

Swiss Section



Getting shipments to change trains like passengers do

Report by George Raymond

To reduce road congestion and emissions, public policy in Europe seeks to shift freight from lorries to trains. Today, the railway offers three main production concepts: block trains, intermodal/combined transport (CT) and wagonload (WL) service. Each has its place. But none of these concepts address the lorry's main market: shipments of lorry size or less travelling 100 to 300km.

Stefan Karch presented this problem – and a new solution – on 21 June 2019 to a gathering of 16 members and two guests of the IRSE Swiss Section. This report is based on Stefan's talk that day and his May 2018 article in the Schweizer Eisenbahn-Revue. Member Ernst Hedinger organised the event in Olten, the presenter's home city. An independent consultant, Stefan also teaches at Dortmund Technical University in Germany. Midway between Basel, Bern and Zurich, since 2014 Olten has also been the home of SBB Cargo, a separately managed subsidiary of Swiss Federal Railways.

The presentation pointed out rail's current limitations. A block train can profitably carry a 200km shipment only if it fills 10 to 15 wagons. CT and WL are generally unprofitable for shipments of less than 400 to 500km. And neither CT nor WL directly handle single-pallet shipments. This task typically falls to freight forwarders who consolidate their customers' small shipments for transport by a CT or – more rarely nowadays – a WL operator.

To address the heart of the freight market, Stefan stressed, rail must enhance its current concepts – block trains, CT and WL – with a fourth production concept (4PC). Under 4PC, trains will run hourly on fixed routes that criss-cross one or more countries. Trains on each route will make multiple stops at high-performance terminals. At each terminal, automatic cranes and robots will quickly unload and load both swap bodies and individual pallets. Some shipments will then pursue their journeys on connecting trains – much as passengers do today. This will enable 4PC to offer even small shipments a competitive transit time between any two points in its network.

Three production concepts today

Stefan described the three main current production concepts for rail freight:

- **Block trains.** Block trains typically carry bulk goods, auto parts or new automobiles and must comprise at least 10 to 15 wagons to be profitable.
- **Wagonload service.** A railway wagon holds roughly twice as much as a lorry. En-route shunting slows WL compared to point-to-point lorry service. And it can usually offer only one departure per day. (In Switzerland, SBB Cargo now

offers three pickups a day for high-volume customers.) But WL can connect any origin-to-destination pair on the rail network.

- **Combined transport.** Intermodal CT trains usually shuttle between two terminals. (More rarely, CT involves swaps of wagon blocks or transloading of loading units between trains at intermediate terminals, but this hurts terminal productivity.) Most CT terminals are stub stations for the start or end of a CT train run, not through stations that simplify intermediate stops. This limits the number of origin-to-destination pairs CT can serve. And only hauls exceeding 500km are generally profitable.

CT is the growth segment for rail freight. It has been replacing WL as rail's core offering. A consensus in Germany is that all the freight that could migrate from WL onto CT already has. WL has been increasingly seen as a niche for dangerous, heavy or oversize goods that cannot use CT because it collects and delivers shipments by road.

Rail decline and stabilisation, and current modal split

After 1950, the spread of motorways in Europe helped progressively shift freight from rail to road. The end of the Cold War and the liberalisation of transport furthered this process. Rail reforms in the 1990s brought taxes on lorries and new train operating companies in the 2000s.

Since 2008, rail freight's market share in Germany has stagnated at about 19%. The table below shows rail freight's 2018 share of tonne-km in all modes (source: Eurostat).

Austria	France	Germany	Switzerland
32%	10%	20%	35%

Differences among countries are even starker in the Alps. Here is the rail and road traffic in millions of net tonnes on trans-Alpine corridors in 2017 (source: Litra).

	Austria	France	Switzerland
Rail	24.1	3.4	27.2
Road	53.1	40.7	11.7
Trans-Alpine rail freight market share	31%	8%	70%

Railway path prices have tended to exceed lorry taxes and tolls. This has been a drag on rail's market share. But the presenter saw another problem. Rail's three current production concepts have abandoned the freight market's biggest segment to lorries:

- Most shipments travel less than 500km, and the lorry has a firm grip on them. This leaves little room for increasing rail's share in this segment.
- Current rail production concepts fail to address the large number of small shipments (from roughly 100kg to 10 tonnes) that ride lorries.
- The infrequent departures of both CT and WL lengthen transit times compared to lorries, as do WL's multiple en-route shunting steps.

Two key results:

- The average lorry shipment is 10 tonnes travelling 150km, whereas the average rail shipment, excluding block trains, is 60 tonnes travelling over 300km.
- Whereas hauls of 1000km or more are often already on the train, hauls of 500km or less are what fill the highways.

To address the main market served by lorries, therefore, rail freight needs to better emulate lorry service by offering lorry-like transit times for small, short-distance shipments. In other words, rail freight needs a way to profitably handle shipments that fill a swap body – or less – and travel 150 to 400km.

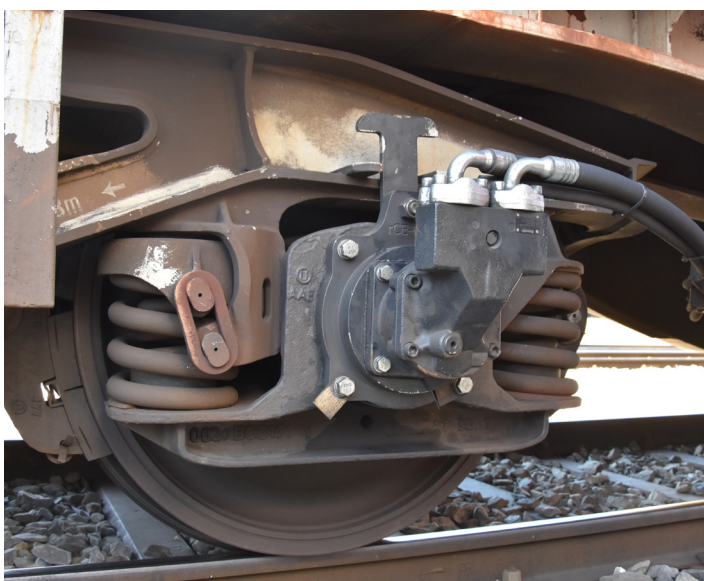
Swiss rail services for small, short-haul shipments

Some such rail services already run today in Switzerland. As part of its ongoing efforts to protect its population and the environment, Switzerland has long banned lorries from driving at night. This ban has spawned overnight domestic rail services. They operate in the 100-to-200-km range generally considered unprofitable for CT and WL. On the Swiss Post's network, for example, swap bodies sometimes ride three different wagons in one night. Another such service is RailCare, a unit of the Swiss supermarket chain Coop. Its shortest run is the 60km between Aclens and Carouge terminal in Geneva. To speed handling, RailCare developed technology that slides a swap body directly between its wagon and its local truck.

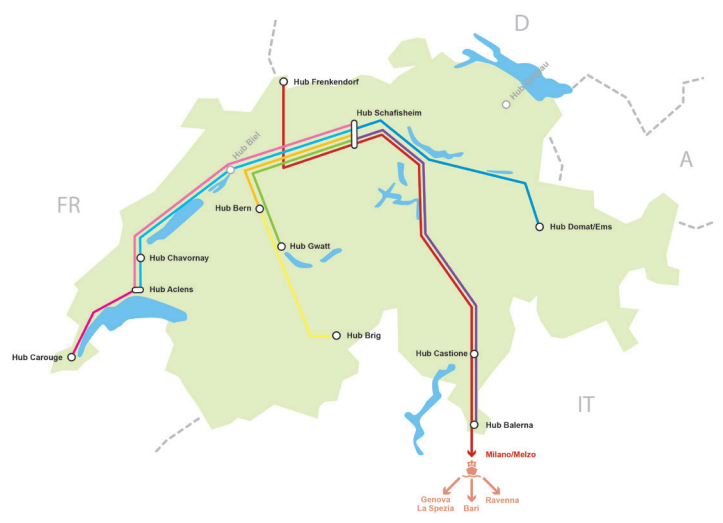
With some exceptions, railways abandoned less-than-wagonload (LWL) services in the 1980s and 1990s because of the high cost of manual sorting. Faced with the night-driving ban, however, some Swiss operators transport LWL shipments in roofed wagons between terminals overnight. Wagons may undergo intermediate shunting. Trucks collect and deliver these shipments, which can be as small as a pallet.



The custom-designed trucks, swap bodies and wagons of the RailCare unit of Swiss supermarket chain Coop enable horizontal loading. Geneva-Carouge, 26 October 2018. Photo George Raymond.



Axle generator for en-route cooling of the groceries in a RailCare swap body. Aclens, Switzerland, 25 October 2018. Photo George Raymond.



RailCare's current Swiss network. RailCare.



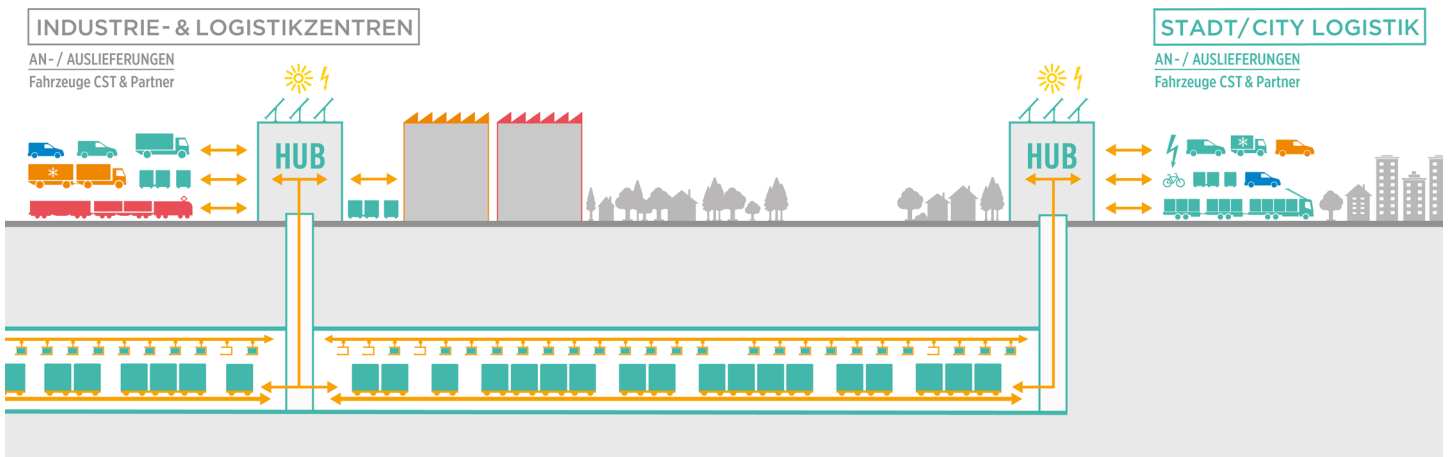
Less-than-wagonload freight in Würzburg, Germany, on 26 May 1978.
Photo Adolf Wagner.



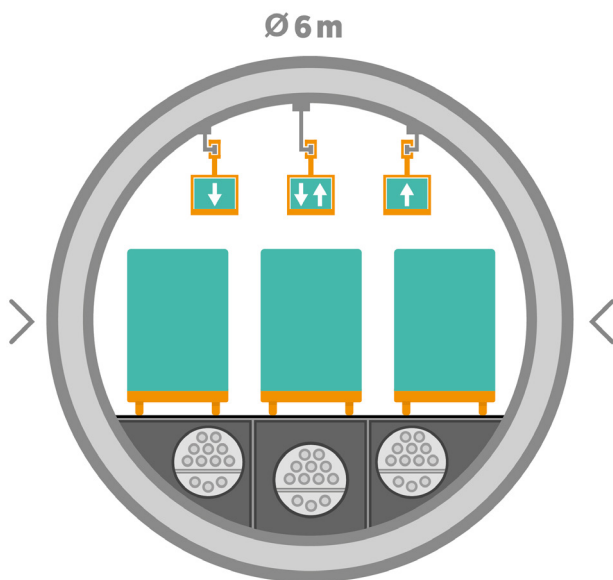
Above, A train of Swiss operator Cargo Domizil readies in Bern for its night run shortly before 18:00 on 1 March 2018.

Left, Outside, the local trucks that brought the small shipments.

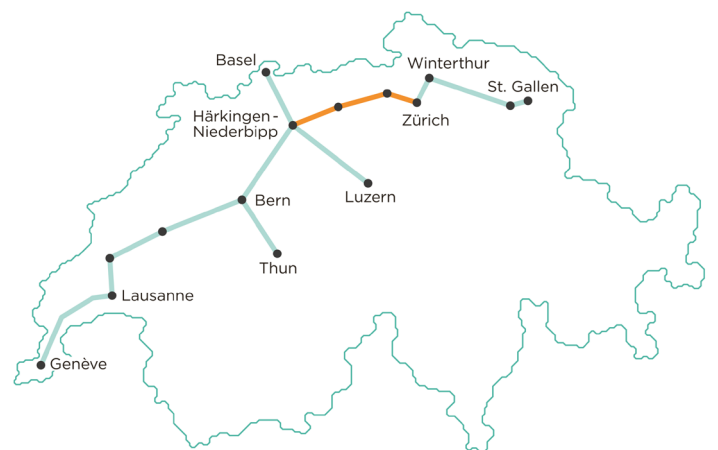
Photos Stefan Karch.



Concept of Cargo Sous Terrain for continuous movement of pallets and mini-containers between major Swiss urban areas. CST.



Cross section of Cargo Sous Terrain tunnel for pallet-sized shipments and mini-containers. CST.



Initial (by the early 2030s) and ultimate Cargo Sous Terrain network. CST.

Fast movement of small shipments is also the *raison d'être* of Switzerland's Cargo Sous Terrain (CST) project, which is advancing towards realisation. It foresees a network of intercity tunnels whose conveyors will continuously forward mini-containers and pallets between logistics centres in and near Swiss cities. However, that the division of labour between CST and the railway and their integration are still unclear.

Passenger-train service as a model

The current production concepts for rail freight – block trains, CT and WL – generally leave a shipment on the same wagon throughout its rail journey. In contrast, much of the European rail passenger service is based on trains shuttling on fixed routes and stopping at intermediate stations where passengers can change trains. These trains often run on (more or less) fixed-interval timetables every 30 or 60 minutes. By allowing mid-trip transfers between trains, such networks get passengers to their destination faster than could less frequent but direct trains connecting a greater number of stations.

4PC: Trains with fixed routes and consists

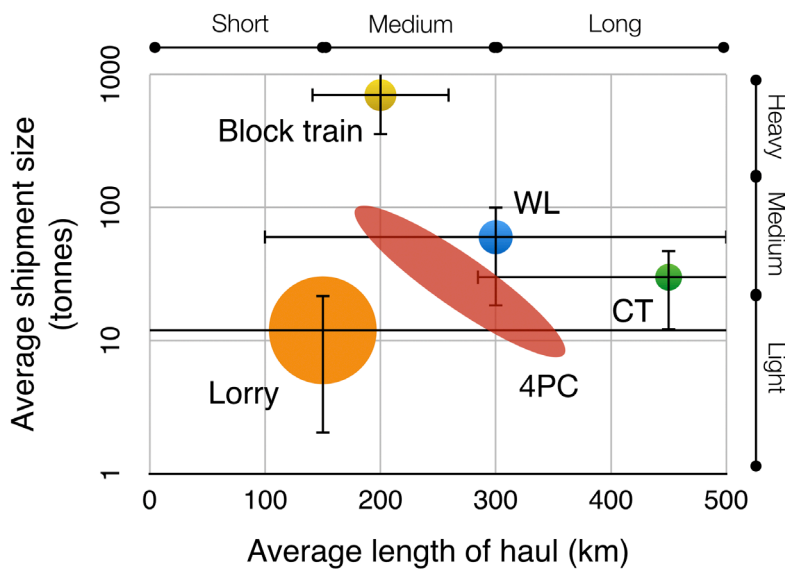
Organising rail freight like passenger service would improve both its profitability and market attractiveness for small, short-haul shipments. This is the objective of Stefan's fourth production concept. Under 4PC, shipments take and change between trains running with fixed routes and consists.

In recent decades, improvements in locomotives, wagons and infrastructure have been boosting train length, axle loads, total weight and speeds. But adoption of innovations like automatic couplers, remote brake checks and electro-pneumatic braking is slow. In the meantime, robotics, digitalisation and automation have forged ahead in other sectors.

In 4PC, fixed train consists eliminate any need for automatic couplers or for brake checks after adding or dropping wagons. Here, too, 4PC emulates rail passenger service, which has nearly eliminated mid-journey coach shunting. Like passenger trains, fixed-consist 4PC trains could cost-effectively be equipped with electro-pneumatic brakes. This would allow for a top speed of 120km/h and a start-to-stop average speed between terminals of 80-90km/h.

	Rail freight production concepts				
	Road transport	Block train	Wagonload service	Combined transport (intermodal)	Fourth production concept (4PC)
Smallest profitable shipment weight (tonnes)	0.1	300	20	10	0.1
Smallest profitable shipment (pallets)	1	400	30	15	1
Available origin-destination pairs	Any	Any rail-served	Any rail-served	Between CT terminals	Between 4PC terminals
Mean distance between terminal and customer loading point (km)	0	0	0	50	30
System speed (km/h)	50	70	15-25	70	60
Service frequency (hours between trains)	Customer decides	Customer decides	8-24	12-24	1-4

Table 1 – Comparison of road transport and the four rail freight production concepts.



Zones of relevance in terms of shipment size and length of haul of the lorry, the block train, wagonload, combined transport and the fourth production concept (4PC).
Stefan Karch.

A track will receive and process up to three trains an hour. Trains will traverse loading tracks without reversing.

True to 4PC’s credo, shipments will not spend much longer in stations than passengers do. With hourly train service and fast handling, shipments will wait an average of 45 minutes between trains. Terminals will need only limited space for shipments waiting for connections.

Loading of swap bodies will be either vertical or – following further development of technology like RailCare’s – horizontal. Horizontal loading would allow catenary to remain over the terminal track. If loading is vertical, terminal tracks will be devoid of catenary and trains will coast into the terminal. For fast horizontal loading of pallets, wagons will be able to open their doors wide. A roof will cover the terminal for all-weather operation.

4PC will also benefit from automated loading of the trucks that will transport shipments up to 30km to their final destinations by road. These vehicles can be electric and recharge during their frequent stops.

The production concepts compared

Table 1 and the above diagram compare road transport and the four production concepts.

Implementation

Train and terminal operators would organise the 4PC system; a 4PC operator might coordinate. The next steps are: a feasibility study, market analysis, risk analysis, the organisation of actors and their interfaces, a business plan and an implementation and migration plan.

Outlook

Stefan concluded that rail freight can rival lorry performance if, in the context of 4PC, the rail freight sector:

- Adopts passenger service as a model.
- Runs fixed-interval trains averaging 80-90km/h between high-performance terminals where shipments can quickly transfer between trains.
- Handles both swap bodies and single pallets.
- Offers a system speed of 50-60km/h between a shipment’s origin and destination terminals.

The freight market is dominated by shipments as small as a pallet travelling as little as 200km. By offering such shipments service comparable to the lorry’s, 4PC can improve rail freight’s modal share, cut road congestion and make freight transport greener.