. Since most of these wagons are quite old and were designed for fewer payloads than new wagons are at present, the use of these wagons is considerably restricted.

*Table 3 Total number of normal gauge wagons ordered for unaccompanied CT services, by wagon types in 2007*

Category	Type of Wagon	# of Wagon	TEU/ Wagon	# of TEU	Share [%]
(a)	60-feet 4-axle	10.800	3	32.400	47,8
(b)	80-/90-feet 6-axle	6.000	4	24.000	34,7
(c)	6-axle double pocket	3.200	4	12.800	18,5
(d)	Other	-	-	-	-
<b>Total</b>		<b>20.000</b>	<b>Ø 3,5</b>	<b>69.200</b>	<b>100</b>

*Source: KombiConsult research and estimates*

Orders and options have been placed for around 20,000 new wagons for CT services in the coming years. Even if the very recent situation (economic decline in the autumn of 2008) leads to orders and options being postponed, these wagons will enter the market in the next 4 to 5 years to the amount of 5,000 wagons, or 17,500 TEU, per year.

### 3.3 Replacement need

The age of the rolling stock currently in use determines the level of demand for wagons, as those that can no longer be used have to be replaced.

Due to their high operational performance, CT wagons have an economic lifetime of around 30 years. Approximately one third of all wagons specifically designed for CT services are under 10 years old. This is true of all double pocket wagons and most other 6-axle wagons, as well as a significant proportion of 60-foot wagons.

As almost no wagons will be going out of service in the near future, the stock of CT wagons will increase in the coming years as a result of pending orders and options.

The conclusion is that the current fleet of CT wagons, around 56,000 wagons [160,600 TEU], will increase through orders and options by 20,000 wagons [69,200 TEU], to reach a total number of 76,000 [229.800 TEU]. Standard wagons will be used as a “silent” reserve, to be brought into service at times of peak demand or for specific uses, such as intra port transport or private sidings (with long staying times). The 60-foot wagon will remain the most popular CT wagon type in the foreseeable future.

All short 4-axle wagons and the 2-axle wagons, a significant proportion of 60-foot wagons, for the most part reconstructed ones, and some 4-axle pocket wagons are over 20 years old and have to be replaced in 10 years’ time.

However, a significant number of wagons will already have to be replaced within the next 10 years as they reach the end of their economic life time, especially:

- almost all 2-axle wagons (“Lgs”)
- almost all short 4-axle wagons
- some 60-foot wagons

This means that around 18,500 wagons [48,100 TEU] need to be replaced between 2012 and 2018. Considering that these shorter 2-axle and 4-axle wagons (Ø 2.6 TEU/wagon) will be replaced by modern 4-axle and 6 axle ones (Ø 3.5 TEU/wagon), this represents a demand for around 14,000 new wagons (see **Figure 9**).

In the following years (after 2018), around 3-4% of the current fleet will need to be replaced per year.

### 3.4 Operational parameters

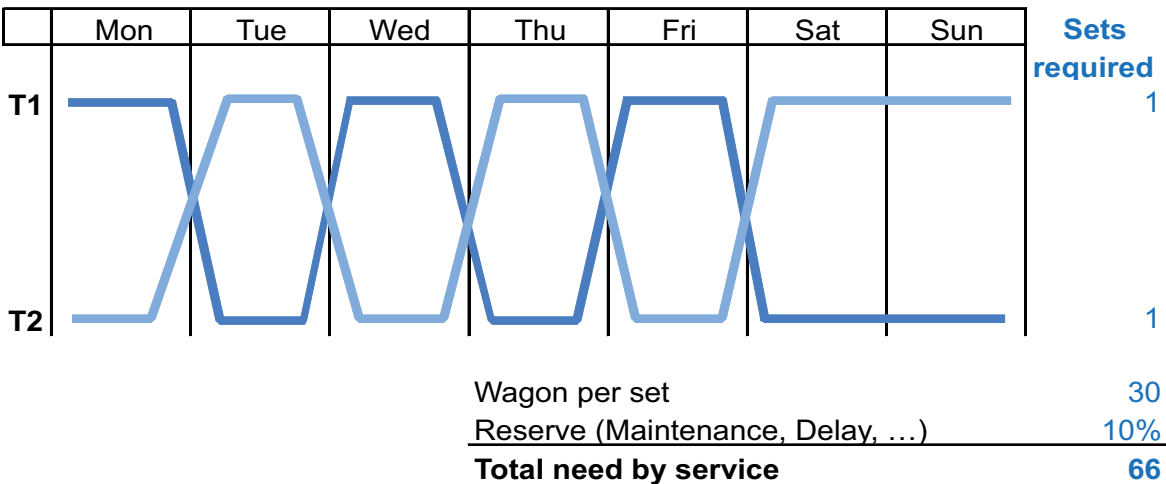
Typical operational parameters influencing wagon demand are:

- Round trip schedules (duration and number of round trips per week or year)
- Maximum train length and weight
- Maintenance reserve
- Utilisation of maximum wagon parameters

The following figures (**Figure 4** to **Figure 6**) demonstrate how many wagons are needed for Day A – Day B (“night jump”), Day A – Day C, and Day A – Day D services in Europe.

**Figure 4    Wagons needed for a Day A – Day B round trip service**

**Typical round-trip circulation plan Day A - Day B service (10 departures)**



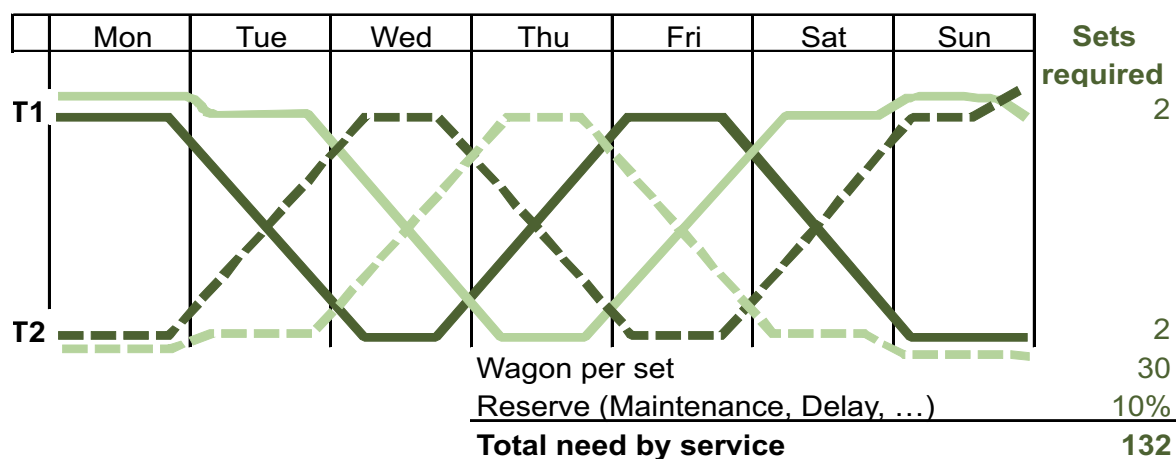
*Source: KombiConsult research and estimates*

A Day A – Day B service with a fixed wagon formation requires 66 wagons, or 191 TEU, for round trips.



Figure 5 Wagons needed for a Day A – Day C round trip service

Typical round-trip circulation plan Day A - Day C service (10 departures)

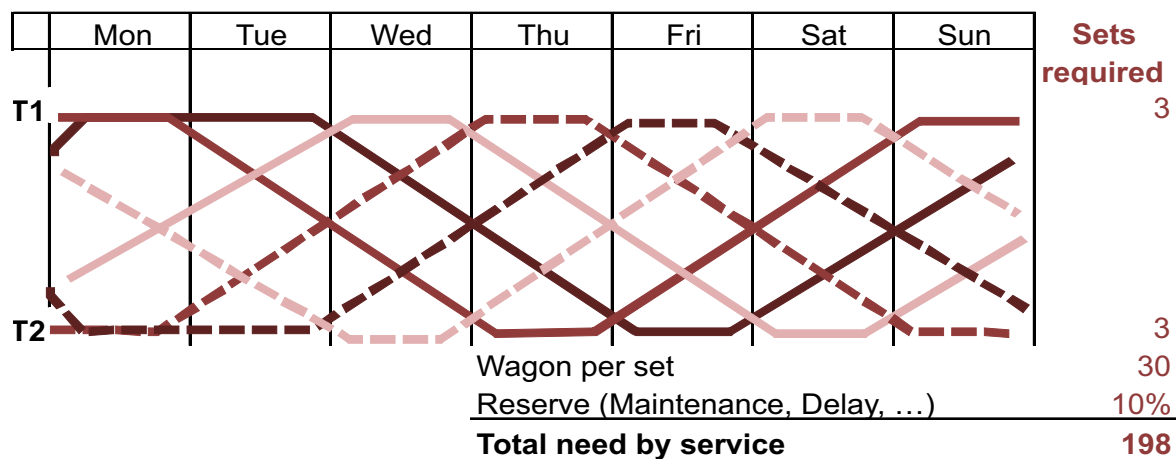


Source: KombiConsult research and estimates

A Day A – Day C service with a fixed wagon formation requires 132 wagons, or 382 TEU, for round trips.

Figure 6 Wagons needed for a Day A – Day D round trip service

Typical round-trip circulation plan Day A - Day D service (10 departures)



Source: KombiConsult research and estimates

A Day A – Day D service with a fixed wagon formation requires 198 wagons, or 574 TEU, for round trips.

45 operational weeks are usually planned for an entire year of regular service, in order to compensate for seasonal interruptions in the summer and winter holidays when transport demand is lower. Transport demand (maximum required capacity) is of roughly 30 shipments for every 25 tonnes. Figures of 750 tonnes net-weight and around 600 m train length correspond to total train weight and length. The tonnage per wagon required to transport this quantity of freight in keeping with typical round trip schedules can be calculated. An average annual tonnage carried by a wagon can thus be deducted: 3,150 tonnes. Considering that this figure (equivalent to 100% capacity utilisation over an entire year) is unlikely to be achieved in all services during an entire year, we reduced this amount to 2,600 tonnes per wagon per year, which amounts to around 82% (see **Figure 7**).

**Figure 7 Average annual tonnage carried by a CT wagon**

	Service Day - Day (10 departures/week)		
	A-B	A-C	A-D
<b>Total wagon need by service</b>	<b>66</b>	<b>132</b>	<b>198</b>
Weeks / year	45	45	45
Departures per week	10	10	10
Shipments per Departure	30	30	30
Tonnes / Shipment	25	25	25
<b>Tonnes per year</b>	<b>337.500</b>	<b>337.500</b>	<b>337.500</b>
<b>Tonnes per wagon * year</b>	<b>5.114</b>	<b>2.557</b>	<b>1.705</b>
Estimated share of service	30%	50%	20%
	100%	3.150	
<b>Ø Tonnes per wagon * year</b>	65%	2.050	
depending on train utilisation	Ø	<b>2.600</b>	

*Source: KombiConsult research and estimates*

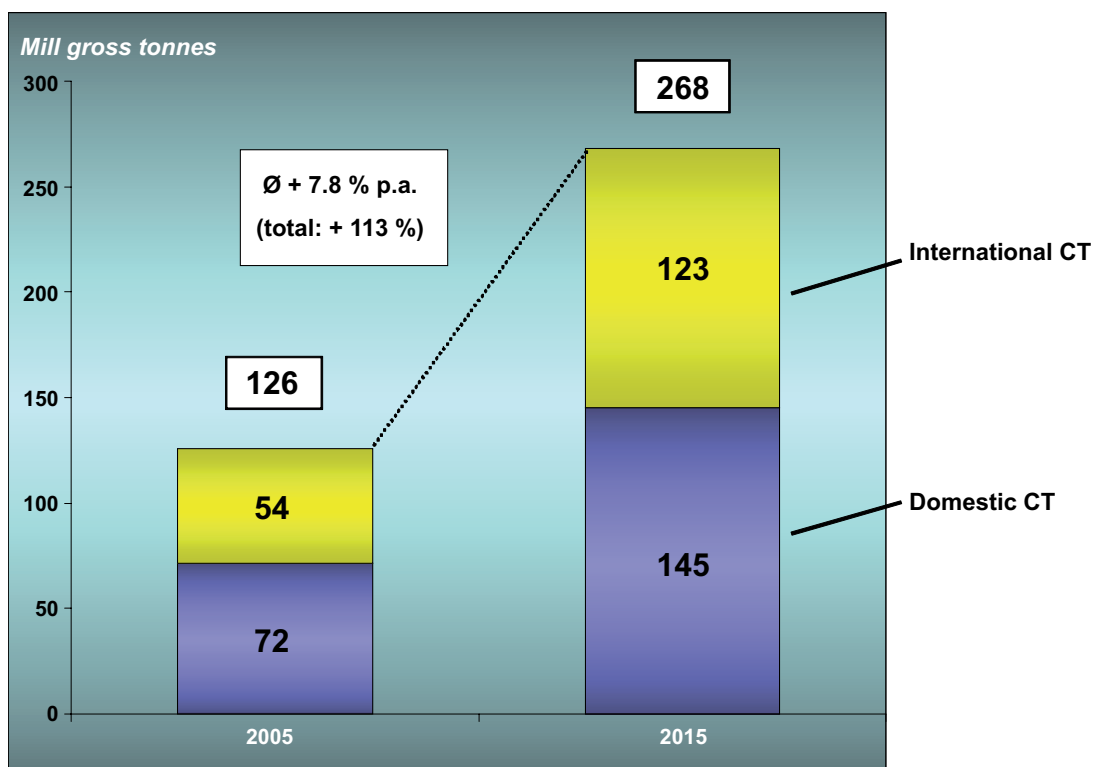
The average annual tonnage per wagon is around 2,600 tonnes. Calibration with 2007 data confirms this figure. According to KombiConsult research (see **DIOMIS 2007 Report on Combined Transport**) around 172.2 million tonnes have been transported on CT services. By dividing that number by the total number of CT wagons and a relevant proportion of standard wagons also used for CT services, the result is an average of 2,628 tonnes per wagon for 2007.

In practice wagon need very much depends on whether round trip schedules can be followed, whether sufficient terminal capacity can thus be provided, and last but not least whether punctuality can be ensured! An overly busy rail network decreases speed and punctuality and increases the need for fallback and reserve wagons. On some networks/network sections the total train length is limited and carrying capacity per train is thus further reduced, the result being a need for more trains and, accordingly, more wagons to compensate eventual delays on two shorter trains rather than one long one. Since we feared that these negative influences would be prevalent, we stood by the aforementioned methodology even though management models aiming for improvement were looking to be applied to increase the efficiency of the wagon use.

### 3.5 Future volume

The future volume of combined transport in Europe has already been projected in the **Agenda 2015 for combined transport in Europe**, which expects the volume of 126 million tonnes in 2005 to more than double by 2015, reaching 269 million tonnes (see **Figure 8**).

**Figure 8** Projected volume of unaccompanied CT, 2005/2015, in million tonnes



Source: UIC Agenda 2015 for Combined Transport in Europe

### 3.6 Investment needed in quantitative and monetary terms

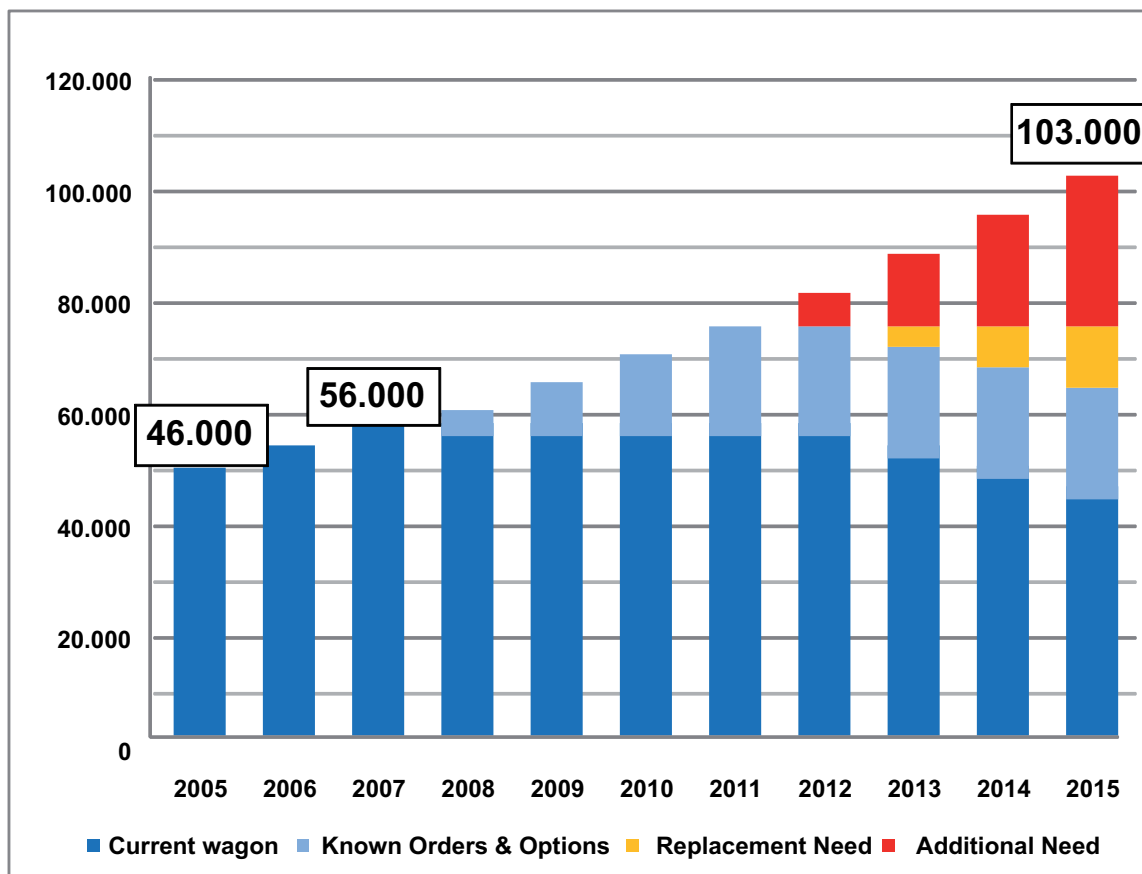
We can therefore expect wagons in service in 2015 to be carrying 143 million tonnes more than the volume transported in 2005. If performance remains at 2,600 tonnes per year, 55,000 additional wagons will be required. In view of the need to replace 11,000 wagons by 2015, a total of 66,000 newly-built wagons will be needed, of which 20,000 are already orders and options. The annual investment need is of around 9,400 wagons, of which 2,900 are already orders and options, if demand is spread over 7 years rather than 4 to 5 years.

The projected course of development presented in **Figure 9**, which takes account of the aforementioned findings, shows that in the near future sufficient capacity will be available to carry CT volume in general. CT wagon stock will most probably cover demand for the next few years, although a shortfall of special wagons is possible.

However, the diagram also shows that wagon demand is higher than the number of wagons specifically designed for CT in the present and currently ordered fleet. A shortage of wagons is likely if the CT volume increases as forecast. Additional wagons will be needed to replace retired ones. A refurbishment programme for existing wagons, resulting from legislation on train noise that is currently being debated, will incur additional costs, as will building new wagons. Consequently, stakeholders should carefully monitor developments and prepare to acquire additional wagons, especially when if developments affect wagon prices.



Figure 9 CT wagon development, 2005/2015, in number of wagons



Source: KombiConsult research and estimates

Wagon prices are determined by a certain number of factors:

- Wagon type
- Quantity of wagons in a single order
- Time frame for delivery
- Market price when the contract is signed
- Amount of components supplied by the customer

As well as these decisive factors, further contractual conditions influence the end price of a complete, “ready to use” wagon, such as:

- Manufacturer and buyer responsibility vis-à-vis certification/licensing
- “Ex works” or “on customer site” delivery
- Payment conditions “according to progress” or “only after delivery and acceptance”

These factors can easily create a price variation, and this is shown in the table.

Due to the rise in prices for steel and certain components such as wheelsets, prices for CT wagons have increased by over 50 % in the past 2 years. **Table 4** shows the results of a brief inquiry carried out in autumn 2008. In order to calculate investment needed in monetary terms, current prices (without inflation) were related to total wagon demand.

*Table 4 CT wagon prices in 2008*

Category	Type of Wagon	Share of orders	Ø Price in Euro	Variation
(a)	60-foot 4-axle	54%	72.500	+/- 2.500
(b)	80-/90-foot 6-axle	30%	105.000	+/- 2.500
(c)	6-axle double pocket	16%	145.000	+/- 5.000
<b>Weighed average price per wagon</b>			<b>93.850</b>	

*Source: KombiConsult research and estimates*

By multiplying this average weighted price per CT wagon by the projected number of wagons required to achieve the anticipated growth of CT by 2015, we worked out that a total of € 6,194 million would need to be invested in intermodal wagons, of which € 1,877 million are already orders and options.

### **3.7 Supply and Demand**

Mirroring the economy, rail freight transport and, accordingly, wagon demand decreased in Eastern Europe after the fall of the iron curtain in the 1990s. State-owned railways rationalised their wagon fleets and ordered little or no new wagons. Consequently, several manufacturers disappeared, or at least reduced their development and production capacities.

Midway through the present decade, particularly since 2006, there has been an increase in wagon demand, mainly among leasing companies.

Prices for steel and components (e.g. wheelsets) have been increasing, due to an increase in worldwide demand for steel. Workers from new EU Member States have used the freedom of the common market to offer their services in Western Europe.

The lack of qualified workers, welders in particular, has become a serious issue in Eastern Europe's wagon workshops. In addition, staff costs in CEE workshops are increasing because of improved welfare for workers. On top of this, the Euro exchange rate has been unfavourable for CEE manufacturers, leading to an increase in the price of finished wagons.


There is an increasing gap between prices on the market for CT services and the cost of procuring rolling stock. The CT service sector already operates with small margins because of the competition of road and river transport. In addition, CT wagon prices have increased by over 50 % in the last two years. This is due to the permanent increase in steel prices and an increase in the prices for wheelsets, because of a shortage of these parts on the market. At present CT wagons are still being ordered and built in great quantities, and new players are even choosing the CT wagon leasing market. However, some lessors have already stopped ordering CT wagons because of the aforementioned market situation. With production costs set to increase further, the cost of procuring CT wagons may exceed the limit under which CT operators can afford to provide their services.

This situation may be slightly offset by the fact that a greater number of older flat wagons being made into CT wagons, but the increase in the number of wagons that can thus be achieved is limited by the age of the existing standard flat wagons in Europe, as well as by demand for these wagons in other freight services. As using standard flat wagons for CT without rebuilding them is detrimental to operations, as mentioned beforehand, such use of these wagons would have a negative impact on the efficiency of CT services. Therefore, it would only be a viable alternative if the shortage of wagons became a serious problem.

The number of wagon manufacturers in Europe has decreased significantly in recent decades. Today there are four major wagon manufacturers in Europe:

- The IRS Group, with plants in Romania and Serbia
- Tatrabagónka in Slovakia
- Greenbrier, with a plant in Poland
- Lostr in the Czech Republic

These four companies represent more than 80% of total production capacity in Europe. Several other smaller companies also manufacture freight wagons. However, most of these do not manufacture CT wagons, which require too high a minimum capacity to be manufactured at a competitive price, or they focus on special (intermodal) wagons.



These are companies such as Ferriere Cattaneo, Josef Meyer (both based in Switzerland), Arbel Fauvet Rail (France) and Kockums Industrier (Sweden). Ferriere Cattaneo has produced the most recent generation of pocket wagons, designed to transport mega semi-trailers. Meyer has recently developed a light wagon prototype providing more payload, while Kockums has produced a small series of 2-axle wagons which can run at 160 km/h, responding to the domestic transport demands of the Swedish postal service. In addition, some former state railways provide manufacturing capacity in their workshops, which is mostly used to rebuild older wagons.

The actual production capacity of wagon manufacturers in Europe amounts to around 12,500 wagons a year. However, not all manufacturers actually produce CT wagons, as was mentioned beforehand, and one of the main four manufacturers does not even produce CT wagons, because the prices at which these wagons can be sold are low compared to the prices of other wagon types. Consequently, around 5,000 CT wagons, with a capacity to carry 17,500 TEU, are currently being produced in Europe every year.

All manufacturers state that they are currently working at full capacity, and that they are fully booked for the next few years. Delivery time for wagons ordered in 2008 is of around 2 years.

In addition to the wagon manufacturers' production capacity, some former state railways have some capacity to produce wagons in their maintenance workshops, which is mostly used to rebuild older wagons. This capacity cannot be precisely estimated because it depends on many parameters, such as the amount of maintenance work requested, the needs of the railway that owns the workshop in question – most former state railways are unwilling to produce or rebuild wagons for their competitors – or the efficiency of the workshops, which determines whether they can guarantee competitive prices. Both types of manufacturers rely on component suppliers for wheelsets or bogies, bumpers, brakes and other key components.

Almost all major wagon manufacturers aim to extend their production capacity, which would increase total production capacity for freight wagons in Europe to around 15,000 wagons a year. Due to the aforementioned market situation for CT wagons however, it is debatable whether this will lead to an increase in CT wagon production as wagon manufacturers are able to achieve better margins with other wagon types.

Moreover, demand for almost all wagon types exceeds supply at present, so manufacturers will tend to increase production of wagon types other than CT wagons.

In addition to the existing wagon manufacturers in Europe, companies from the CIS countries and Asia have shown interest in the European market, and some have tried to buy some of the smaller European manufacturers. Although these attempts have not been successful so far, these companies may become serious competitors to European manufacturers in the medium term. None of these companies are currently able to match European quality requirements, but if they were to benefit from the engineering know-how of a smaller European manufacturer, this situation could change. Asian manufacturers also face the problem of distance, as the cost of transporting a wagon would not enable them to offer competitive prices for wagons produced in Asia. However, if plans for a standard gauge railway line from China to Europe were realised in the future, wagons from Asia could be delivered to Europe while carrying containers on their journey.

Service industries, such as logistics and the rail sector in particular, depend on the production economy as a whole. The prices of steel and oil are particularly important as they have an impact on both ends of the value chain (wagon cost and prices of CT services). A higher volatility in the production costs is challenging the stakeholders. Efficient wagon management models are therefore needed to optimise the use of the existing fleet.



## 4. MANAGEMENT MODELS

### 4.1 Introduction

The overall objective of wagon management can be summarised by a simple sentence: “To provide the appropriate number, type and quality of CT wagons at the right place, at the right time and at a reasonable cost”. In order to meet these requirements, CT wagon management covers the entire life cycle of a wagon, from market research, procurement and financing, service assignment and operations to maintenance and exploitation of used wagons (see **Figure 11**).

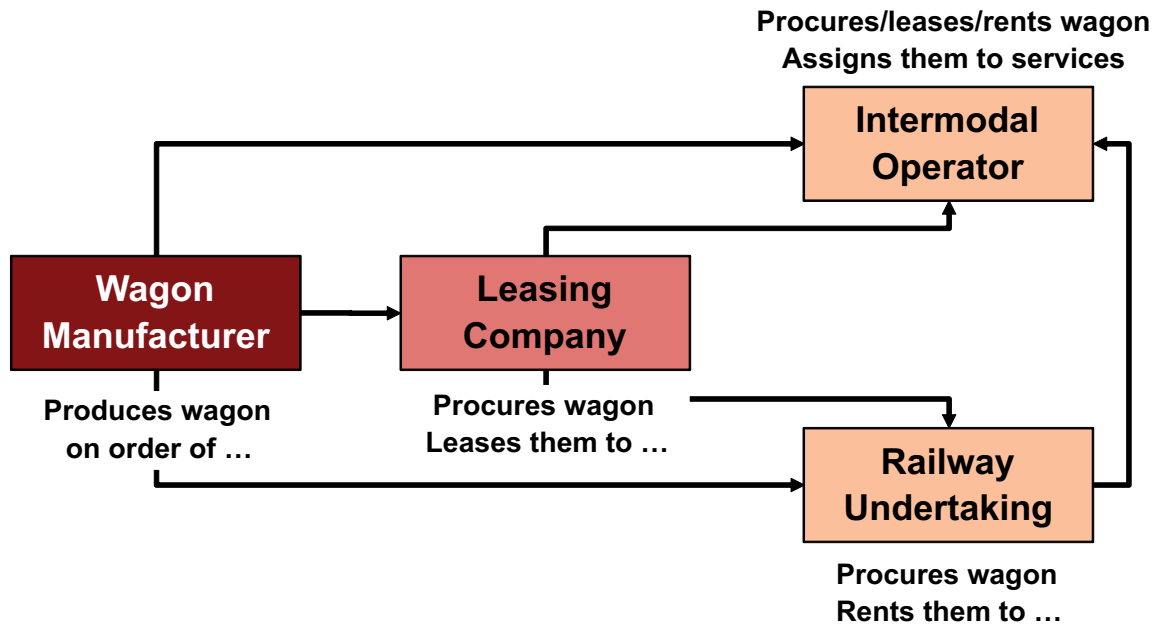
The aims of procurement and financing are to provide wagons at the lowest possible cost. In their procurement activities wagon managers seek to exploit manufacturing capacities all over Europe, ordering vast quantities of wagons in order to achieve economies of scale. To ensure appropriate wagon use, an increasing number of leasing companies in particular order standardised vehicles (when possible).

Several financing models can be applied (see **Chapter 5**). In the past, bank loans were “cheaper” for companies with a focused business that reached a higher financial rating at respective rating firms. Leasing companies have increased their fleets considerably. They have also been able to place their company headquarters in tax-optimised locations: Zug/Switzerland for AAE and Wascosa, Luxemburg for IRS, Delaware/USA for TTX, while most established railways and intermodal operators are limited to their country of origin.

**Figure 10** shows the relationship between wagon manufacturers, who produce the wagons, and leasing companies, railways or intermodal operators who procure them directly or indirectly. Depending on the model, a higher number of intermediaries may be involved in the process, but generally these four parties form a basis. In the past (see also **Figure 2**) railway undertakings were the only customers ordering vast quantities of CT wagons. Intermodal operators and leasing companies, AAE being the first and still the largest, then entered the scene.



Figure 10 Business models for rolling stock, “from shop to service”



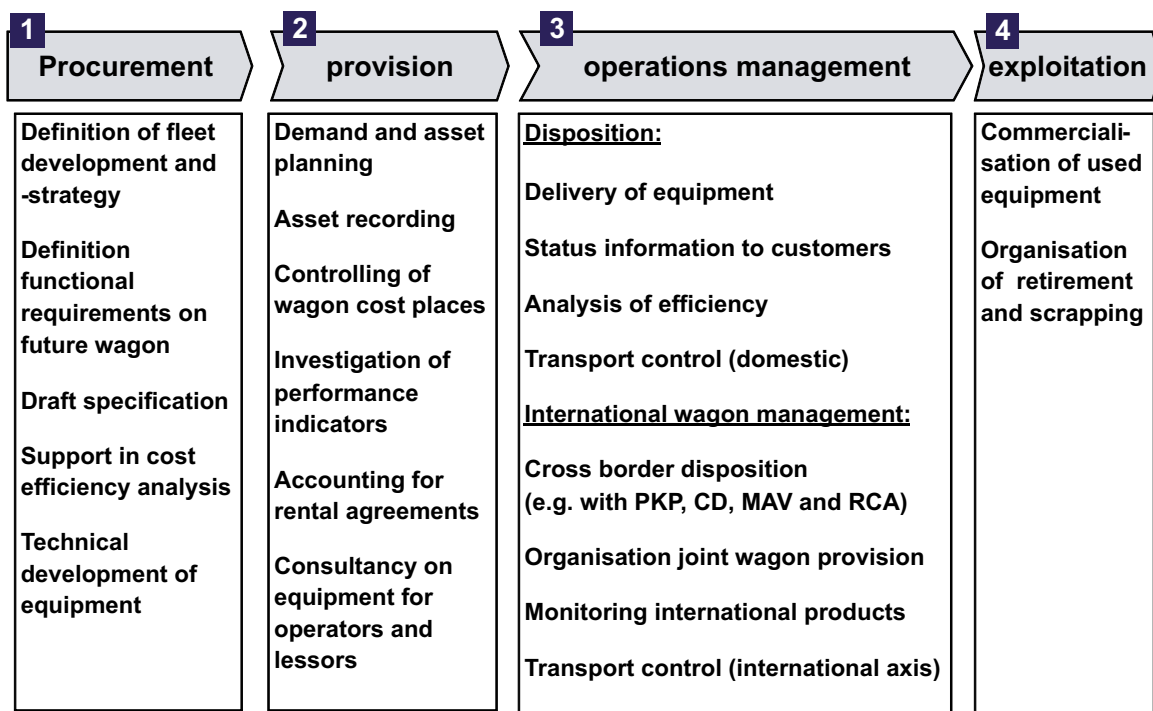
Once the wagon is procured, the aim of wagon management is to assign it to CT services. This can be done within one company – many railways and intermodal operators do this internally (e.g. Hupac, Kombiverkehr, Cemat), within a grouping (see the DB Intermodal Services business case in **Chapter 4.1**), or between companies (see the TTX Company and Railrelease business cases). Wagon utilisation (per year) can also be increased during operations: certain rail production forms enable this, such as shuttle trains, which carry out efficient round trips for wagons, or “string-of-pearls” type operations, via gateway terminals (see DIOMIS report on **Production systems including long and heavy trains**). However, wagon managers also depend on rail networks to ensure train punctuality (see **Chapter 3.4**).

Wagon maintenance is important during operations in order to increase wagon availability for intermodal services. Three criteria have to be kept in mind: purchasing new wagons requiring fewer repairs, using standardised components and spare parts which are available throughout Europe, and setting up on-site maintenance teams to reduce idle time between operations and the workshop.

## 4.2 DB Intermodal Services GmbH case study

DB Intermodal Services GmbH, based in Mainz (Germany), was created through a merger in 2003 of Buss-Trans-Container Service GmbH and Kombiwaggon Servicegesellschaft für den Kombinierten Verkehr mbH, based in Mainz. It acts as a European-oriented ancillary service provider for complementary services in intermodal transport. It is divided into seven business units, one of which is dedicated to “wagon and loading unit management”. This unit handles all of the Deutsche Bahn group’s (intermodal) wagons. Its activities span the entire life cycle of a wagon, from procurement and provision to railways and operators to operation management and exploitation (see **Figure 11**).

**Figure 11 Life cycle management of CT wagons**



Source: DB Intermodal Services, 12/2008

### 4.3 TTX Company case study

TTX Company provides wagons<sup>1</sup> and freight-related wagon management services for the North American railway industry. Its pooled wagons are destined for intermodal and automotive services, as well as lumber, machinery, building materials, steel, and other commodity groups where flat wagons, covered wagons and open wagons are required. TTX Company's stock is owned by 10 North American leading railways who are also TTX's primary customers. Wagons are provided for railways at competitive hiring rates.

It is essential to know that TTX works as a cooperative company, and that the business model as well as contracts and pooling agreements are under the jurisdiction of the Federal Department of Transportation's (DoT) Surface Transportation Board. TTX is granted a limited anti-trust immunity, or "exemption", as we would say in Europe.

Over the past ten years, TTX has invested \$ 3.9 billion (approx. € 2.5 billion) in new wagon purchases, of which 61%, or € 1,525 million, were destined for intermodal wagons. Annual intermodal investment therefore amounted to € 152.5 million. Compared to this already vast sum, the investment required in Europe until 2015, which was estimated at € 6,052 million (see **Chapter 3.6**), is five times higher (approx. € 865 million p.a.).

TTX was founded in 1955 by 41 railways with the aim of sharing assets, in particular TrailerTrain equipment, for which railways wanted to share the economic risk as it was new to them.

Presently the leading railways in the U.S., Canada and Mexico are TTX's primary customers and they own all TTX's common stock. Their respective shares in TTX capital do not necessarily reflect current wagon use, as they are linked to the situation when the company was founded. These are the owners, in alphabetical order:

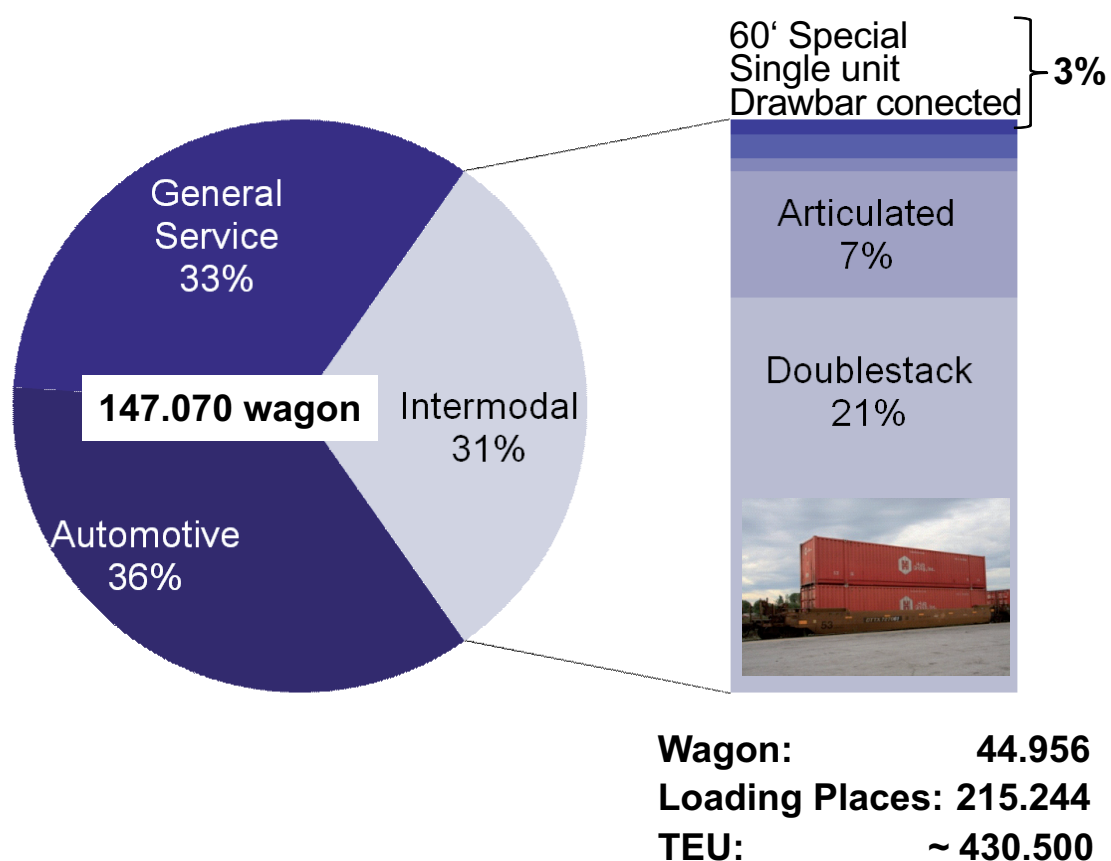
- Burlington Northern Santa Fe (BNSF)
- Canadian National (CN)
- Canadian Pacific (CP)
- Ferromex
- Kansas City Southern (KSCI)
- Kansas City Southern de Mexico
- Norfolk Southern (NS)

1 American English terms have been converted to European expressions when possible.

- Pan Am Railways
- Union Pacific Corporation (UP)
- CSX Transportation (CSX)

TTX provides the North American railways with a fleet of reliable, high quality wagons to meet the specific demands of their customers. It supplies well-maintained equipment wherever needed at the lowest possible cost. TTX is also responsible for keeping the fleet at a reasonable size, balancing new equipment acquisitions with innovative modifications and upgrades of the existing fleet. The operational fleet of over 140,000 wagons includes three different types: intermodal, autorack and general use wagons (see **Figure 12**). Thanks to the technical capacities offered by other wagon types (double stacking, possible coupling to very long units) operational capacity in TEU is almost 10 times higher than the number of wagons.

**Figure 12 TTX operational fleet (July 2008)**



Source: Interview with Tom Wells & Pat Casey, [www.TTX.com](http://www.TTX.com)

TTX has three maintenance divisions performing various types of repair and modification work, and 31 Field Maintenance Operations carrying out inspections and less extensive repairs on site.

The intermodal Equipment Distribution Services handle day-to-day management for all intermodal wagons. On an average day, 92 to 94 % of the fleet is in service. TTX's distribution system enables wagons to be directed from railways with excess capacity to railways that are short of wagons. This helps ensure that customers have sufficient equipment when they need it. In addition, wagons are directed to and from repair facilities and new wagons are brought from manufacturers to the railways. TTX does not assign wagons to services, nor does it determine wagon sequences in trains or wagon loads!

In short, the benefits TTX brings to railways are:

- Low-cost equipment, resulting in inexpensive hire rates
- A reduction in idle days thanks to an efficient, North America-wide pool of wagons
- Capital conservation – railways do not have to bear the capital cost for new equipment
- The owners' equipment risk is virtually eliminated, thanks to the possibility to return wagons within 5 days and modifications made to wagons for alternative uses
- Market analysis and planning
- Engineering research and development


#### **4.4 Railrelease case study**

Railrelease B.V. Rotterdam (Netherlands)<sup>2</sup> is a newly created company which provides rail wagons according to market demand, in particular short-term and “spot” transports. This increases flexibility for rail operators and improves wagon use. Railrelease targets the market niche between “day-by-day” management and leasing (contract duration 2-5 years), with typical contracts lasting from a few days to a year.

The company's assets are a set of wagons “of their own”, supplied by a leasing firm, and around 600 wagons (Ø 160 days in service) supplied by private firms. The target customers are shippers, shipping lines, logistics service providers, as well as intermodal and rail operators. Railrelease usually acts as a “broker” between supply and demand in wagons, while the railway companies remain responsible for safe operations.

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2 Source: Interview of Mark Remie, MD of Railrelease, [www.railrelease.com](http://www.railrelease.com)



Railrelease's current plans for extension by acquiring wagons loads may be judged as a potential conflict of interest with their customers. They also act as an intermediary in terms of wagon management.

#### **4.5 Conclusions**

The management models applied in North America by TTX for example, which aim to pool a vast quantity of wagons and provide them for their customers, and those applied in Europe, where leasing companies or wagon managers operate large fleets of (intermodal) wagons on behalf of single railway undertakings or intermodal operators, can contribute to more efficient wagon use.

In addition, there is a wide range of models that developed over time and were implemented in order to occupy strategic areas of interest and/or create niche markets.

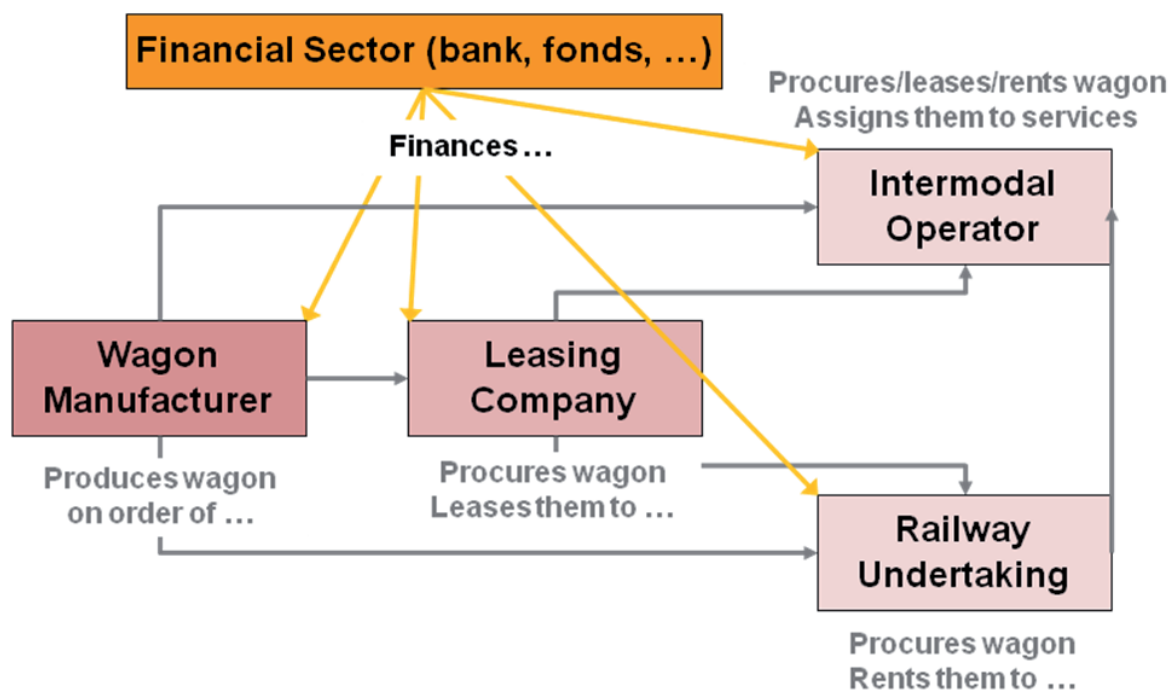
The purpose of management is to control, among others, the economic risk of long-term assets. Management also has to benefit from appropriate financing models.



## 5. FINANCING MODELS

In addition to the management models applied to the intermodal wagon fleet operations, several models exist for financing rolling stock in rail business. **Figure 13** illustrates how the financial sector can support intermodal operators, railway undertakings, leasing companies and, to a lesser extent, wagon manufacturers in supplying wagons for intermodal operations.

**Figure 13** Financing models for rolling stock



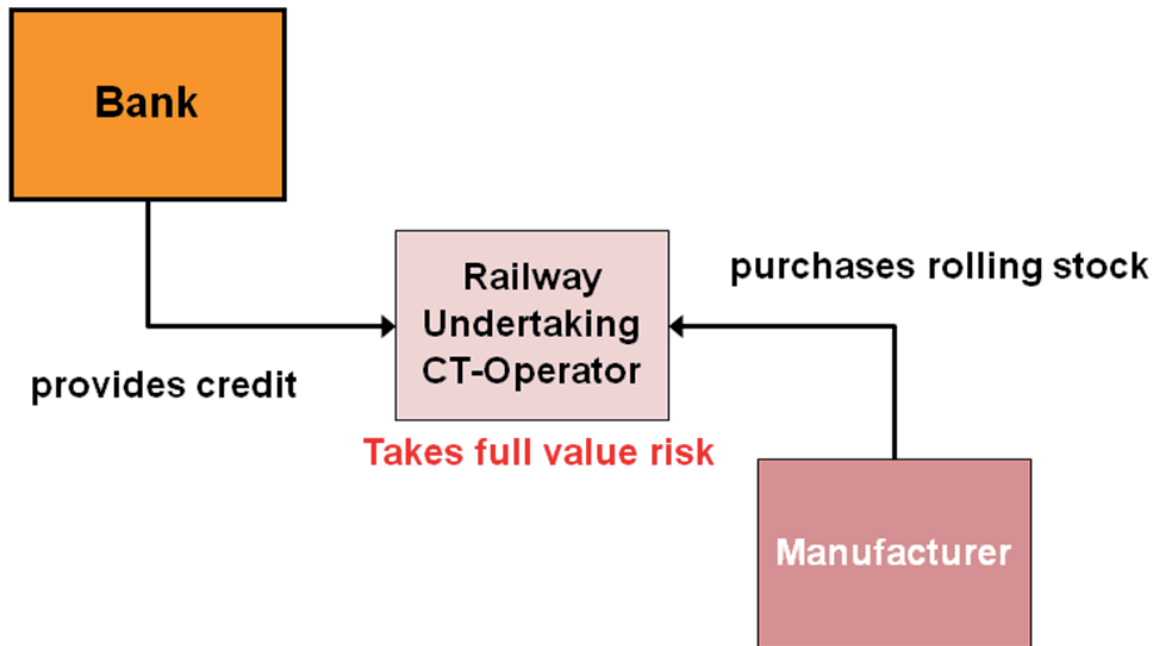
*Source: KombiConsult research*

Several different financing models exist:

- Credit finance and finance leasing
- Operative leasing ("dry" lease, "wet" lease) or rental
- Other financing models

In conventional credit finance (see **Figure 14**) a bank provides credit to a company wishing to procure wagons. The credit is paid back by revenue from transport contracts. Large companies in particular can benefit from good credit conditions at their banks. These companies remain fully responsible for the value-related risk of their assets.

**Figure 14 Financing by credit**

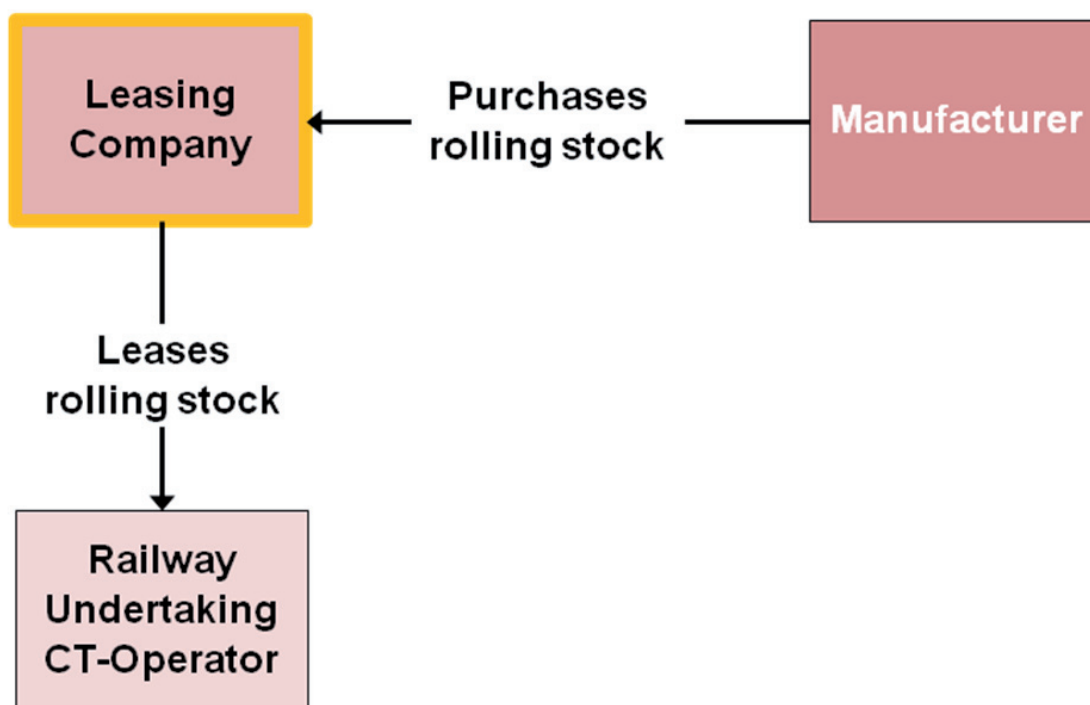


*Source: KombiConsult research*

In the case of finance leasing, the leasing company provides funds as a bank would, but is the formal owner of the assets. The railway undertakings or CT operators (“lessors”) assume the operational risk over the lifetime of the asset, including the residual value-related risk when the leasing contract expires. The finance leasing model is appropriate if a bank is unable to provide a railway undertaking or CT operator with good credit conditions at the time of procurement, or if this undertaking or operator does not want to have the assets on its balance sheet for legal, strategic or tax reasons.

In the case of operative leasing (see **Figure 15**) the leasing companies not only provide money, they also assume the value-related risk over the assets’ lifetimes, while the lessors (intermodal operators or railways) are only responsible for the operational risk for the duration of the leasing contract (e.g. 2-5 years). The sector draws a distinction between “dry” and “wet” lease, depending on the range of services supplied by the leasing company in addition to the assets.

Figure 15 Financing by operative leasing

**takes residual value risk***Source: KombiConsult research*

The distinction between “wet” leasing and conventional renting is often unclear. When a (leasing) company rents a wagon, this company is the formal owner of the assets and it assumes the operational risk over the asset’s lifetime, while railway undertakings and/or CT operators only assume the risk during the relatively short period of the rental agreement.

In other financing models (e.g. funds and bonds) finance is generated by a specific fund or bond rather than a bank loan. Funds are issued by particular undertakings or leasing companies/railway undertakings/CT operators.

Different ways of financing rolling stock exist and are applied according to the size and strategy of a company. Asset-oriented finance has been gaining interest, particularly in recent times as the financial sector has demonstrated that it was to a great extent unable to control its own “structured products”.



## 6. CONCLUSIONS AND RECOMMENDATIONS

Current developments in the European intermodal industry make a careful analysis of the means of production – terminals, tracks and wagons – necessary. The aim of this report was to provide information on the role of the latter, which have become a key success factor in achieving anticipated growth.

The current fleet consists of around 56,000 CT wagons [a capacity of 160,600 TEU] and a small proportion of the 65,000 [160,000 TEU] standard wagons that can also be used for CT services. These wagons will remain in service in the short term.

Even if the current situation (economic decline in autumn 2008) leads to orders and options being postponed, these wagons will enter the market in the next 4 to 5 years, at the rate of 5,000 wagons or 17,500 TEU per year. The stock will thus increase to reach a total of around 76,000 wagons [229,800 TEU] (see **Chapter 3.3**).

On some networks/network sections the total train length or weight accepted is limited, and capacity is thus further reduced. More trains have to run to transport the same quantity of freight, therefore more wagons are needed. In addition, wagon demand very much depends on whether round trip schedules can be followed, whether sufficient terminal capacity can thus be provided, and, last but not least, whether punctuality can be ensured! An overly busy rail network hinders speed and punctuality and increases the need for fallback and reserve wagons. Projected wagon demand has to be accompanied by an improvement in network and terminal capacity.

If performance remains at 2,600 tonnes p.a., 55,000 additional wagons will be required to respond to projected transport demand. Considering the need to replace 11,000 wagons by 2015, a total of 66,000 new wagons will be needed, of which 20,000 are already orders and options.

This requires a total investment of € 6,194 million in intermodal wagons, of which € 1,877 million are already orders and options (see **Chapter 3.6**).

Due to the increase in steel prices and additional increases in prices for certain components such as wheelsets, CT wagon prices have increased by over 50 % in the last 2 years. CT service prices have not increased lately, so there is a gap between the cost of procuring rolling stock and the prices of CT services.

Wagon manufacturers can achieve higher margins with wagon types other than CT wagons (tank, box) and are unlikely to increase their CT wagon production capacity. With an increasing gap developing between service costs and wagon prices, investment in wagons is becoming risky, and wagons may become a key success factor for intermodal growth.

Manufacturers – or railways with their own workshops – should increase their capacity in order to build intermodal wagons.


Railways, intermodal operators and leasing companies are active customers of manufacturers. The liberalisation of the European rail market and “open access” allows stakeholders to be more flexible in reacting to market trends. This stands in contrast to the situation in North America, with its regional or corridor monopolies, where wagon need has to be balanced between railways.

In the past however, established European railways tended to keep their wagons rather than rent them directly to a potential competitor, even if they were not being used properly.

Co-existence of management models within railways, within groupings of railways, involving leasing companies and flexible short-term management capabilities fulfil the needs of market parties.

The TTX model, a cooperative “pooling potential” involving major state-owned railways, does not exist in Europe because European companies see access to wagons as a competitive edge, and such cooperation would therefore not be viable.

Management models cover the entire life cycle of an intermodal wagon. Wagon management in the sense of the best possible rail wagon use is needed to improve the economic situation for the intermodal industry, because costs are increasing while prices have to remain competitive vis-à-vis road transport.



Efficient wagon management is also needed to compensate for the loss of efficiency on overly busy rail networks. It is necessary for benchmarking key-performance indicators, such as:

- Tonnage per wagon and year > 2,600 tonnes
- Maintenance reserve < 10% of the fleet

Appropriate financing models should be used to mobilise the financial resources of € 6.194 billion required by 2015.




## 7. VALIDATION WORKSHOP

In order to discuss preliminary findings with stakeholders and raise awareness of the potential lack of wagons and appropriate management models at an early date, a workshop was organised and hosted by UIC at its headquarters on 11 December 2008. The target audience – representatives of railway undertakings, intermodal operators, leasing companies and manufacturers – was either present or represented. The workshop was opened by Eric Peetermans as part of his role as head of the UIC combined transport and wagon users groups. The agenda included every aspect mentioned in this report and led to the findings being generally confirmed:

*Table 5 Workshop participants*

Category	Company	Name
Railway Undertakings	DB Intermodal	Eric Pfaffmann
	Croatian Railways	Zeljko Cindric
	RCA	Andreas Stajerits
	SNCF Fret	Didier Mercey
	ZSSK Cargo	Peter Homola
	ACTS Luxemburg / CFL	Eric Lambert, Nathalie Joffroy
Intermodal Operators	CEMAT	Maria Antonietta Zocco (excused)
	Hupac Intermodal	Pierro Solca (excused)
	Kombiverkehr	Daniel Jähn, Kristian Kölsche
	TRW	Vincent Bourgois (excused)



Category	Company	Name
Manufacturer	Kockums Industrier	Björn Widell, Christer Beijbom
Lessors/ Managers	AAE	Giuseppe Forgia
	DB Intermodal Services	Elisabeth Wismeth
	Wascosa	Fabian Stadler (excused)
Other	SNCB/NMBS	Eric Peetermans
	UIC	Sandra Gehenot, B Schmitt
	KombiConsult	Klaus-Uwe Sondermann, Kurt Fuchs

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