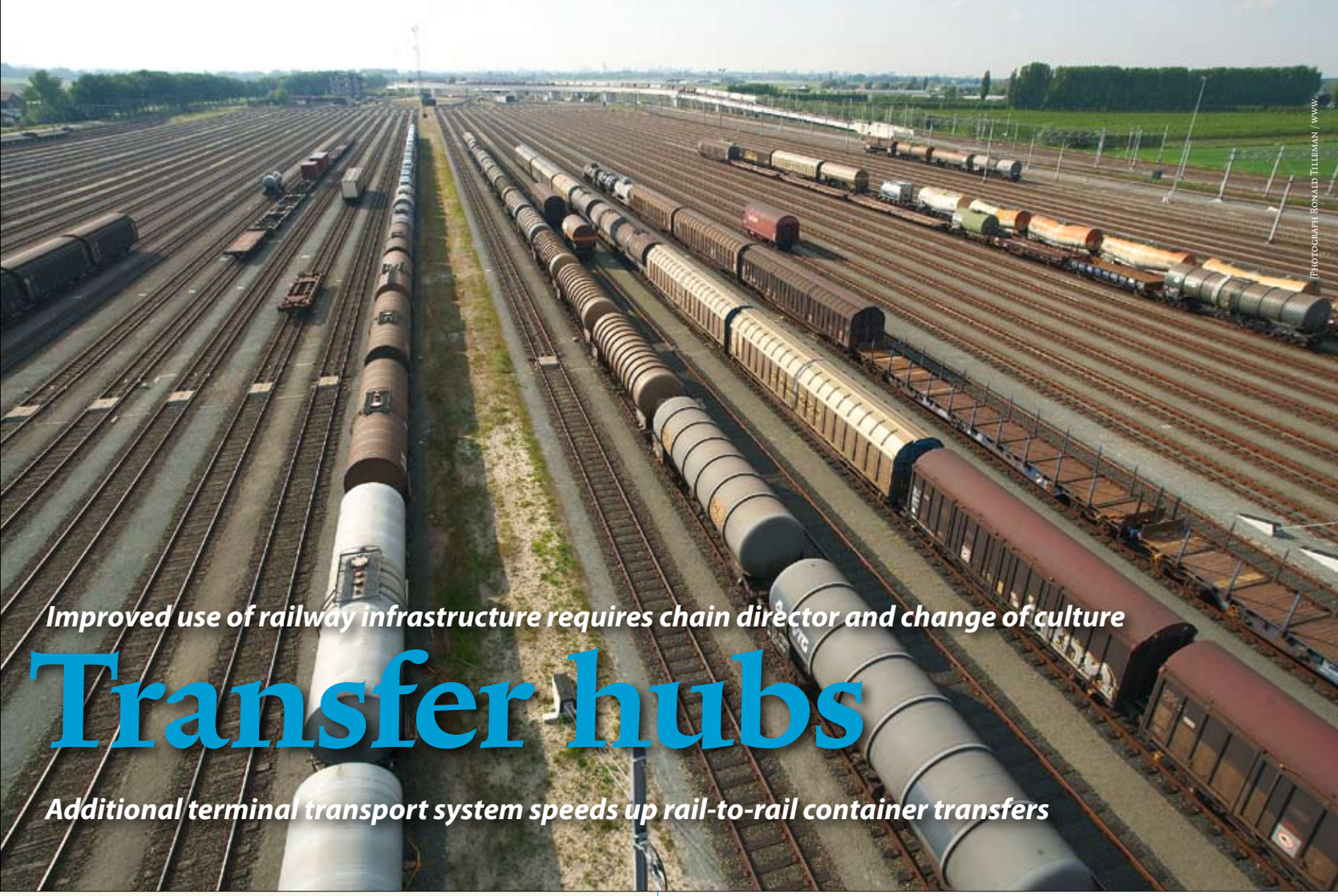


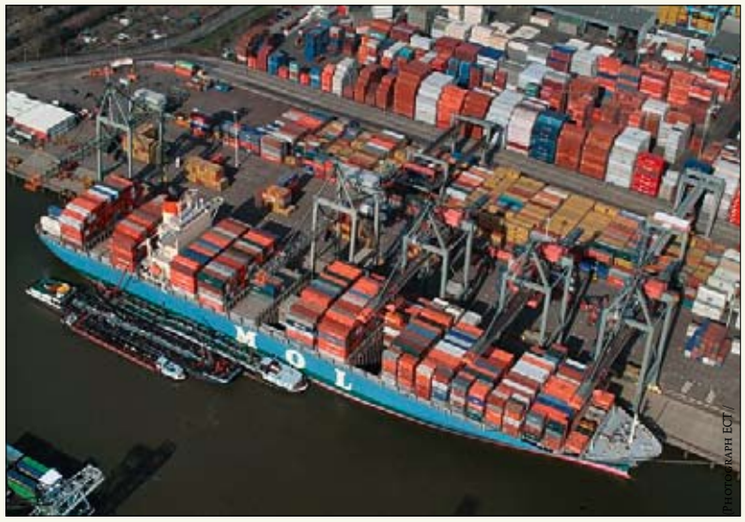
Photograph Ronald Tilleman / www.

Improved use of railway infrastructure requires chain director and change of culture

Transfer hubs

Additional terminal transport system speeds up rail-to-rail container transfers

The Kijfhoek shunting yard near Barendrecht. This is where many of the wagons coming from Europort are sorted by destination. Most container trains do not come through the Kijfhoek yard, as they already received their destination cargo at the sea terminal. Each day 25 to 35 container trains leave for the hinterland.

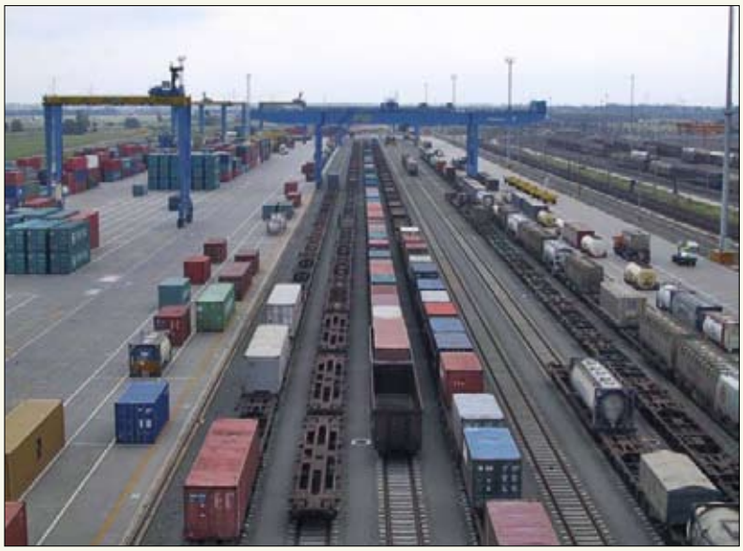


Photograph ECT Rotterdam

The source of containers for all transport to the hinterland is the sea terminals of the various transhipment companies, including ECT and Short Sea Terminals.

Road transport systems suffer from congested roads, environmental legislation, and the threat of pay-as-you-go systems. All grist to the mill as far as the railways are concerned. Unfortunately cargo transport by rail is not exactly renowned for its flexibility and reliability, and the quality offered for the price is not competitive enough for all markets. One of the main bottlenecks is the time-consuming shunting operations. Researcher Yvonne Bontekoning at the OTB research institute of TU Delft compared the performance of various shunting and transfer techniques. The fastest turned out to be a terminal with an ingenious supporting transport system. However, it would have to process at least nine goods trains a day to become economically viable. Unfortunately, things are different in the real world, which is why Bontekoning thinks the best solution for now for optimising the use of our rail infrastructure is to adapt the existing rail-to-road terminals.

Astrid van de Graaf

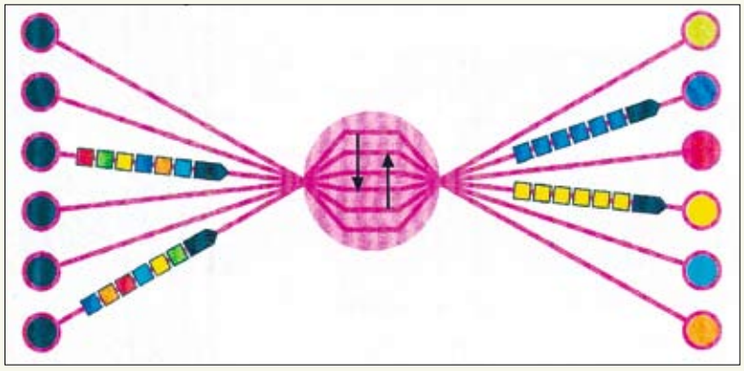


[INTERFERRYBOATS, ANTWERPEN] HTTP://WWW.INTERFERRYBOATS.BE

The Main Hub of Antwerp, with eight parallel tracks. Gantry cranes sort the containers by destination.

EWS RAILWAY / WWW.EWS-RAILWAY.CO.UK

The gantry cranes are fitted with a spreader that can be rotated so containers will always be loaded onto the train with the door ends facing each other. One of the reasons this is done is to prevent theft.



To move as much goods traffic as possible off the roads, which are plagued by congestion, it would be e good idea to introduce hub-and-spoke systems. These allow smaller volumes (less than half a train daily) to be shipped economically by rail. The circles on the left represent different sources, such as sea terminals and inland terminals in different areas. At the source terminals the containers for different destinations are loaded onto a train. When the trains arrive at the hub, the containers are sorted by destination by either of two different techniques. The containers can be lifted by a gantry crane from one wagon to another, or the wagons are shunted to be reformed into single-destination trains.

We tend to forget they are there, since goods trains operate mostly at night. At the end of each day, lorry drivers drop off their containers at the terminal in Rotterdam. The next morning the containers arrive in Duisburg, Germany, where they are loaded onto new lorries. Each day, some 25 to 35 trains like this depart from Rotterdam for destinations in the hinterland. This is the generally accepted model for transporting freight by rail, known as the point-to-point model. At the start and end terminals the containers change transport mode. Intermodal transport combines the advantages of the various transport options. The advantages of transport by road are flexibility and accessibility, while trains offer the existing network without congestion.

"Point-to-point transport requires large numbers of loading units like containers so that trains can travel daily to each destination. The large volumes and direct transport without stops on the way keep the transport price per loading unit low," says Ir Yvonne Bontekoning, a traffic & transport researcher at the OTB research institute, an interfaculty institute within TU Delft. Besides the point-to-point model there is the so-called hub-and-spoke network, in which the rail tracks (the spokes) converge in a central node (the hub). At the hub, trains carrying loads for different destinations are split up and their parts reassembled into trains each with a single destination. This type of network is starting to fade from the railway landscape, and being replaced by point-to-point transport.

Time-sensitive products

Big volumes are needed to make trains a viable proposition. A goods train carries about 30 to 45 containers and can be 400 to 600 metres long. In the current system, there is simply no room for small volumes. To get small transport back onto the tracks, hub-and-spoke networks need to be reintroduced, according to Bontekoning. Small consignments of cargo can be assembled into mixed trains at various starting stations, to be redistributed at the hub for the various end destinations. However, a scenario like this will only work if the transfer stage can be made quicker than it currently is. Shunting a train of wagons takes about six hours.

"Trains shouldn't be standing still, trains should roll," says Bontekoning. "At least, that is what the European commission thought when they decided to make the improved use of the existing rail infrastructure one of the main policy objectives of the fourth framework programme (1994-1998). This decision led to a flurry of activity. Companies, consultants, and scientists came up with all sorts of concepts to get goods transport back on the rails."

Terminet was a project by TU Delft that investigated the effect of new networks and transfer techniques. Bontekoning, previously a management trainee at the Rotterdam-based container company ECT, joined the project as coordinator. Armed with the know-how and experience she gained, she started her doctoral thesis.

"If you want to maker better use of the rail infrastructure and move goods traffic from the roads to the railways, your best bet is to go for the small volumes of time-sensitive products such as fruit and flowers, or urgent shipments. Companies that keep their stock levels low must be certain that the containers will arrive in the morning. Reliability and speed are essential if a company is to make the transition from road to rail."

Terminal test

To make the transport of small, time-sensitive loads by rail a viable proposition, the transfer process must be speeded up. How can this be done? What are the available transfer techniques, and which of them offers the best performance in a hub? Bontekoning thinks of her research for her doctorate as a consumer test: which of the existing techniques offers the fastest handling of containers at the lowest price?

Goods transfer techniques come in two basic varieties, shunting train wagons, or moving separate containers. Shunting involves rearranging entire trains until all the wagons for the same destination have been formed into a new train. The technique itself comes in two varieties, gravity shunting and flat shunting. In flat shunting, the wagons are pushed by a shunting engine, whereas in gravity shunting the engine pushes the wagons up and over a shunting hump, from which they are left to roll downhill, where points are switched to send them onto the right sorting tracks.

"Shunting takes a lot of time. The couplings between the wagons have to be released by hand, and the hoses of the braking system have to be disconnected." As an alternative for shunting, containers can be transferred between trains

at the hub. Two types of container transfer terminals are currently in use, start and end terminals for road/rail transfers, and a new generation of hub terminals, which are used for rail-to-rail transfer during the night, and for rail-to-road transfer and vice versa during the day.o

Latest hub The new generation hub features the latest innovations in transfer techniques and is fully robotic. There is only one thing wrong with it. The hub has yet to be built to its full size. The system has been the subject of much research and studies, and a prototype of the gantry crane and transport system has been built and extensively tested. The new hub is much quicker, but it is also very expensive.

The supporting transport system is one of the main innovations of the new hub concept. The large cranes each service their own area in different parts of the transfer site. They straddle their territory like a bridge, suspended from which a spreader travels to and fro to pick up containers from one train and deposit them onto empty wagons or the transport system's wheeled pallets. At right angles to the travelling direction of the spreaders, two extra transport tracks run beneath the cranes, on which the magnetically guided wheeled pallets move the containers from one crane to the next.

Bontekoning: "Cranes are big, heavy and cumbersome. Even a fast gantry crane can only move forwards and backwards at a slow pace. Putting the containers onto a wheeled pallet saves lots of time, in spite of the fact that it is an extra step. The transport system supports the cranes in their most time-consuming travelling direction, which is sideways."

She has calculated that some 60 to 70 minutes transfer time can be saved by using six cranes spread out over the terminal. More cranes means less transfer time. Cost however, is a different story, since each additional cranes makes the transfer operations more expensive.

Cost and time According to Bontekoning the absolute upper limit for goods transport by rail is EUR 50 per loading unit.

"In fact, the cost should be as low as 25 to 30 euro. In Germany, transfer prices of EUR 15 are not uncommon for time-insensitive products such as coils of steel, since the investment in infrastructure has been spread out over a long period by the government, so prices need to cover little more than the exploitation costs."

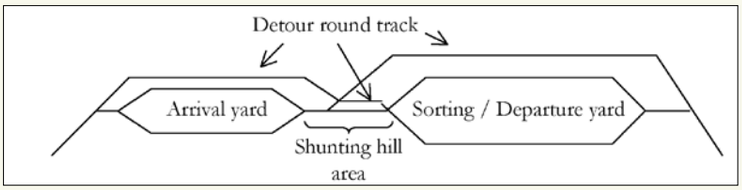
The maximum stopover time at the hub must be considerably less than the current five to six hours. What's more, the total transport time may not exceed the transport time by road. With this to go on, Bontekoning calculated a maximum stopover time of 120 minutes at the transfer station.

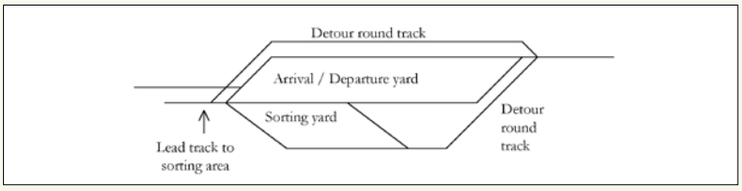
"Those two hours include everything, the transfer itself, delays, waiting times, power cuts, and cranes that are out of order. Given this transfer time and a travelling speed of 80 kilometres an hour, a goods train can travel 800 kilometres during the night, which takes it a fair distance into Germany or France."

Bontekoning did calculations for the four different transfer techniques in a model simulation, arranging them according to transfer time and cost per loading unit. The new generation hub with four to six cranes emerged as the best option.

Synchronous These innovations and calculations are all very well, but which conditions does it take to make the new hub stand any chance? Well, to operate the new hub economically at least nine trains must be processed every day, preferably in three batches of three trains each. That is quite a lot, compared with the current situation in the Netherlands. And it is not the only condition. To rapidly switch containers between trains, the goods trains must arrive exactly on time. The ideal arrival pattern is to have a train come in every five minutes, so all the trains involved in the transfer can be present within five to 25 minutes.

"The actual transfer of goods takes 20 minutes. Of course, for safety reasons trains cannot arrive simultaneously. By keeping the arrival intervals as short as possible, in an ideal case the entire cargo can be redistributed within 44 minutes. The containers of the first train can be pre-sorted on pallets. If everything runs according to plan, the transfer of containers from three mixed trains can be over and done with in an hour. Given ten cranes the transfer can be done within fifteen minutes. The method beats any shunting system hands down since disconnecting the air hoses and changing engines alone takes more than half an hour."





Two different shunting methods are in use in the Netherlands, hump shunting and flat shunting. Hump shunting uses an engine to push wagons onto a hump from which they roll down one by one by gravity alone, to be directed by a set of points onto the right sorting track to form a new train. In flat shunting the engine picks up the wagons singly or in small groups to move them to different sorting tracks. Although this method is very time-consuming, it takes up less space and requires fewer infrastructure facilities.

(Photograph Ronald Tilleman/ www.tilleman.

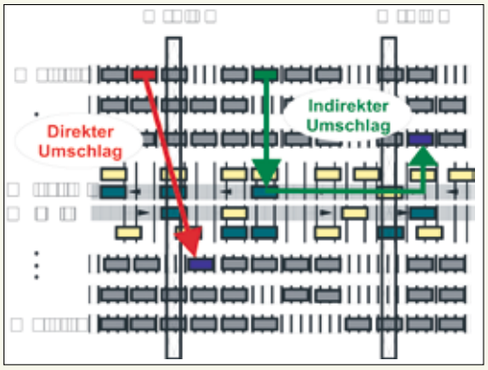
Modern hump sorting yards feature automatic braking systems fitted between the tracks. These calculate exactly how much each wagon must be braked in order to bring it to a timely standstill on the sorting track. This prevents the wagon from crashing into the previous wagon.

(Photograph Ronald Tilleman/ www.tilleman.

Before the train can be pushed up the hump, the air hoses of the braking system that run between the wagons must be disconnected and the couplings unscrewed. At the highest point the coupling is released by an assistant wielding a stick.

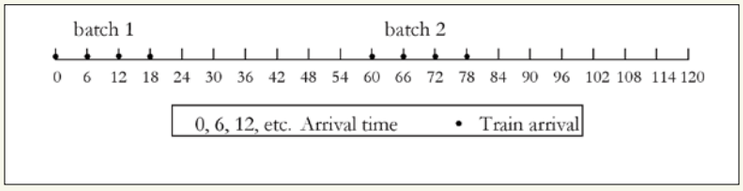
Noell Crane Systems Würzburg, Duitsland
http://www.noellcranesystems.com/

The exchange of containers at the Noell hub is speeded up enormously by a smart system of magnetically controlled wheeled pallets that carry the containers between the relatively sluggish cranes. A pilot plant at Hamburg has already been successfully tested.



Knut Alicke / IFL, Uni-Karlsruhe

Containers can be transferred in either of two ways, directly and indirectly. In direct transfer, a crane is used to pick up a container from one train and load it onto another train, whereas in the indirect system one crane picks up the container and loads it onto a wheeled pallet, from which another crane picks it up to move it onto the receiving train.



Knut Alicke / IFL, Uni-Karlsruhe

Essential for the proper operation of a hub-and-spoke system is the synchronised arrival of trains that form a batch. This means that the trains arrive within only a few minutes of each other. To minimise waiting time, the trains of the next batch must not arrive before the previous batch has been processed.

Unreliable Unfortunately, real life is different. There is a simple reason why the new hub system has not yet been implemented. The reliability of the complete chain will have to be improved first. Far too many trains are still running late. A delay of 30 minutes or more ruins the whole scheme. The delay figures show that in international transport only 70% of goods trains arrive within 30 minutes of the planned time. In addition, 23.5% come in more than an hour late. This is far too much, according to Bontekoning. Nationally the percentage of trains arriving within half an hour is much higher, at 90%, but even that is not enough. An acceptable figure would be 95%.

The lack of reliability was one of the main reasons why a number of hub-and-spoke networks with shunting yards were discontinued. The hub at Metz in France was closed in 2004 after 10 years of service. X-net, the hub at Herne in Germany, folded after only 2 years. Both these hubs were owned by the Intercontainer/Interfrigo company.

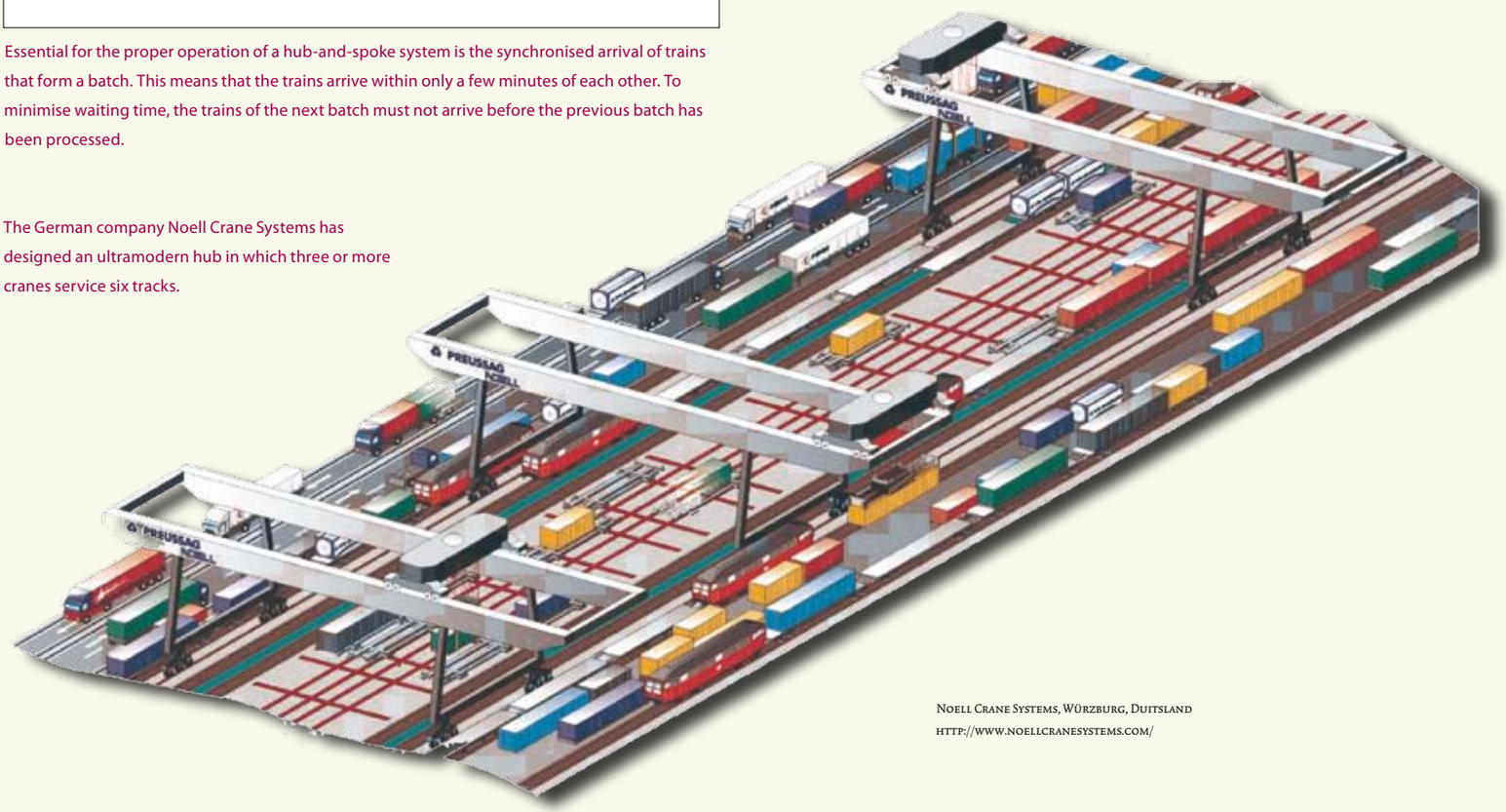
"The closing down of these hubs is in fact at odds with EU policy, which is to promote the transport of goods by rail. The point-to-point model appears to be the trend in the railway industry, and has been since the 1990s.

The conditions that would enable the new generations of hubs to operate economically simply are not being met. There is too little cargo on offer, the network lacks reliability, and synchronous arrival patterns cannot be arranged. So what can be done? According to Bontekoning the best solution would be to expand the existing terminals to make them suitable for rail-to-rail transfer.

"The essential point is to have the support of a transport system. This can take the form of magnetically guided wheeled pallets, or AGVs (Automatic Guided Vehicles), or manually operated lorries, which are highly flexible and fast."

Liberalisation Technically speaking goods transport by rail can play a much larger role than it does at present, but first the planning and organisation side of things will have to be sorted out. This is far from easy with so many interested parties in a transport industry that has just deregulated. Bontekoning: When the networks, traction and train services were all in

The German company Noell Crane Systems has designed an ultramodern hub in which three or more cranes service six tracks.



Noell Crane Systems, Würzburg, Duitsland
http://www.noellcranesystems.com/

one hand. organising goods transport may not have been easy, but so far deregulation hasn't really improved matters. But it is early days yet, and the process is slow and laborious. Existing and potential clients I interviewed said they though the current railway industry culture would be blocking progress for a while yet."

In fact, Bontekoning considers it nothing short of a miracle that any goods trains remain running at all.

"At each border crossing, engines and drivers have to be changed. This is an international regulation. Dutch drivers are not allowed to drive trains on the German railways, and vice versa. All the time, new engines prove unavailable, or a driver fails to turn up. The culture of sluggish government organisations all over Europe is also partly to blame. Their employees cling on to the rights they have acquired over the years. Now they are now being joined by new players who are cheaper, with more flexible employees who quite like having an all-round job."

Liberalisation certainly offers opportunities, according to Bontekoning.

"Liberalisation per se is not a bad thing, certainly not in areas in which the government acts weakly or simply sits back. Rome was not built in a day either. Many problems remain to be solved, and that is what the EU is doing. One thing you do notice is how shipping companies like P&O Nedlloyd are starting to handle the traction part themselves. Purely out of dissatisfaction with the current state of affairs, they are working themselves deeper into the chain. The only thing missing is the urgency to innovate. What the transport industry needs is a market leader to force suppliers into offering performance and innovation by setting strict delivery conditions. Unfortunately, the rail transport industry still lacks a chain director of such stature."

For more information please contact Ir Yvonne Bontekoning, phone +31 (0)15 2786953, e-mail Y. Bontekoning@otb.tudelft.nl, or Ir Ekki Kreutzberger, phone +31 (0)15 278 6992, e-mail E. Kreutzberger@otb.tudelft.nl.

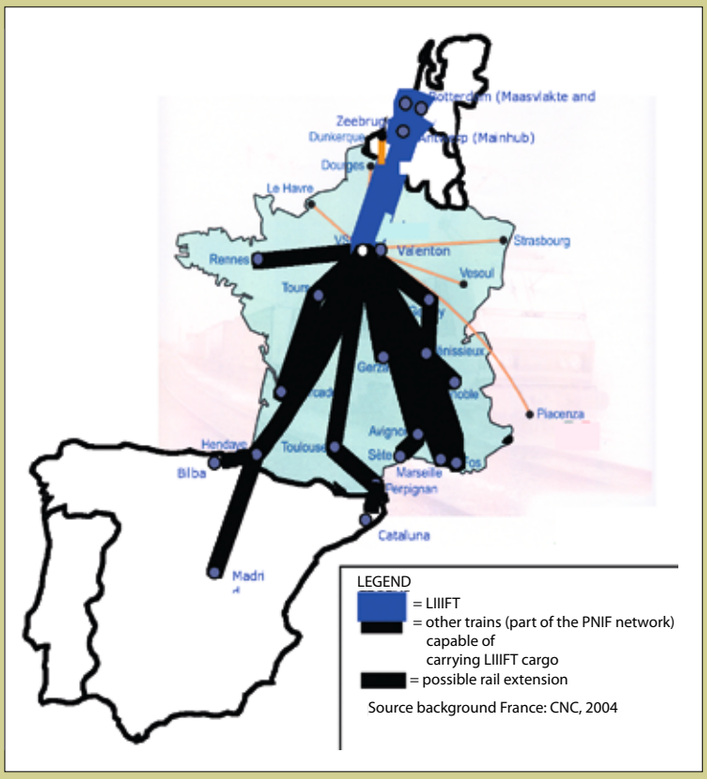
SBB, Zwitserland / www.sbb.ch

Most goods trains run at night, so shunting yards tend to be busy mainly at night, with most of the tracks lying empty during the day.

The time window available to trains for moving from source to destination terminal is called the night jump. Slower transfer techniques mean less distance travelled during the night jump. At an average speed of 80 km/h a train can travel over 800 km during a 12-hour night jump (from 6 p.m. to 6 a.m.), if the transfer can be completed in one hour, which should be possible with the new transfer technology. Given a transfer time of 5 hours (hump shunting), a train will travel less than 600 km.

KombiVerkehr, Ludwighafen, Duitsland

Road/rail terminal at Ludwigshafen, Germany. Existing road/rail terminals would offer the best candidates for the hub transfer technique, provided the cranes are supported by a local transport system. It may not even be necessary to use a robotic wheeled pallet system like the one at the Noell Megahub, or based on AGVs (Automated Guided Vehicles). The existing terminal lorries could be used instead. In this way, investments can remain limited, and the terminal would not be dependent on one type of service network, the hub-and-spoke system.



Cost-cutting by upscaling

Trains stretching over a kilometre

"The concept of running kilometre-long trains is not so strange. Once you start thinking about cost-cutting, upscaling soon becomes an option," says Ir. Ekki Kreutzberger, senior transport & infrastructure researcher at the OTB research institute. This is why a number of European countries have been experimenting with long trains, i.e. about a kilometre long rather than the current length of 500 to 700 metres. In the United States many trains are operated that are several kilometres long.

The use of long goods trains on the Rotterdam-Antwerp-Paris line is the central concept of the LIIIFT (Long, Innovative, Intermodal, Interoperational Freight Trains) project, which is being implemented by a French/Belgian/Dutch consortium. The project partners are Fret-SNCF, B-Cargo, ProRail, ERS, CNC, the Rotterdam Port Authority, OTB, and French technology companies, Martec and Advanten. A major first step in the project is to investigate whether a market exists for trains up to a kilometre in length. You will not find any running in Europe today.

Technically speaking, the LIIIFT concept is feasible. Matters such as traction, stresses and communication between engine and wagons are being looked at in a fresh light. In addition, such legal technicalities as acceptance procedures are being reviewed. Surveys suggest that there is a market for trains at the current length, based on five departures a week. Longer trains might already be viable between Antwerp and Paris. The forecasts indicate that in some scenarios the goods flow will have increased sufficiently in five years to run long trains on the entire route. The reduction in price due to upscaling plays a major role.

"Even so, much depends on the future development of the rest of the rail network. Planning a LIIIFT will determine to a large extent whether enough freight will be forthcoming for the long train," says Kreutzberger. This has become a topic now that the PNIF network, a national hub-and-spoke network in France, has closed down to make way for more direct transport services.

The development adversely affects the potential market of the LIIIFT. Filling the LIIIFT with cargo for French destinations other than Paris, say Lyon or Marseille has now become more difficult. Paris as the only destination of the LIIIFT is not an option yet, so new train services will have to be introduced to replace the PNIF services. This is a serious possibility, and the LIIIFT consortium is currently working on elaborating the concept and preparing a pilot project.