Developing Infrastructure and Operating Models for Intermodal Shift

Best practices for the management of combined transport terminals (Workpackage A4)

February 2007

ISBN 2-7461-1308-2

Contents

1 Objectives and methodology

The UIC study on “Infrastructure Capacity Reserves for Combined Transport by 2015“ completed in June 2004, called for a further enlargement of the combined transport (CT) terminal capacity in key European transport areas to ensure the forecasted growth of CT volumes could be accommodated. It also recommended to investigate the opportunities of coping with restrained physical CT terminal infrastructure and extending their transhipment capacity by applying “soft” or managerial measures in addition to enlargement investments.

Operators of European CT terminals, which were designed to accommodate specific services and an expected volume of shipments, very often find themselves in a situation where the terminal capacity is saturated and the layout and process organisation can no longer cope with the service requirements of intermodal operators, their customers and railways serving the terminal. If they are not able to enlarge the infrastructure terminal, operators may try to find pragmatic solutions to reduce obstacles on a short-term basis and “muddle through” instead of bringing about a fundamental change to the situation.

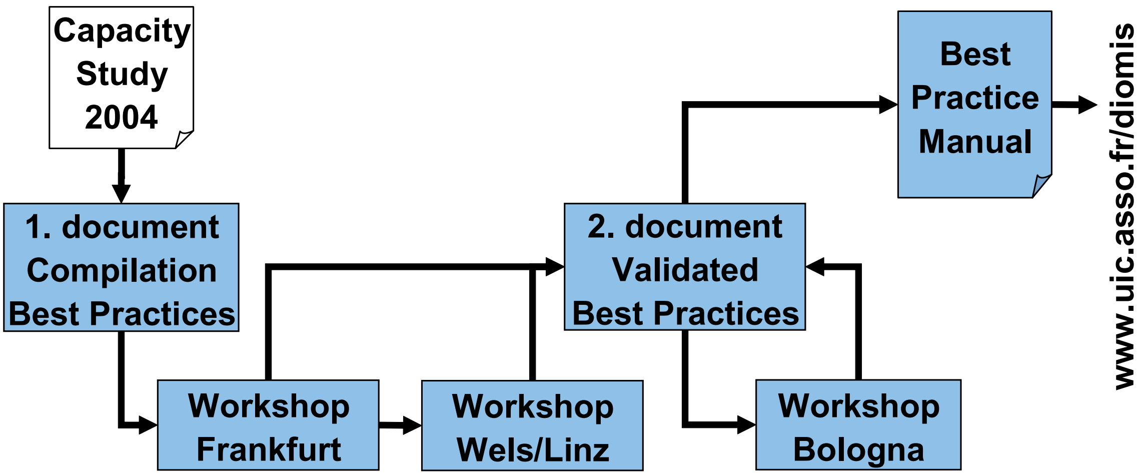
On the other hand many terminal operators all over Europe have developed advanced terminal control and management systems (best practices). This knowledge, however, has not been disseminated elsewhere and thus fails to enabling the development of equally high performing terminals for international CT services.

Against this background the present study was given the following objectives:

- to provide a survey of best practices for CT terminal management in selected European countries;
- to set up recommendations on how “soft” management measures can contribute to using existing terminal infrastructure in an optimum way or increasing the transhipment capacity without major investments;
- to foster the exchange of capacity management knowledge between European intermodal terminal operators.

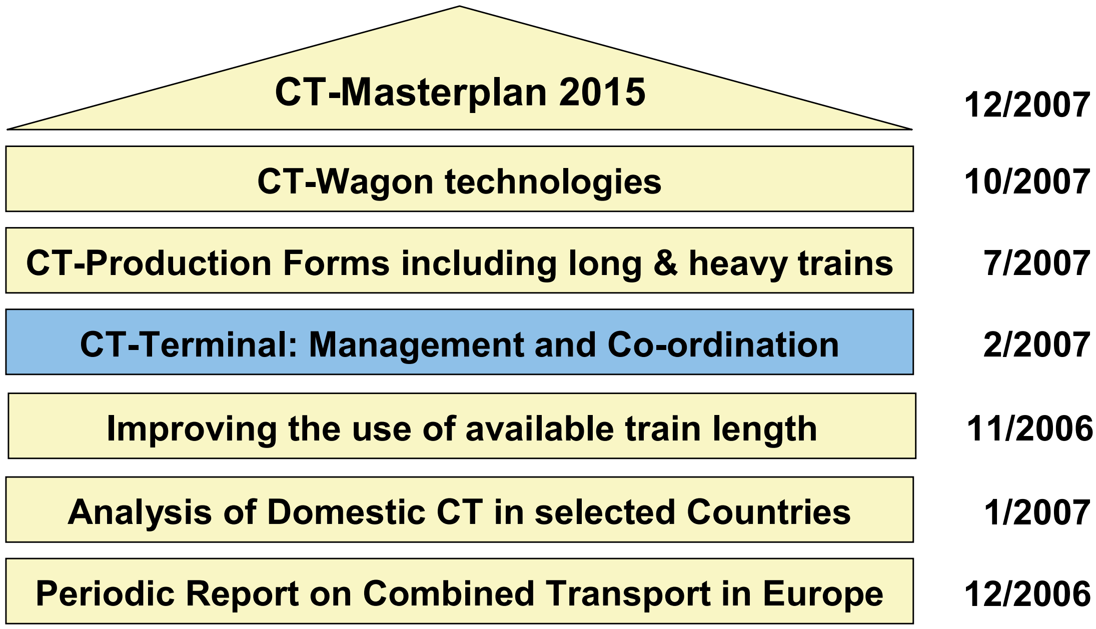
The main achievement of this investigation is a manual of best practices on intermodal terminal capacity management. Methodologically, the information comes from basic findings of the "Capacity Study", from KombiConsult expertise in terminal design and process organization and from three workshops with terminal managers operating about 80 intermodal terminals across Europe.

Figure 1-1: Methodology to achieve the "Best Practice Manual"



The findings of the present study will contribute towards a UIC "Masterplan on combined transport 2015", which will contain components that enable to improve and promote combined transport in Europe. The Master Plan will be completed by the end of 2007.

Figure 1-2: Methodology of the DIOMIS-Project to achieve a CT-Masterplan 2015



2 Impact of combined transport evolution on terminal capacity

The UIC "Capacity Study" published in 2004, evaluated the development trends of international combined transport on almost all major Trans-European corridors and elaborated a forecast of transport volumes by 2015. The DIOMIS project has been complementing the above mentioned study by carrying out an assessment of the current situation and the evolution of domestic unaccompanied CT in six countries by the same time horizon. These countries are key for European combined transport since they provide the core network and/or represent major volumes of domestic CT. The results of these investigations are summarized in **Figure 2-1**.

Figure 2-1: Total unaccompanied combined rail/road transport in 6 countries: volume 2005/2015

Country	Total unaccompanied combined transport (million gross tonnes)							
	Domestic		International		Transit		Total	
	2005	2015	2005	2015	2005	2015	2005	2015
Austria	3,12	4,85	6,43	14,79	7,92	17,32	17,47	36,96
Belgium	6,40	13,20	10,07	22,97	0	2,76	16,47	38,93
France	4,63	10,26	2,76	10,26	5,62	20,42	13,01	40,94
Germany	19,11	41,71	23,94	56,14	7,5	16,19	50,55	114,04
Italy	12,83	26,65	24,3	53,22	0	0	37,13	79,87
Switzerland	4,47	6,16	3,65	6,02	15,63	34,39	23,75	46,57
All countries	*50,56*	*102,83*	*71,15*	*163,4*	*36,67*	*91,08*	*158,38*	*357,31*

Source: KombiConsult analysis, K+P Transport Consultants

The impact of the estimated evolution of total unaccompanied combined rail/road transport including both domestic and international traffic on the terminal handling capacity in the countries surveyed has been assessed using the following methodology:

- Analysis of current intermodal terminal handling capacity (2005),
- Calculation of the required terminal handling capacity by the year 2015 based on the detailed transport programmes for individual combined transport market segments,
- Analysis of enlargement investment schedules in the period 2005-2015,
- Calculation of the additional capacity enlargement need.

The overall aggregated results of these investigations for Austria, Belgium, France, Germany, Italy and Switzerland, disregarding the regional distribution of terminals and capacity requirements, are presented in **Figure 2-2**.

Figure 2-2: Total unaccompanied combined rail/road transport in 6 countries: terminal handling capacity 2005/2015

Countries (n° of terminals			Terminal handling capacity (in loading units p.a.)				
			2005	2015			
			Existing	Enlargement planned	Total planned	Required	Enlargement need
Austria		16	1,404,000	510,000	1,914,000	1,789,000	65,000
Belgium	*)	13	1,290,000	403,000	1,693,000	1,089,000	428,000
France	*)	20	1,658,000	112,000	1,770,000	1,616,650	301,230
Germany		58	4,419,000	830,000	5,249,000	7,139,000	2,006,000
Italy		43	3,165,000	1,230,000	4,395,000	5,372,000	977,000
Switzerland	*)	8	284,000	265,000	549,000	n.a.	n.a.
Total		**158**	**12,220,000**	**3,350,000**	**15,570,000**	***17,005,650***	***3,777,230***

*) Subtotals aggregated from available terminal data included in country section.

Source: KombiConsult analysis, K+P Transport Consultants

Since the country reports on Belgium, France and Switzerland (see DIOMIS Report A1) did not provide a comprehensive list of detailed information for all terminals the subtotals are not comparable to the other countries. Nevertheless a total of the available data has been calculated. The largest terminal handling capacity by 2015 is required in Germany and Italy. In spite of the extensive planned enlargements in these countries an additional annual handling capacity need for more than 2 million loading units in Germany and almost 1 million loading units in Italian terminals is required in order to ensure the anticipated growth of total combined transport. The enlargement schedules in Austria widely do correspond to the required volumes although an additional annual handling capacity need for about 65,000 loading units has been calculated.

Figure 2-3 lists those 30 transport areas in the six countries selected, which will rank top in 2015 as regards the expected intermodal transhipment volume concerning all segments of unaccompanied combined rail/road transport. According to the country analysis the ten largest transport areas will be the “mega area” Milano/Novara, Verona, Oberösterreich (Wels/Linz/Enns), Köln, Mannheim/Ludwigshafen, München, Duisburg, Bologna, Paris and Nürnberg.

Figure 2-3: Total unaccompanied combined rail/road transport in 6 countries: terminal handling capacity of top 30 transport areas 2005/2015

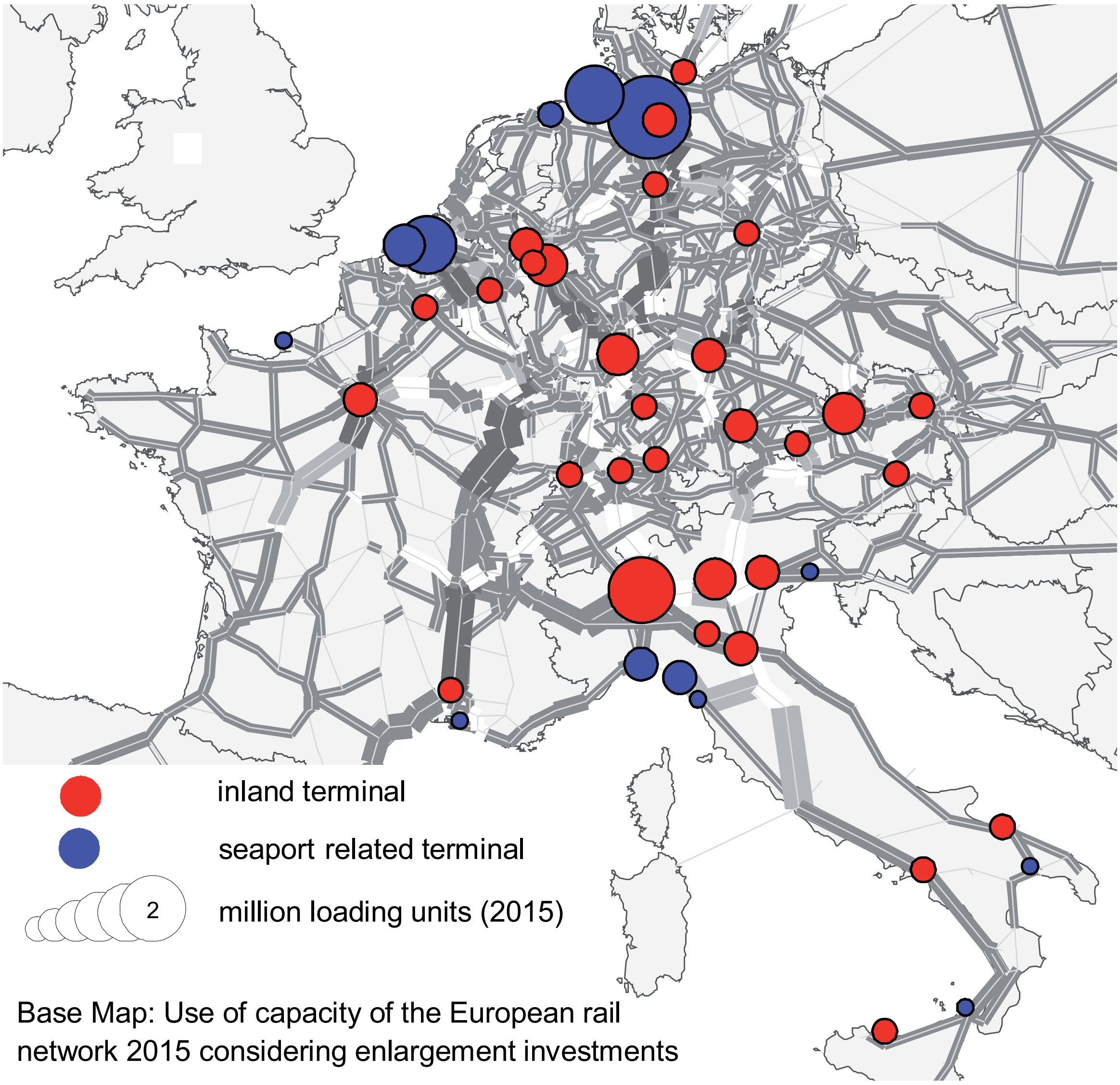
Transport Area (n° of terminals)			Terminal handling capacity (in loading units p.a.)				
			2005	2015			
			Existing	Enlargement planned	Total planned	Required	Enlargement need
Milano/Novara	IT	12	1,316,000	597,000	1,913,000	2,157,000	244,000
Verona	IT	5	441,000	464,000	905,000	905,000	
Oberösterreich	AT	4	617,000	50,000	667,000	679,000	12,000
Köln	DE	3	545,000	30,000	575,000	672,000	97,000
Mannh./Ludwigshafen	DE	4	450,000		450,000	662,000	212,000
München	DE	1	220,000	100,000	320,000	590,000	270,000
Duisburg	DE	3	320,000	90,000	410,000	548,000	138,000
Bologna	IT	1	220,000	15,000	235,000	501,000	266,000
Paris	FR	4	328,000		328,000	422,000	94,000
Nürnberg	DE	3	288,000	50,000	338,000	407,000	69,000
Padova	IT	1	141,000		141,000	406,000	265,000
Hamburg (continent.)	DE	1	195,000	55,000	250,000	381,000	131,000
Wien	AT	2	176,000	213,000	389,000	344,000	
Hannover	DE	3	62,000		62,000	331,000	269,000
Stuttgart	DE	2	140,000	140,000	280,000	294,000	14,000
Leipzig	DE	1	120,000	120,000	240,000	268,000	28,000
Modena	IT	4	255,000		255,000	255,000	
Bari	IT	2	98,000	11,000	109,000	246,000	137,000
Steiermark	AT	3	190,000	37,000	227,000	242,000	15,000
Muizen	BE	2	110,000		110,000	224,000	114,000
Basel	DE	1	155,000	35,000	190,000	219,000	29,000
Lille	FR	1	200,000		200,000	218,800	18,800
Sicilia	IT	4	174,000		174,000	217,000	43,000
Napoli	IT	3	212,000		212,000	212,000	
Lübeck	DE	2	142,000		142,000	208,000	66,000
Neuss	DE	1	140,000		140,000	200,000	60,000
Salzburg	AT	1	125,000	75,000	200,000	190,000	
Singen	DE	1	156,000		156,000	175,000	19,000
Avignon	FR	1	112,000		112,000	172,800	60,800
Ulm	DE	1	100,000	50,000	150,000	168,000	18,000
Subtotal		**77**	**7,748,000**	**2,132,000**	**9,880,000**	**12,514,600**	**2,689,600**

Source: KombiConsult analysis

Although, in these top 30 transport areas, enlargement investments are already scheduled totalling an annual handling capacity of 2.1 million loading units, our analysis has given evidence that a further capacity enlargement need of about 2.7 million loading units is required to make sure that the expected transport volume could be served appropriately.

Figure 2-4 illustrates the required terminal handling capacity by the year 2015 both of the top 30 "dry" inland transport areas and of rail-side intermodal handling facilities related to the most important container ports in the countries involved in the present survey.

Figure 2-4: Required intermodal terminal handling capacity in 6 countries: top-30 inland transport areas and major seaports 2015



Source: KombiConsult analysis

3 Determinants of combined transport terminal capacity

The terminal is a key component of the intermodal transport chain since it has to ensure an efficient and safe interchange between road and rail.

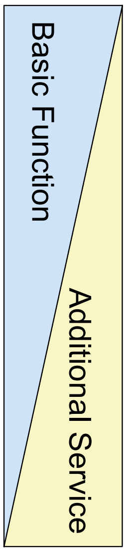
In most European countries the terminals differentiate between the ownership of the terminal infrastructure- and superstructure and the operation and management. The common understanding of terminals is based on the following principles:

- Principle of non-discriminative access to terminals (at least for those that have received public funding):
- Rail-side access for all licensed railway undertakings,
- Road-side access for all operators,
- Transparent capacity allocation and pricing,
- Bundling of different cargoes (maritime container, continental cargoes), and market segments (international and domestic relations) and thus improved capacity utilisation.

This type of terminal is an own entity in the transport chain. It is analysed in the present study irrespectively of the legal, corporate or financial relations that may exist between the terminal operating company, the terminal owner, the infrastructure manager, the railway undertakings and the intermodal operators that have led to a variety of owner/operator models in Europe. Thus we are focusing on improving the **operational functions and services** and thereby the capacity of intermodal terminals.

Figure 3-1 shows both the so-called basic functions, which are related to the rail/road interface position in the supply chain and any intermodal terminal is required to match, and additional services, which a terminal operator may or may not offer depending on the local demand for them.

Figure 3-1: Basic functions and additional services of CT terminals



- Transhipment of loading units between different transport modes
  Road - Rail - Inland Navigation
- Terminal Handling
  - Check-in/-out
  - Security check
- Intermediate Buffer for loading units / vehicles
- Agency function for railways and operators
- Storage of loading units (Container-Depot)
- Temperature controlled -/ dangerous goods
- Trucking Service
- Container Repair
- Customs Services
- …

Source: KombiConsult analysis

The measures presented and described in detail in **chapter 4** are thus starting with improving the basic functions, namely the transhipment capacity.

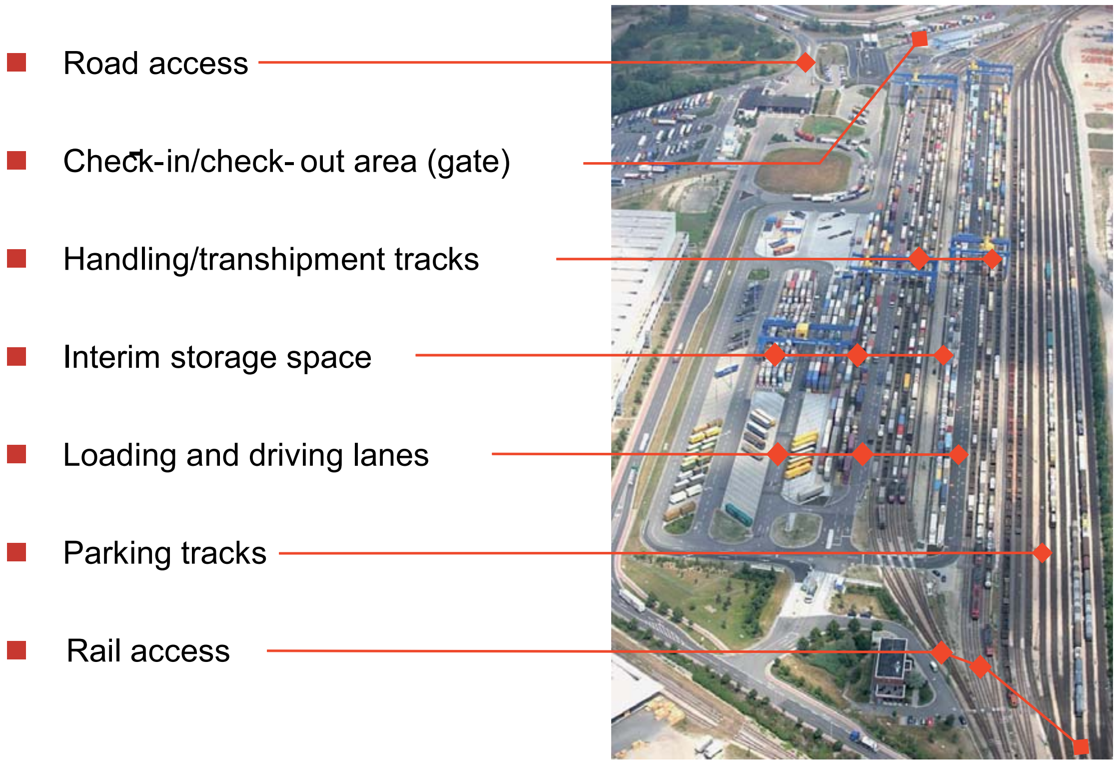
The capacity of a CT terminal is determined by a couple of factors, which can only partly be influenced by the local terminal manager. The primary influences are the position of the terminal within the rail and road network, the size and shape of the real estate, the length of the handling tracks, and the number and capabilities of the handling equipment. In recent years a modular shape of terminals (cf. **Figure 3-2**) has been developed which is made of:

- one – or better double-sided rail access, where
- signalling allows for entry with momentum and direct departure of the train by the main line traction unit,
- three to five “train long” (length can vary between countries) handling or transhipment tracks, with
- rail-mounted gantry cranes (RMG),
- two to three interim storage or buffer lanes,
- one loading and one driving lane,

- road side access with
- check-in / check-out area (gate) and sufficient parking space.

One typical module of that kind should be able to handle about 120-150.000 loading units p.a. (rail-in and rail-out handlings). While a doubling or even trebling could improve the capacity accordingly.

Figure 3-2: Basic components of CT terminals

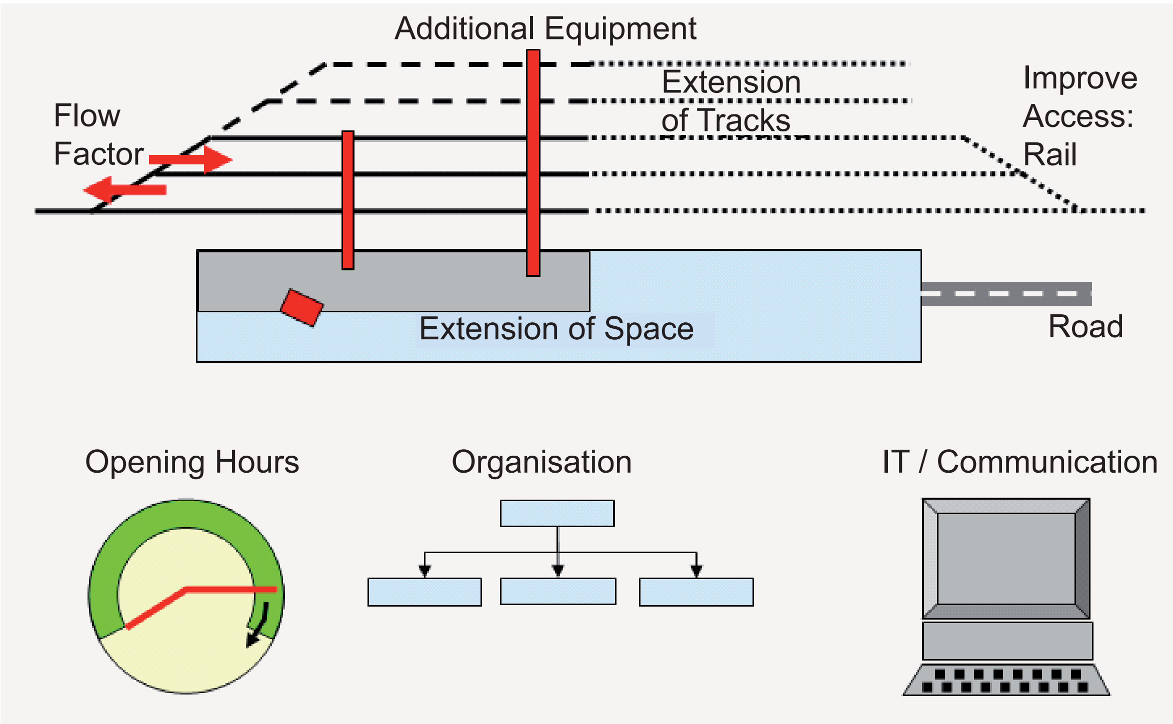


Source: KTL Kombiterminal Ludwigshafen

4 Best practices in terminal capacity management

Generally, the transhipment capacity of intermodal terminals can be enlarged by either increasing the physical infrastructure or suprastructure e.g. building of additional handling tracks, extension of tracks, upgrading the rail and road side accessibility, extending the storage of buffer space or the acquisition of additional or more efficient cranes. These we will call “hard” measures, Alternatively “soft” measures can be used. These particularly concern improvements in the process organization or in communication procedures.

Figure 4-1: Handling capacity enlargement of CT terminals by “hard” and “soft” measures



Source: UIC Capacity Study

Considering the objectives of the present study we have focused on “soft” tools recognized as suitable for improving the management and transhipment capacity of existing CT terminals. In this respect the following main actions have been identified through interviews and workshops with CT stakeholders:

- Increase of flow factor,
- Control of shunting services,
- Supply of road trucking services,
- Extension of terminal opening times,
- Bonus-malus incentives for the use of interim storage space,
- Sophisticated capacity management systems,
- Automated loading unit identification,
- Separation of rail-side and road-side handlings,
- Task management according to pre-notification,
- Punctual rail services.

4.1 Increase of flow factor

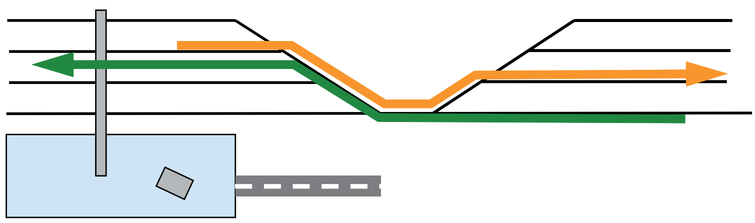
If the track capacity of a given terminal infrastructure, on a daily average, is employed by only one intermodal train including the inbound and outbound services the terminal applies a static operational concept. In this respect the so-called “flow factor” which is the mean frequency the total length of the handling tracks are employed, is 1.0. In contrast to that, a flow factor of 2.0 means that every meter of handling track on average has been used by two different trains or services for inbound and outbound shipments.

It is obvious that the implementation of such a dynamic operational concept is one of the most effective measures to enhance the capacity of a given terminal infrastructure. Raising the flow factor from 1.0 to 2.0 implies a – theoretic – doubling of the transhipment capacity. Since the capacity impact is so tremendous this “soft” operational measure is recommended to be enforced in as many terminals as possible (cf. **Figure 4-1**).

Every terminal operator, however, is not in a position to increase the flow factor of its facility. The following prerequisites must be fulfilled:

- In the first place, it requires sufficient demand of intermodal services.
- If the terminal is served by multi-frequency shuttle trains, which require fast turnaround times of about three to six hours, handling tracks could be employed a couple of times per day.
- If those efficient shuttle services don’t call at the terminal the wagon sets need to be shunted between the handling and parking tracks to allow for the exchange of trains. This requires either for an appropriate number and length of parking tracks at the transhipment facility or close to the site to avoid uneconomic shunting operations.
- Since it is most unlikely that, both in export and import, all intermodal loading units could directly be transhipped between truck and wagon (live-lift operation) a well-dimensioned intermediate storage space is absolutely required.
- Also, the capacity of the handling equipment (cranes, reachstackers, terminal trucks) must be sufficient to cope with an increased amount of units.

Figure 4-2: Increase of flow factor

Measure	**Increase of Flow Factor for use of handling tracks**
Description	Achieve a double use of at least some handling tracks, by shuttle train operation, or change of wagon sets between handling and parking tracks during the day 
Involved Parties	Terminal Operator, Railway Undertaking (Shunting Service), Intermodal Operator
Examples	Many, but still not all terminals
Capacity Impact	**+50-100% related to the transhipment tracks** (subject to sufficient number of handling equipment)

Source: KombiConsult analysis

Not only when applying the “flow factor” but also in usual operation the wagon sets entering and leaving the terminal require a shunting operation. Shunting is also needed to replace damaged wagons or include additional ones. The shunting operation can be organised in different ways. The most common practice is that the lead railway undertaking or local railway undertaking manages and physically performs the shunting operation.

4.2 Control of shunting services

The railway undertaking charged by the intermodal operator with the main rail haul is also used to take the train in and out of the intermodal terminal yard with its own staff and locomotive. If, for the local terminal service, the railway undertaking employs a shunting locomotive or the long-distance engine depends on the scheduling of locomotives and staff, efficiency criteria and the technical accessibility of the terminal e.g. by electric locomotives.

Usually, the same railway also perfoms the shunting of train or wagon sets between the terminal yard and parking tracks, removes damaged wagons or brings additional wagons. To ensure a high performance of these logistics tasks i.e. that an appropriate shunting loco and personnel are available at the right time, a good co-ordination and synchronization of this interface and the works between terminal and shunting service operators is required.

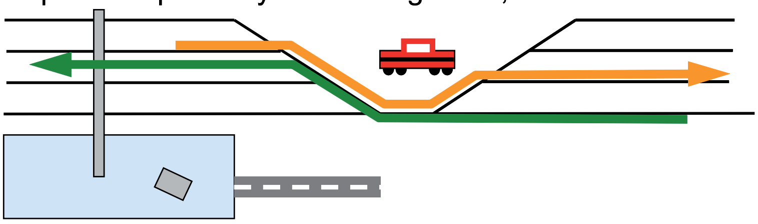
In some European intermodal terminals, however, the shunting service is managed by the terminal operator entirely on its own or in co-ordination with the railway undertaking (cf. **Figure 4-3**). Such a measure can have several positive effects:

- It simplifies processes and reduces frictional losses between the actors involved.
- It enables the terminal operator to reduce train delays.
- It raises the operational flexibility of the terminal management.
- It facilitates the prioritization of shipments.

Such positive experiences were reported from DUSS terminals, the Interporto Bologna, the HUPAC terminal Busto Arsizio, the CEMAT terminal Verona Quadrante Europe and the German private terminals of KTL Kombiterminal Ludwigshafen and Baltic Rail Gate (Lübeck). The terminal operators reported a capacity effect of 5 to 10 per cent resulting in particular from a reduction of delays and the priorization of shipments.

At Verona Quadrante Europa shunting operations are carried out by Quadrante Servizio, a subsidiary of the Interporto operator and the railways, that serves the various rail traction service providers. Also in other terminals a local railway undertaking is responsible for the shunting operations and provides for the wagon inspection for different long-haul railway undertakings. A neutral shunting service managed by the terminal operator would thus not only improve the use of the terminal capacity but also facilitate railways to serve terminals without providing their own equipment and personnel in every terminal.

Figure 4-3: Control of shunting services

Measure	**Control of shunting services by terminal operator**
Description	Disposition of shunting service, e.g. for flow factor, but also for damaged and optional wagon by terminal operator according to transhipment and pick-up and delivery needs Requires disponibility of shunting locos, - tracks and visitors 
Involved Parties	Terminal operator, railway undertaking (shunting service)
Examples	Most DUSS terminals, Bologna, Busto Arsizio., Verona Q.E., Baltic Rail Gate (Lübeck), KTL Ludwigshafen
Capacity Impact	**5-10% related to the transhipment tracks,** in particular in order to reduce delays and priorize shipments/trains

Source: KombiConsult analysis

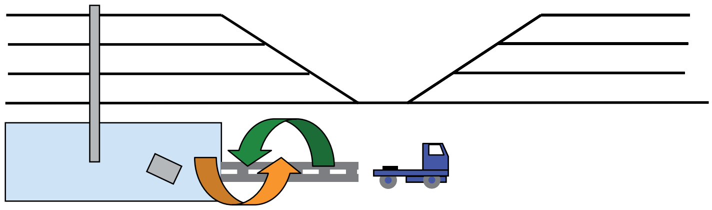
4.3 Supply of road trucking services

A similar reasoning has motivated some terminal operators to offer or manage pick-up and delivery road trucking services. Terminal operators such as KTL in Ludwigshafen recognized, in the first place, the need for internal transfer of loading units between different transhipment modules of the terminal owing to Gateway shipments or between handling area and external buffer and storage places. At Ludwigshafen, BASF AG, the owner of the terminal, also called on KTL to perform the trucking of intermodal loading units from and to its nearby production site.

KTL now offers the trucking services based on a fleet of road vehicles and chassis to any other user of combined transport in Ludwigshafen. These services may create a win-win situation. The intermodal customer must not care for organizing the road trucking and the terminal operator is more flexible as concerns the sequence of intermodal loading units to be transhipped. This particularly applies if trains arrive delayed. Although the direct impact on the transhipment capacity may be marginal proprietary trucking services can also be used to clear handling and storage lanes from semi-trailers or non-stackable loading units such as swap bodies and take them to an outside parking yard.

In contrast to rail/road terminals that are predominantly called by continental intermodal services it is much more common with intermodal facilities with a large share of deep-sea containers that they provide integrated terminal handling and trucking services. This applies for example to intermodal operators such as Metrans. Shipping lines often require for the pre-and on-carriage from terminals like in the ports of Linz (Austria) or the WienCont terminals Wien-Freudenau Hafen and Krems. In those cases the scope of services supplied by the terminal operators is much more extended and includes container maintenance and repair, depot, or customs clearance (see also **Figure 3-1**).

Figure 4-4: Supply or management of road trucking services by terminal operator

Measure	**Supply or management of road trucking services by terminal operator**
Description	Pick-up and delivery of loading units takes place randomly, some trucks are delayed while others are waiting and the terminals interim storage gets stuck. The terminal might offer trucking service to clear the terminal according to terminals' needs, and circulate the trucks in efficient round-trips. 
Involved Parties	Terminal operator, intermodal operators, customer
Examples	UBM München, KTL Ludwigshafen, Metrans terminals, Melzo
Capacity Impact	**Marginal**, some times used to park semi-trailers outside transhipment area for direct pick-up

Source: KombiConsult analysis

4.4 Extension of terminal opening time

Though the exact opening time of combined transport terminals for serving road-side customers differs from site to site typical schedules have evolved in Europe over the years. This assumption was clearly confirmed by our survey of some 350 European terminals including information obtained from the UIRR database (www.uirr.com). Only very few intermodal facilities are working on a single-shift-basis and are open for 8 to 10 hours. About 30 per cent of all the terminals examined are open more than 16 hours. Nearly 70 per cent of the sites, however, apply a two-shift scheme serving pick-up and delivery vehicles for about 12 to 16 hours, from Monday to Friday. Terminals are used to open between five or six o'clock in the morning and close around 7 to 10 in the evening. Considering a 24-hours-economy these terminals on average are open to customers 53 per cent of the maximum possible time.

According to our inquiries most terminal operators are prepared to broaden the opening time if customers demanded it. Intermodal operators, however, have also reported that they have sometimes difficulties to get terminal slots outside the published opening times.

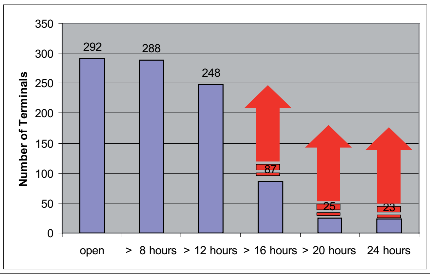
Although terminal managers are arguing that customers do not want to arrive at different times the two options of extending the opening times shall be looked at carefully in the perspective of raising terminal capacity:

- The first option is to enlarge the **operating times** (internal and rail-side) to deal with gateway transhipments, second departures or just “clearing” the handling and buffer lanes outside of peak hours.
- The second option is to extend the **opening time** also for road-side pick-up and delivery of shipments.

Extending the terminal opening time could mean increasing the daily opening period or open also on Saturdays or even Sundays. The terminal managers involved in our investigation expect that the extension of customer-related opening times will bring about an increase of transhipment capacity of at least 10 to 20 per cent compared to the initial situation.

The capacity impact in the first place, depends from the customers’ acceptance whether they are able (opportunities) or willing (behaviour) to take the opportunity from enlarged opening times. The size of the capacity effect will be determined by the difference between the new and the old time window, the extent of gateway services at the terminal and whether industrial customers are calling at the terminal. When extending the opening time it should be taken account of the need to reserve sufficient hours for maintenance and repair of the terminal equipment.

Figure 4-5: Extension of terminal opening time

Measure	Extension of terminal opening times
Description	Extension of opening time in two ways: 1. **Operating** times to deal with gateway, second departure or just "clearing" handlings 2. **Opening** time road side for pick-up and delivery - Each day (1-5) - Saturday - Sunday 
Involved Parties	Terminal operator, public authorities, trade unions, infrastructure manager, railway undertakings, intermodal operators, customers
Examples	Verona, Busto, Nürnberg, Praha, Valenton, Madrid, Duisburg
Capacity Impact	**10-20%,** depending on initial opening time, and gateway functions and industrial customers. Terminals require also buffer time for maintenance and repair (1-1,5 days)

Source: KombiConsult analysis

4.5 Bonus-malus incentives for the use of interim storage space

During the workshops with terminal operators we discussed if incentives would encourage intermodal operators or their customers to use the terminal off peak hours and if so, what incentives. It has been felt that generally it would not be economic for intermodal customers to just pick up or deliver shipments e.g. at midnight to save some 2 to 5 €, which would be about the equivalent of 10 to 25 per cent discount on the transhipment charge. The additional personnel cost incurred by the night shift of the road operator would more than outweigh this advantage.

The situation, however, would change if the final customer of the shipment has also opened his logistics services overnight or if the shipment has to be carried over long distances so that the road vehicle and the driver would be employed efficiently. It seems that there is some hidden potential for optimizing infrastructure employment by homogenizing the flow of transports. In this respect the DUSS terminal Köln-Eifeltor recently has received some positive feedback on its decision to open its facility 24 hours/day.

In contrast to that the starting position is very different as concerns the management of interim storage space at intermodal terminals. While inland port terminals – or more generally, facilities serving maritime containers - generate a considerable share of their revenues from interim storage and depot services the majority of “conventional” rail/road terminals rather suffer from loading units remaining on their premises longer than 12 to 24 hours prior to or after the rail journey. This is particularly owing to the fact that these terminals were primarily designed to enable the transhipment of loading units between rail and road. Ideally, the loading units would be directly transferred from wagon to truck and vice versa. In fact, reality prevents operators from optimizing their terminals in this way. Delayed trains, the exchange of trains between transhipment area and parking tracks, the shunting of damaged wagons, and the pick-up and delivery behaviour of road operators require the intermediate buffering of loading units. In addition, some terminals experience that their terminals are used for parking loading units according to typical intermodal supply chain.

In order to avoid that they get stuck, an incentive or bonus/malus system aimed at the management of the interim storage space was designed and implemented at terminals such as Busto Arsizio, Ludwigshafen KTL, Duisburg-Ruhrort Hafen and Köln-Eifeltor. The system foresees a reward (“bonus”) for a customer who picks up his shipment early for example in the first three hours after the time of availability of the train, and a penalty (“malus”) if the shipment is collected e.g. 24 to 48 hours after the arrival. The terminal management and bookkeeping system levels the rewards and penalties per client and generates a monthly invoice.

The experience reported by KTL or Rail Cargo Austria and WienCont that apply similar pricing schemes is very encouraging. Terminal managers estimate that such a measure ensures a total capacity increase effect of about 5 per cent depending on the initial pick-up and delivery behaviour of the customers.

The incentive system is also able to take into account the size (space consumption) and the stackability of loading units and thus allows a further differentiation according to local needs.

It needs to be emphasized that the implementation of such incentive systems basically requires a terminal management system, which makes sure that relevant data and information such as the arrival time of trains, the availability of shipments, the time of pick-up by road vehicles as well as all associated operational handlings are collected properly and could be verified for invoicing purposes.

Figure 4-6: Bonus-malus incentives for the use of interim storage space

Measure	**Bonus-malus incentives for efficient use of parking and interim storage space**
Description	Differentiated pricing system for transhipment rail-road and buffer services, including bonus-malus system for buffer use: Pick-up after MAD — BONUS 0- 3 hours: -4-8 € (depending on LU-size/stackability) 3-24 hours: -2-4 € MALUS: 24-48 hours: +3-6 € 48-72 hours, … +9-15 €, … 29 €
Involved Parties	Terminal operator, intermodal operator, customer
Examples	Busto Arsizo, KTL Ludwigshafen, Köln-Eifeltor, Duisburg WienCont/Linz: 1€/TEU*day, 2€ after 3. day Raol Cargo Austria: Second handling price after first (free) day
Capacity Impact	**+5%**, depending in initial pick-up and delivery behaviour and customers' reaction

MAD = Mis-à-disposition (time of availability); LU = loading unit

Source: KombiConsult analysis

4.6 IT-based capacity management systems

For more than two decades stakeholders in combined rail/road transport services in Europe have felt the need for an information technology (IT) support of the operation of intermodal terminals. Despite strong efforts, which were partly embedded in research and development projects, useable terminal management software applications have only been created in recent years. Among them are the following:

- BLU (DB Netz/DUSS,
- GOAL (Hupac),
- INTERMAN (Rekencentrum/Interferryboats),
- KLV2000 (Rail Cargo Austria),
- INFORM.

Each of these systems is more or less transforming the core operational functions of intermodal terminals in a piece of software and supporting them. This support generally is related to the road-side inbound and outbound clearance of intermodal shipments, the rail-side in-bound and outbound clearance of trains, and the road/rail transhipment of loading units. Since these systems considerably facilitate and enhance combined transport operations they should become part of the fundamental equipment of every intermodal terminal.

But even these IT solutions, are not currently capable of addressing the specific challenges for the management of contemporary intermodal terminals, which result from tremendous changes of the market structure, the production system and the applied technologies of European combined transport in the last 15 to 20 years. Amongst the most significant influences that determine the requirements towards an advanced IT terminal management system, are the following:

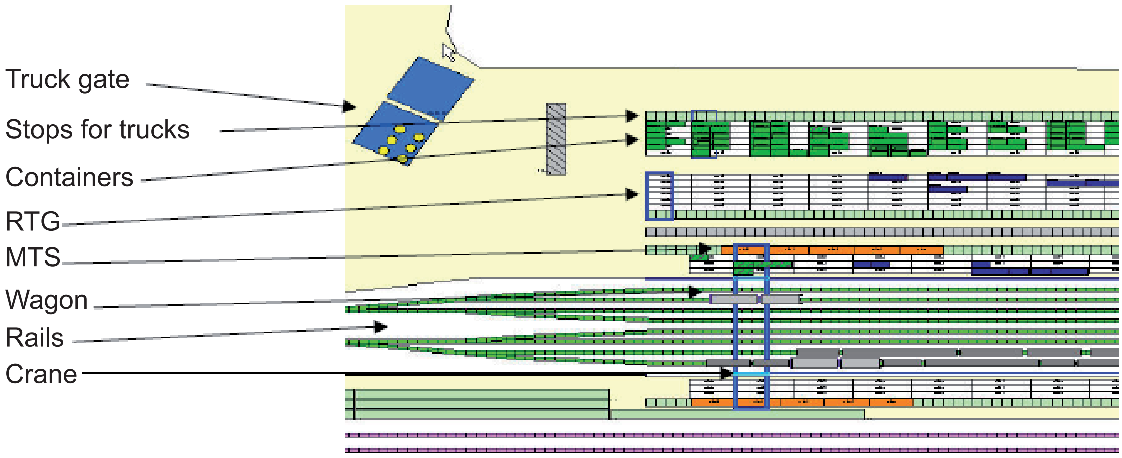
- Concentration of intermodal services on a network of priority terminals, handling volume considerably increased per terminal yard,
- From a rather homogeneous to a heterogeneous market to be handled at terminals: maritime/continental freight and loading units, domestic/international shipments, type of cargoes,

- Block train services shift economic risk from railways to intermodal operators and produce conflicts with terminal operators as regards process of loading/unloading trains,
- Establishment of new rail production systems: shuttle trains, multi-departure services,
- Establishment of hub systems (Gateway) requiring for rail/rail transhipments at terminals,
- Intensified employment of terminal facilities: from a static to a dynamic employment of handling tracks,
- Changed mix of loading units (more units stackable), but also more semi-trailers on some relations,
- Reduction of live-lift handlings, extended interim storage periods,
- Multi-client terminal operations owing to liberalized market access with respect to operators and railways,
- Terminals increasingly are becoming platforms for various logistic services,
- Terminals must try to compensate for poor quality of rail traction services.

These changes of the European world of combined transport tremendously increased the complexity and interdependency of processes in intermodal terminals.

In recent years a couple of terminal management systems have been developed and implemented in combined transport terminals. The operators that have installed such systems report a capacity increase of 5 to 10 per cent although the main target of the management system is to increase the quality and efficiency of terminal operations.

Figure 4-7: Functionality of a Terminal Management System (example Interman)



Source: Interferryboats

Figure 4-8: IT-based capacity management systems

Measure	**IT-based capacity management systems**
Description	IT-based terminal management system composing of: ■ Train-, truck in/out ■ Yard planning including instructions for RMG, RTG, MTS, shunting gang ■ Electronic transport related information (consignment note data, train disposition) ■ Invoicing of terminal services ■ Statistics, master data (wagon, loading units, stations, …)
Involved Parties	Terminal operator, railway undertakings, intermodal operators and customers
Examples	Systems: KLV2000, BLU, Interman, TESS, GOAL, Modality, …
Capacity Impact	**5-10%,** but mainly increase of quality

RMG = Rail-mounted Gantry Crane, MTS = Multi trailer system,
RTG = Rubber-tyred gantry crane / Reach Stacker

Source: KombiConsult analysis

4.7 Automated loading unit identification

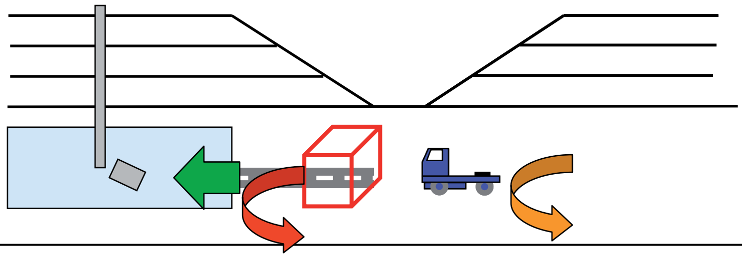
Another potential component of a comprehensive terminal management system is an automated loading unit identification system installed at the road-side or/and rail-side access of a terminal.

Today’s standard technology is based on a portal with an optical camera system, which automatically or semi-automatically recognizes the identity code or number of loading units passing this portal. Such systems often also comprise a damage detection feature. The pictures taken at the portal are stored and, if claims are made, allow to check whether the unit had already been damaged before. The gate portal allows – by means of image recognition – the identification of loading units by their painted numbers. The pre-check allows not only the identification of loading units, documentation of damages but also the refusal of inappropriate trucks (damaged, not authorised, incomplete loading papers) that avoids congestion inside the terminals.

The positive impact on capacity is mainly focusing on the capacity gain for the gate-in/gate-out procedure, where the automation is about to speed up procedures and thus reduce the idle time between the physical arrival of the loading units and their availability for pick-up/delivery (transhipment).

Radio frequency identification (RFID) systems have also been tested during various projects. To date it hasn’t become accepted in combined transport since its effectiveness depends on a wide-scale application of this technology across Europe while optical systems are suitable to generate benefits locally. Intermodal stakeholders also refrained from investing into RFID systems owing to high risks and costs.

Figure 4-9: Automated loading unit identification

Measure	**Automated loading unit identification (rail-/road-side)**
Description	Digitial-Camera Portal and image recognition software, or RFID-devices, as well as manual pre-check to refuse inappropriate trucks (avoid congestion in terminal) 
Involved Parties	Terminal operator
Examples	RSC Rotterdam, Duisburg, KTL Ludwigshafen, HH-Billwerder
Capacity Impact	**Marginal**, but mainly on gate-in process (reduced time, increase of security) and relive of internal terminal from inappropriate trucks

Source: KombiConsult analysis

Figure 4-10: Automated loading unit identification (example of Hamburg-Billwerder)

Source: DUSS Hamburg

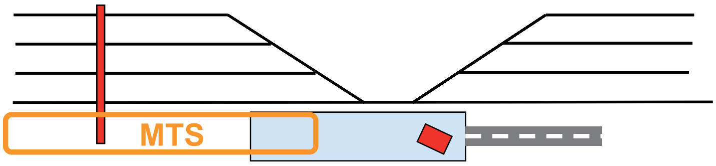
4.8 Separation of rail-side and road-side handlings

The CT terminal Rail Service Centre (RSC) Rotterdam handles containers, swap bodies and semi-trailers. About 40 per cent of its volume is generated by the neighbouring container port terminals while 60 per cent of the units are delivered or collected by road vehicles. The terminal is situated next to the port railway line (”Havenspoor”) with double-side access for the trains at least in one of two modules. Some of the trains are shuttle services between the hinterland terminals and the RSC Maasvlakte with only a short staying time in the RSC Rotterdam (“opstap-shuttles”).

In order to maintain the trains’ schedules the rail-side and the road-side handling as well as the stacking area were separated. The rail-side handling is effected by four rail-mounted gantry cranes (RMG). The “customer area” of pick-up and delivery road vehicles, the internal transfer between customer and transhipment areas and the stacking areas, however, are served by six mobile reachstackers and five terminal trucks with articulated multi-trailer-system (MTS) The enforcement of this system including the **separation of services** in conjunction with the shuttle concept the rail-side handling capacity could be increased by approx. 25 per cent.

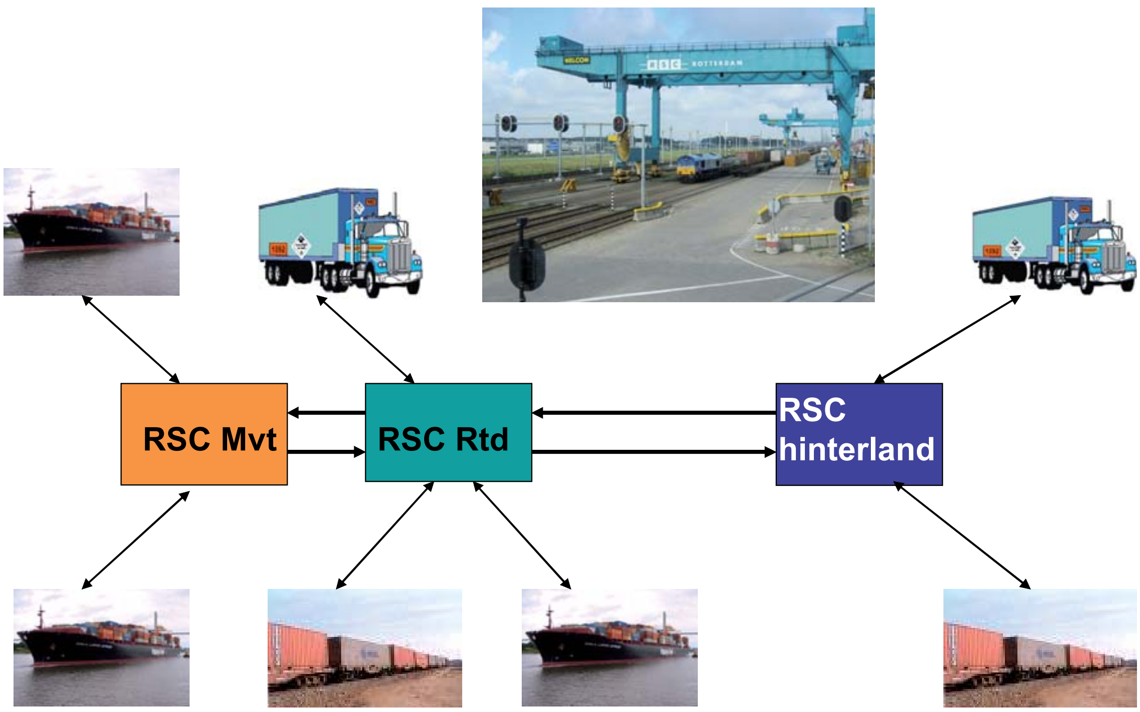
RSC also claims to handle the trains according to timetable if they arrive on time and reports that 80 per cent of all trucks are served within 30 minutes.

Figure 4-11: Separation of handling services

Measure	**Separation of rail-side and road-side handlings**
Description	Dedicated areas and devices for rail- and road-side with e.g. Multi-Trailer System (MTS) for transfer for priority service according individual train and truck schedules 
Involved Parties	Terminal operator
Examples	RSC Rotterdam
Capacity Impact	**25%,** related to the rail-side gantry crane productivity.

Source: KombiConsult analysis

Figure 4-12: Train operation system of RSC Rotterdam



Source: RSC Rotterdam

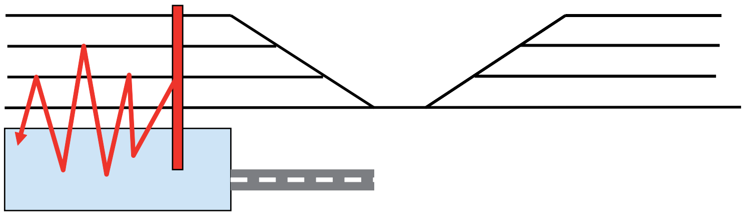
4.9 Task management according to pre-notification

The terminal is the focal point between rail and road and seeks to bridge between the requirements of both modes. Although the terminal service is contracted by the intermodal operator, in daily operation the terminal is managed according to the sequence of scheduled trains and the arrival and departure of trucks upon their arrival. This is often leading to somewhat lengthy and non-optimal movements of the cranes and other equipment in the terminal.

The terminal managers are convinced that they could improve their service quality and increase the utilisation of the equipment if they were notified not only about the delay of inbound trains - which is claimed to be neglected very often - but also of the envisaged pick-up and arrival time of collecting vehicles. As concerns outbound services, they, too, are requesting for an earlier notification about the expected composition of wagon sets and priority shipments. Both would contribute to increase the effectiveness of the cranes and the transhipment capacity by about 5 to 10 per cent.

The information needed to do that carefully could be a subset of the “UIRR consignment note” data that the intermodal operators own in their respective management system in conjunction with the reservation or booking. The wagon list indicates the sequence of wagon in the train and can be obtained from the railways. The terminal operators in turn could deliver the same list or set of data upon completion of loading to the intermodal operators and railways, and the related terminal.

Figure 4-13: Task management according to pre-information

Measure	**Task management according to pre-notification**
Description	Terminal operators are planning their tasks, e.g. crane jobs according to pre-notifications received for the pick-up and delivery of loading units on the evening before the train arrival 
Involved Parties	Terminal operator, intermodal operators and their customers
Examples	Not yet fully operational for both, in- and outbound operation
Capacity Impact	**5-10%,** but also quality increase due to improved information exchange

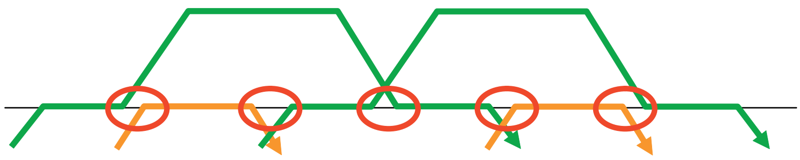
Source: KombiConsult analysis

4.10 Punctual rail services

Terminals that are already congested or operating at capacity limits have few or no further buffer to compensate delayed trains. Only if trains are operated with a high rate of punctuality can terminal slots be used as contracted with operators (cf. **Figure 4-14**). Un-reliabilities, as a matter of fact, are "wasting" scarce terminal resources and reducing the technical capacity. This becomes even more serious if several railway undertakings and intermodal operators are calling at a same terminal. While one operator may accept a shifting of priorities between "his" own trains he is unlikely to agree on a shift to the benefit of a competitor.

In the workshops we discussed a concept, which might induce a change of behaviour. It foresees bonus-malus incentives for delayed services and priority rules such as "punctual trains are served first". The concept is dealing with the obligation and rights in the interplay of terminal operator, railway undertaking and intermodal operator calling at a terminal. This innovative approach hasn't been completely elaborated for the time being but the terminal operators involved in the workshops are committed to continue working on the conditions.

Figure 4-14: Punctual rail services

Measure	**Punctual rail services**
Description	Terminals operating at their capacity limits have few or no further buffer to compensate delayed trains. It is a must to operate trains with high rate of punctuality, so that terminal "slots" are used as contracted to (different) operators. 
Involved Parties	Infrastructure managers, railway undertakings, intermodal operators, terminal operators
Examples	Concepts but not yet agreed terms of operation, that should foresee bonus-malus regime for delayed service, and priority rules, e.g. "punctual trains are served with priority".
Capacity Impact	**Up to 20%**, depending on initial occupation rate and buffer time.

Source: KombiConsult analysis

5 Conclusions and recommendations

An increasing number of intermodal terminals in Europe, which are often also key for domestic and international networks of intermodal services, is confronted with saturated transhipment capacity. These bottlenecks – like the capacity constraints on major sections of the European rail network (cf. DIOMIS Report “Trends in domestic combined transport”) – are hampering or even jeopardizing the otherwise possible growth of combined transport volumes.

We are aware of the fact that enlargement investments in CT terminals or the building of new sites, for various reasons such as planning period, times for approvals or budget restrictions, though necessary at any rate would not be sufficient to remove the constraints. With this present study we have collected numerous “soft” measures generally not requiring large infrastructure investments that are suitable for enabling a considerable increase of the transhipment capacity at congested terminals.

A couple of typical measures have been investigated by KombiConsult and discussed with intermodal operators, railways and in particular operators of about 80 combined transport terminals in Europe. The measures that have been described in the previous chapter have demonstrated their impact on the increase of the terminals capacity in selected terminals. They can therefore be regarded as “best practices” for the specific cases with a potential of transferability and application to other terminals as well.

The workshops organized by KombiConsult and Interporto Bologna have shown that there is also a need for direct communication between the terminal operators in addition to the talks that involve other actors. **Figure 5-1** shows a survey of the selected measures and the actors that are involved in their implementation.

Figure 5-1: Overview of measures and actor involvement

Improvement measure \ Main actor and involved parties	Infrastructure Manager	Railway Undertaking	Intermodal Operator	Terminal Operator	Customer (Road)	Other	Capacity impact
Increased flow factor		□	■	□			+ 50-100%
Control of shunting service		□	□	■			+ 5-10%
Supply trucking services			□	■	□		small
Extension opening times	□	□	■	□	□	□ 1)	+ 10-20%
Bonus-malus incentives			□	■	□		+ 5%
Capacity management		□	□	■	□		+ 5-10%
Loading unit identification				■			small
Separation of rail-/road-side				■			+ 25%
Task management pre-info		□	■	□	□		+ 5-10%
Punctual rail services	□	■		□			+ 20%

1) Public Authorities, Trade Unions ■ Main Actor □ Involved Party

Source: KombiConsult analysis

The measures in detail, the measures that are recommended for transfer and applicability to increase the terminal handling capacity and the quality of service are the following:

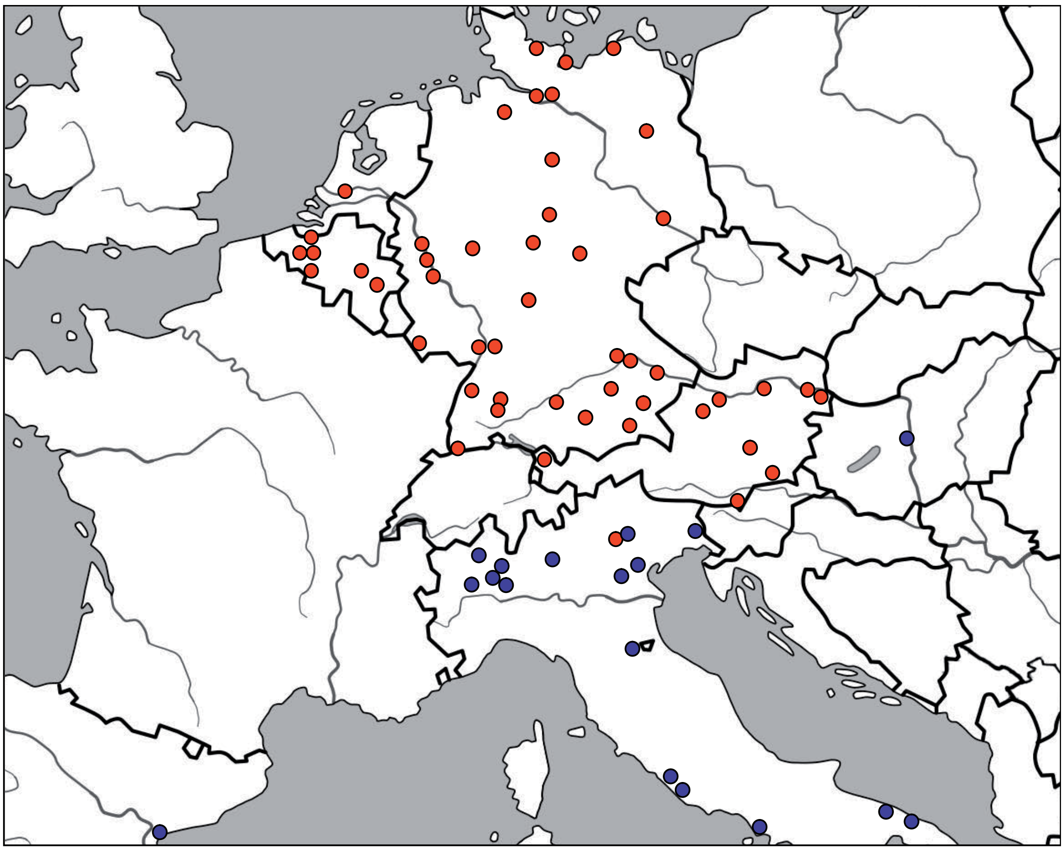
- Increase of flow factor for multiple use of handling tracks during the day;
- Control of shunting services by terminal operator;
- Supply or management of road trucking services by terminal operator;
- Extension of terminal opening and operating times;
- Implementation of bonus-malus incentives for efficient use of parking and interim storage space;
- Installation of IT-based capacity management systems to interchange with partners in the transport chain and manage the terminal more effectively;
- Automated loading unit identification (rail-/road-side);

- Separation of rail-side and road-side handlings;
- Task management of e.g. crane handling according to pre-notification;
- Operating punctual rail services.

6 Workshop participants

The three workshops organised in the framework of the present Study cover in total the experience of almost 80 terminals in eight countries (see **Figure 6-1**). The collective experience represented in the workshops and thus in this report represents a capacity of almost 8 million loading units and a realised transhipment volume of more than 6 million loading units in 2005. This is about 56 per cent of the transhipment volume of terminals on the corridors selected for the study and approximately 54 per cent of all European inland CT-terminals. The average utilisation rate of these terminals is almost 80 per cent.

Figure 6-1: Geographic coverage of terminals



Source: KombiConsult analysis

Invited Participants and considered feedback of 1st Workshop (1.12.2006, Frankfurt/Main), the follow-up workshop (8.02.2007, Wels/Linz) and 2nd Workshop (16.02.2007, Bologna) related to the terminal operating companies and their terminals listed in **Figure 6-2**.

Figure 6-2: List of terminals

Terminal/Operator	Terminal Locations
Baltic Rail Gate	Lübeck
BILK	Budapest
Cargo Center Graz	Graz
Cemat	Verona Q.E., Milano Segrate, and other Italian terminals
Cogefrin Bulk Terminal	Bologna
DUSS	About 30 sites in Germany.
Gran Europa	Puerto Seco Azuqueca
Interferryboats	Antwerpen (4x), Muizen (Mechelen), Liege (Renory),
Interporto Bologna	Bologna, Padova
Interporto Modena	Modena
KTL Kombiterminal	Ludwigshafen
Kombiverkehr	Shareholder in about 12 sites in Germany
Linz AG	Linz
Nord Est Terminal	Padova, Bologna, Parma, Brescia, Verona P.N.
Quadrante Servici	Verona Q.E.
Rail Cargo Austria	St. Michael, Villach, Wels, Wien, Wolfurt
Rail Service Center	Rotterdam
RFI	About 60 per cent of Italian terminals
Sogemar	Melzo, Rho
TCB	Barcelona
Terminal Intermodale Nola	Nola (Naples)
TMT (Pegasus Maritime)	Trieste, Cervignano
WienCont	Wien, Krems

List of figures

ETF
EDITIONS TECHNIQUES FERROVIAIRES
RAILWAY TECHNICAL PUBLICATIONS - EISENBAHNTECHNISCHE PUBLIKATIONEN
16 rue Jean Rey - F 75015 PARIS

http://www.uic.asso.fr/etf/

Printed by

Xerox Global Services France

16, rue Jean Rey 75015 Paris - France

April 2007

Dépôt légal April 2007

ISBN 2-7461-1308-2 (English version)