

EUROPEAN MODULAR SYSTEMS INTERACTION WITH INTERMODAL TRANSPORT SYSTEMS

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Abstract

TFK has in cooperation with vehicle manufacturers, the former National Road Administration and The Swedish Association of Road Transport Companies among others, carried out studies concerning the use of longer and heavier vehicles according to the European Modular System (EMS) for road haulage. EMS is based on two different types of load-carriers: swap bodies and semi-trailers, both commonly used in Europe. Sweden and Finland are the only European nations that in general allow 25.25 m long vehicles according to EMS.

Intermodal transport has long been recognized as a sustainable and efficient way to accommodate the increasing amount of cargo. Major research and development (R&D) have been undertaken in this area. However, this has not been corresponded by an equal increase in transport volume. In order to increase the interest in intermodal transport among haulers the economic synergies and other advantages of using intermodal transports needs to be communicated. This study presents two proposals of how to support a development towards increased use of intermodal transports among haulers by exceeding current EMS limitations.

Firstly, a possible improvement to adopt the EMS system for intermodal transports is to implement road vehicle combinations consisting of three class C swap bodies with a length of 7.82 m and a maximum weight of 16 tonnes each. This would be possible with increased length restrictions of 27 meters. The gross weight would hence be approximately 64 tons and could be allowed especially in intermodal road connections. Secondly, a further step would be to implement double semi-trailers as currently tested.

A purpose was also to map how EMS with current and future scenarios can facilitate intermodal transports. The study has estimated the intermodal compatibility of the largest Swedish fleet providers for load carriers. The study has also mapped the haulers view on intermodal transport using EMS.

In general, haulers using intermodal transports are satisfied with the load carriers that already are in use for intermodal service. The possibility to use EMS vehicles and load carriers seem to be important, especially 25.25 m long vehicles as it provides more opportunities.

Keywords: European Modular system (EMS), Dolly, Intermodal transport, Semi-trailer, Swap body

1. Introduction

1.1 Background

TFK has in cooperation with the former National Road Administration, the Swedish Association of Road Transport Companies and the heavy vehicle manufacturers Scania and Volvo Trucks and among others, carried out studies concerning the use of longer and heavier vehicles according to the European Modular System (EMS) for road haulage. EMS is based on two load-carriers: swap-bodies and semi-trailers that are commonly used in Europe. Sweden and Finland are the only European nations that in general allow 25.25 m long vehicles according to EMS. Trials have been carried out in the Netherlands and Denmark. Today those vehicles also are commonly used in commercial services in Denmark and the Netherlands.

2.1 Intermodal transports

Intermodal transport has long been recognized as a sustainable and efficient way to accommodate both the increasing amount of cargo. Major research interventions have been undertaken in this area. However, this has not been corresponded by an equal transport increase in transport volume. In order to increase the interest in intermodal transport among haulers the economic synergies and other advantages of using intermodal transports needs to be communicated.

It is of great interest to study if and how the EMS can facilitate intermodal transports with current regulations and possibly with even longer EMS combinations than the current 25.25 m. Furthermore it needs to be investigated to what extent the use of EMS makes it favorable for haulers to choose intermodal transports instead of road transports. It is also of interest to study how the road transport part of an intermodal transport chain affects the entire transport chain. Efficient road transport and cargo handling when shifting modes of transport should increase the interest in using intermodal transports since the economic advantage of rail transport thus become easier to use.

Historically, intermodal transports and EMS has been studied separately, but an overall view, and studies covering the interaction between the two, has been lacking. EMS facilitates intermodal transport in consisting of standardized load-carriers currently in use. However, there are still concerns regarding how EMS affects the use of intermodal transports. The allowed vehicle restrictions of 60 tonnes total weight and 25.25 meters length induces high loading capacity which can be seen as a factor that weakens the competitiveness of rail transports. The long-term effects has however not been studied. Yet another factor concerning the competitiveness between transport modes is the fact that a low amount of all load-carriers can be transshipped onto railway wagons.

2. Aims

The aim of the study was to map current EMS influence on intermodal transports and how an extension of EMS allowances would affect competitiveness and the tendency of haulers to choose transport solutions.

A purpose was also to estimate the amount of load-carriers currently in use in Sweden that are possible to transship onto intermodal transport solutions. The current situation is that a relatively low share are trans-shippable, 2-10 % for semi-trailers (Bärthel, 2011) has been mentioned. Implicitly, this delimits the possibility and flexibility to choose the most favorable transport solution at all times.

3. Expectations

The study was expected to increase the knowledge concerning the effects of using EMS in intermodal transport, especially in which extent increased vehicle dimensions affects the competition between the modes and if EMS could have a positive effect on the use of intermodal transports. The study was also expected to investigate any possible problems of using intermodal transports and EMS. As a result of the investigation, possible future research topics with the purpose of increasing the amount of intermodal transports might arise.

4. Definitions

4.1 Intermodal transports

Intermodal transports (also combined transport), is usually defined as freight transports where goods is loaded into a load carrier at the place of origin and hauled to the point of destination where it is unloaded. The load carrier is transshipped at least once during the transport (Jensen, 1990). In order to increase the efficiency in the intermodal transport chains improvements are required in all steps of the transport chain, including the handling of load-carriers when shifting modes.

4.2 Load carrier types

The most common types of intermodal load carriers are:

- ISO-containers
- Semi-trailers
- Swap bodies

ISO-containers were developed according to the demands of sea transports and when used in intermodal transport, the transport chain generally contains a sea transport. Their advantages are that they are cheap, robust, very common and at least stackable. The limitations or disadvantages are that they are not compatible with EUR-pallet system and have a high tare weight. They have an outer width of 8 foot, heights from 8 foots to 9 foots and 6 inches and lengths of 10, 20, 30 and 40 foots (Bark ed., 2002). Today 20 and 40 foot are the commonly used sizes of containers, both for national and international transports.

Semi-trailers hauled by tractors (trucks) are the most common vehicle combination for long distance road transports in Europe. The advantages of the vehicle combination are low costs. The semi-trailer can also be equipped with devices for intermodal handling (grabber pockets) and it is also flexible and robust, compatible with EUR-pallets and easy to handle at terminal areas when loading and unloading. In Europe the allowed maximum weight for a semi-trailer and tractor is commonly 40 tonnes. Hence, the weight of a semi-trailer is usually some 32 tonnes and the loading capacity will then be about 25 tonnes.

The allowed maximum length of a semi-trailer and tractor combination is in most European countries 16.5 m and the maximum length for the semi-trailer itself is 13.6 m. The allowed width is in Europe in general 2.55 m (2.60 with insulated load carriers) and the allowed height is 4.0 m. For domestic transport in Sweden it is however possible to use longer, wider (2.6 m) and higher (4.5 m) semi-trailers.

Swap bodies are commonly divided in to a longer class A, with a length from 12.2 m (40 foot) to 13.6 m (the same length as a semi-trailer), and the shorter class C. The most common lengths of the class C is today 7.45 m and 7.82 m. Other lengths also exist such as the former main standard of 7.15 m. The general allowed width of swap-bodies is in Europe 2.55 m.

The height regulation prescribes that a road vehicle loaded with a swap-body cannot exceed 4 m in most European countries. Swap bodies class C are usually allowed to have a maximum weight of 16 tonnes which in many cases is difficult to achieve without exceeding the common regulation of gross weights of 40 tonnes. It is possible to transport two class C swap bodies with a maximum length of 7.82 m on a lorry (truck) with chart or full-trailer, within the common European regulation of a maximal length of 18.75 m.

4.3 The European Modular System (EMS)

The European Modular System (EMS) consists of a number of vehicle modules complying with EU-directive 96/53 (EU, 1996). The vehicles and load carriers are combined with one or two coupling units in order to produce a number of vehicle combinations as shown in figure 1. The vehicles A, B and C have a maximum length of 25.25 m and weight of 60 tonnes.

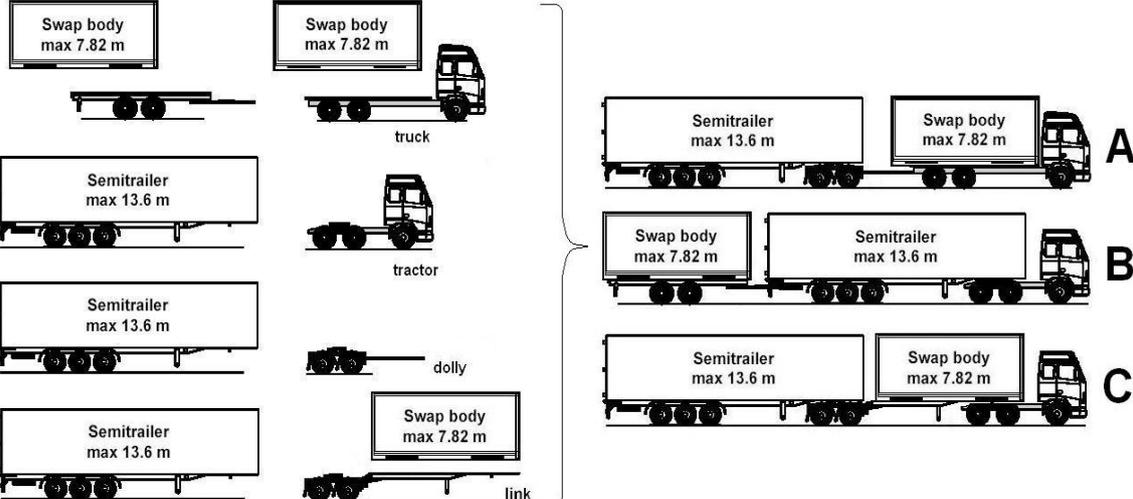


Figure 1 – European Modular System (EMS) with the commonly used load carriers to the left, and the possible vehicle and load carrier combinations to the right

The different types of load carriers are not listed explicitly in the directive; rather they are the results of all the limitations in the directive. The dolly and the link are vehicles that are not listed at all. It is also notable that the shorter types of load carriers may be rigid load carriers permanently attached to the frames of trucks or semi-trailers of the same frame. Instead they may in many applications be. However EMS commonly consists of one shorter and one longer load-carrier. In order to transport the load-carriers, lorries, tractors or trucks are used. In order to form longer vehicle combinations dollies or links are used. The shorter load-carriers are commonly class C swap-bodies. The short load-carrier is usually used together with a lorry but can also be used with a link or a centre axle trailer. The short load-carrier is usually a swap body, meaning it can be removed from its vehicle. The other load-carrier within EMS is a semi-trailer.

5 Intermodal transports in Sweden

5.1 Growth figures

Intermodal transports in Sweden have in recent decades seen a consistent growth, albeit from low levels. In 1998, 4 699 million tonnes of goods was transported by intermodal transports, representing 8.4% of the total amount of goods transported on rail. In 2010 that number had more than doubled to 11 308 million tonnes was transported using intermodal transports, which represented 16.5% of the total amount of railroad transport (Trafikanalys, 2011).

The growth can however strongly be attributed to the increase in the traffic to and from the Port of Gothenburg.

5.2 Road haulers perspective of intermodal transports

Swedish road haulers are in general satisfied with the networks and services provided by intermodal operators. The main reason for using intermodal transports instead of a road only transport solution is economic since intermodal transports are cost effective at long distance transports. One of the questions asked to Swedish haulers in this study was how they perceived the standard and services offered at Swedish intermodal terminals. The interviewed haulers claimed that the services offered were sufficient and that they did not think that adding services would increase their use of intermodal transports. In fact, they claim a short turn-over time at the terminal and services provided at a low cost are more important. This is most likely due to the short pre and post haulage distances and that the trucks begin and end their days at the haulers own terminal where they can refuel and carry out service if necessary.

5.3 Environmental aspects of intermodal transports

Another reason for using intermodal transports is the reduction of Carbone dioxide (CO₂) and other pollutions. An intermodal transport between the Swedish cities of Stockholm and Malmo reduces CO₂ of almost 99%, 1.57 tonnes of CO₂ for a road only transport and 0.016 tonnes of CO₂ for the intermodal transport (Ecotransit, 2011). Using an intermodal transport solution also shows a significant reduction of used energy, 795 kWh for the intermodal transport, compared to 6 946 kWh for a road only transport solution, a reduction of almost 88% (Ecotransit, 2011). The calculations on intermodal transport include energy consumption and associated CO₂ emissions for handling at the intermodal terminal of Årsta in Stockholm and the intermodal terminal in Malmo. Ecotransit is a website operated by the International Union of Railways (UIC) and supported by, among others, Green Cargo and DB Schenker.

5.4 The successful Railport concept

The growth that occurred during the period is mostly due to the port shuttles that operate between the Port of Gothenburg and a number of dry ports throughout Sweden (Jonsson, Bark, 2009). Port of Gothenburg introduced its port shuttles, also known as The Railport concept, in 1998 (Roso, 2006). The concept is based on a number of railroad shuttles between the port of Gothenburg and a number of inland intermodal terminals, called dry ports.

By using this concept, a large number of pure road transports to and from the can be replaced with intermodal transports between the dry port and the port, in this case Gothenburg. Mainly 20 and 40 foot ISO-containers were transported by the shuttles and about 42 % of all ISO-containers that left or entered the Port of Gothenburg by land in 2011 were transported by railway (Port of Gothenburg, 2012). Dry Ports have also been shown to have a positive effect on businesses in the intermodal area. The dry port concept has increased the competitiveness for Port of Gothenburg against other European ports by providing efficient transport solutions to the middle and south parts of Sweden (Jonsson, Bark, 2009).

The break even distances in intermodal freight transport are in general 500-600 km, but for connections between ports and dry ports this distance is commonly about 350-450 km.

5.5 Intermodal operators

After the discontinuation of CargoNet's Swedish branch at the end of year 2011, the Swedish intermodal market is dominated by publically owned Green Cargo.

Other actors on the Swedish intermodal rail market are CFL Cargo, Hector Rail, Rush Rail, Real Rail, TX Logistik, Tågfrakt and Tågåkeriet i Bergslagen.

6 Improving road transports in intermodal transports chains in Sweden

6.1 Basic facts – cost issues

The cost of an intermodal chain is divided in the three posts, pre and post haulage (PPH), handling at the terminal and the railroad transport. The cost for PPH is often claimed to constitute 50% of the costs in an intermodal transport chain. This is a fairly high share considering the short distance usually traveled. There are three possible ways to reduce this cost; (1) improved production planning (scheduling and routing); (2) shorter PPH distances and (3) by locally allow longer or heavier vehicle combinations.

6.2 Traditional intermodal road transports

The reason is that a traditional Swedish road vehicle with a gross weight of 60 tonnes (and length of 24 m) offers a payload of about 40 tonnes. A semi-trailer with dimensions according to the European rules and adopted for intermodal transports will at the same time offer a payload of 27 tonnes (Åkerman, Jonsson, 2007). If the transport instead is carried out with two C class swap bodies the payload would be about 25 tonnes. That means that the intermodal transport payload would be about 65 % of the payload for a traditional road transport. If both cases have about the same basic cost for a heavy lorry, tractor or truck, fuel and a driver the costs would be 60-65% higher, according to payload, for the intermodal road transport compared to a pure road transport in the same distance. This has made it difficult to organize competitive intermodal transports when road transports between intermodal terminals and customers exceeds 20 km.

6.3 The basic EMU concept (25.25 m)

The implementation of the European Modular System (EMS) has opened for improvements in intermodal transports. Many road haulers that are using rail transports for the long distance part of an intermodal transport chain have acquired load carriers and vehicles adopted for intermodal operations that consists of a lorry (truck), a swap body class C (7.45 or 7.82 m length), a dolly and a semi-trailer (see Figure 1 above, vehicle A).

With the EMU concept the vehicles payload in road transport was increased to 40 tonnes or to the same level as for traditional road vehicles in Sweden. A disadvantage of his system was that it is a combination two quite different types of load carriers.

In other European countries the shipper or transport operator chose between semi-trailers or swap bodies as load carriers. A combination is quite uncommon. That means that shipments where a semi-trailer and a swap body are combined mainly are a domestic solution for intermodal transports in Sweden. For cross border transports a solution with efficient road transports of either intermodal semi-trailers or swap bodies class C would be interesting.

6.4 Improvements of the EMU concept – conceptual ideas

A main question asked is whether road vehicles and load carrier combinations longer and heavier than those allowed today could increase the competitiveness and use of intermodal transports. This is allowed in Germany where road vehicle combinations in intermodal transports are allowed to weigh an additional 4 tonnes within 150 km from an intermodal terminal meaning a gross weight of 44 tonnes (Bärthel, 2011). This is claimed to lower the costs for the intermodal road transport modes by 13-14 %.

Longer and heavier vehicle combinations in Sweden, consisting of a single type of load carrier are of great interest to study as a way to increase the interest and market share for intermodal transports. The main idea is to make the pre and post road haulage (PPH) cheaper and more efficient and thus making the entire intermodal transport from door to door cheaper. The two main alternatives that were assessed in a study were road intermodal road transports by vehicles consisting of two semi-trailers or three class C swap bodies.

Three class C swap bodies

The Swedish office furniture manufacturer Kinnarps has since a number of years studied, and tried to perform road tests, of a vehicle combination that contains of three class C swap bodies, with a length of 7.82 m, one of them placed on the lorry (truck) and the other two on two centre-axle trailers (see Figure 2).



Figure 2 – Alternative configuration of a longer vehicle for three class C swap bodies according to the European Modular System (EMS)

The length of a vehicle combination that is loaded with three swap bodies with a length of 7.82 m would be about 27 m and the gross weight about 64 tonnes, if a maximum weight of 16 tonnes each should be allowed for each swap body. If the gross weight of the vehicle would be limited to 60 tonnes, the payload would be decreased to about 38 tonnes.

The load carrier is well integrated in Kinnarps logistics concept and well suited for use in intermodal transports (Jarlsson, 2008). These swap bodies are used in Kinnarps own distribution system where a lorry (truck) with a single centre-axle trailer transports two swap bodies. The swap bodies are also well suited for city distribution and the trailer could be decoupled and the lorry used for distribution in two journeys. Alternatively the load carriers could be shifted to special city distribution vehicles.

Double semi-trailers

Volvo, DB Schenker and the Swedish Infrastructure Administration along with other partners have tested a combination consisting of a tractor, two semi-trailers and a dolly (see Figure 3). The test and study has no defined intermodal approach (DUO2, 2012).



Figure 3 – Alternative configuration of longer vehicle for double semi-trailers according to the European Modular System (EMS)

The equipment used complies with the EU-directive 95/53 (EU, 1996) and produces a vehicle combination with a length of 32 meters and a gross weight of 80 tonnes (DUO2, 2012). Early results indicate a 27% decrease in fuel consumption and carbon dioxide emissions per transported tonne or volume compared to a tractor with single trailer.

The test of a vehicle with two semi-trailers is today restricted to traffic on the E6 motorway between Gothenburg and Malmö with at least two lanes in each direction, separated by a barrier.

For traffic on other roads the vehicle has to be shared into two combinations consisting of a tractor and a semi-trailer. However it seems doubtful that this combination will be allowed on secondary roads which also means for possible transports to and from intermodal terminals.

According to interviews with Swedish road haulers that are using intermodal transports and intermodal rail operators, longer and heavier combinations is not a single factor that would increase the use of intermodal transports as Sweden already allow longer vehicle combinations compared to Germany for instance. But also due to the fact that the haulers like to keep a standardized fleet that can handle a lot of different types of transports and cargo. Instead they would like to keep their fleet of vehicles and load carriers simple and flexible in order to meet changes in the customer demands. Further, they claimed that it would be even more difficult to arrange an effective pre and post haulage (PPH) of two semi-trailers than a semi-trailer and a swap body. This is probably in part due to that the semi-trailer and swap body combinations has become a well-known and commonly used combination.

6.5 Intermodal handling of load carriers

Technical possibilities to handle load carriers

Load carriers fitted with mountings, for intermodal handling with lifting devices adopted to grapple arms, have a higher tare weight and are more expensive than standard equipment. Currently there are a lot of load-carriers that are not equipped with such mountings, thus limiting the possibility, or making it impossible, to use intermodal transports. According to (Bärthel, 2011), only 2-10% of all semi-trailers in Europe are fitted with mountings.

A survey was therefore carried out as a part of the study tried to determine the share of semi-trailers and swap bodies in use in road traffic that are fitted with mountings to enable intermodal transports. The survey carried out for this paper asked the three largest fleet providers of load carriers in Sweden how large part of the Swedish market they held and how large part of their stock was fitted with mountings.

	Market share	Share of load carriers fitted with mountings
Company A	60%	90%
Company B	25-30%	90%
Company C	20-25%	50%

Table 4 – The three largest fleet providers of load carriers in Sweden, market share and share of rolling stock fitted with mountings for intermodal transports.

As seen in table 4 above, companies that are leasing (short or long term) load carriers to Swedish haulers have a modern stock of load carriers with a high percentage fitted with mountings for intermodal transports. The interviewed companies claim that there is no shortage of load carriers with grabber pockets, if a hauler would like to implement an intermodal transport solution, there are no problems to get the needed equipment.

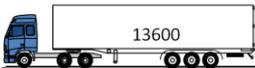
Handling of load carriers

Semi-trailers and swap bodies are commonly handled by gantry cranes or counterbalanced trucks equipped with lifting devices with grapple arms. A semi-trailer is bulkier (exceeding 32 tons gross weight) than a class C swap body (exceeding 16 tons gross weight), thus making the semi-trailer a cost driver for the handling equipment.

Some class C swap bodies are also possible to handle with fork lift trucks that are a far more cost efficient method for handling of load carriers (Bark, Skoglund, 2009). Semi-trailers are like most of the swap bodies not stackable which making them less space efficient at terminals storages compared to ISO-containers.

7 Analysis

The existing and possible future intermodal road transport vehicle combinations has been analysed and compared (see table 5).

	Gross-weight	Pay-load	Total vehicle length	Length of load area	Load capacity	
	(tonnes)		(metres)		volume (m ³)	EUR-pallets (num.)
	40	27	16.5	13.2	90 (100)*	33 (33)*
	40 (44)**	25 (27)**	18.75	14.6	100	36
	60	40	25.25	20.5	140	51
	64 (60)	42 (38)	27	21.9	150	54
	80	56	32	26.4	180	66

* Volume according to a mega trailer

** In Germany for example allowed weight for transports to and from intermodal terminals within a distance of 150 km

Table 5 – Analyses of capacity for different intermodal road vehicle combinations (based on and translated from Bärthel 2011)

The analysis indicated that it would be a big step take when starting to use double semi-trailers, according to the EMS system, for intermodal road transports between intermodal terminals and customers. Instead it was indicated that it would be a small step and a preferable solution to make it possible, according to the EMS system, to transport three class C swap bodies on the same vehicle combination in an intermodal road transport. It would also be preferable to allow a gross weight of at least 64 tonnes for those vehicle combinations.

The argument for an increased gross weight, from 60 tonnes, is that it would make it possible to transport swap bodies with a maximum weight of 16 tonnes each.

Interviews and analysis has also shown that longer and heavier combinations are most beneficial in transport solutions with a smooth flow and with few and small variations. They are also primarily looking for a cost effective way to perform their transports. The fact that intermodal transport provides a “greener” alternative compared to a road only solution is welcome but in general, neither the hauler nor the transport buyer is interested in paying anything extra for it. Longer and heavier combinations could also be a way to lower the cost of the pre and post haulage, but haulers claim that it is not as easy to implement over night.

8 Conclusions

In general, the haulers already using intermodal transports are satisfied with the technology and load carriers that already are in use for intermodal service. The possibilities to use EMS vehicles and load carriers seem to be important, especially 25.25 m long vehicles.

A possible improvement, and a first step to improve the EMS system, seems to be an implementation of road vehicle combinations for three swap bodies, of class C, with a length of 7.82 m and a maximum weight of 16 tonnes each. This could be possible if 27 metre road vehicles with a gross weight of about 64 tons were to be allowed. Especially in intermodal service for transporting swap bodies.

In a further step double semi-trailers also can be a possibility for intermodal road transports.

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