TramForward

Tram forward endorses the recent consultation of Network Rail Tram-Train systems link urban tramway infrastructure with the regional heavy rail network around cities. After the first generation of those systems in Germany (Karlsruhe and Saarbruecken) new systems have evolved now.

From the mid-nineties There has been a real boom period regarding TramTrain feasibility studies. Many cities and regions with a regional railway network, with or without an urban tramway and of similar size as Karlsruhe have been asking if the concept is transferable to their situation. Most of these projects have not proceeded or at least been heavily delayed and not given high priority. The reasons differ, but we question whether asking the right basic questions early enough would have avoided big studies which went straight into the archives.

Despite the flexible and context sensitive nature of TramTrain our aim is to identify at least some generic TramTrain characteristics, since we feel that a clear view of these will enable promoters to recognise a new set of (potential) applications or to revise earlier schemes which may have been reviewed before under narrower conditions.

The EC-project CROSSRAIL was an attempt to deliver a standardised or at least harmonised approach to TramTrain, but concentrated heavily on rolling stock issues and specifications. The current LIBERTIN thematic network goes into a similar direction, but is covering light rail in general.

We need an approach which is more focused both on urban context and the economic viability of projects. Technical issues do not need to become obsolete for decision making (especially as technical issues influence costs!). However, technical feasibility is not enough.

While in the early days of TramTrain one spoke of the "Karlsruhe model", "track sharing" or "joint running" it is necessary today to distinct between different groups.

Classic light-rail/tramway operation
- Conversion
- Single-Mode Track-sharing

TramTrain-operation
- Dual-Mode Electric/Electric
- Dual-Mode Diesel/Electric

TrainTram-operation
- Existing tramway network
- No existing tramway network

Conversion projects are schemes, which make use of former railway infrastructure converted for light rail for a considerable part of the network. There is no mix between tramway and railway operation. Infrastructure is taken over usually, so no track access charges apply. Single mode (electrification 600/750V) track sharing schemes also involve the use of railway infrastructure, but in track-sharing mode with freight trains or other non-electric trains (thus the railway is still used by other railway traffic). This is how Karlsruhe started with the Albtalbahn. In most cases infrastructure is also owned by the light rail operator and track access charges do not apply.

TramTrain-operation involves both track-sharing light rail/heavy rail and dual- or multi-mode operation (Heavy rail voltage / Light rail voltage). The track-sharing sections may also include main line heavy rail infrastructure. Usually infrastructure (tracks and stations) is owned by the railway infrastructure owners (DB Netz, RFF, Prorail, Network Rail etc.) and track access and station use charges apply for the light rail operator.

TrainTram-operation is reversing the tram-train idea; direct access from the region to city centres is not achieved by bringing the tramway out onto the railway, but by bringing heavy rail vehicles onto the urban tramway or onto a tramway-like alignment. The heavy rail vehicles being used under urban conditions follow tramway regulations. Usually TrainTram will not involve a through-running of railway vehicles from one end of a city to the other, but access the city centre from one side only.

Karlsruhe: Success, Failure and Weaknesses

The name "Karlsruhe" all around the world is used as a synonym for success. However, the scheme demonstrates a number of features which are difficult to sell elsewhere!

The Karlsruhe compromise of running high- and medium floor light rail vehicles through an urban "low-floor" network has to be seen as a killer argument for TramTrain in France and likely in all other countries, where the full accessibility of public transport is an absolute requirement. Therefore level access for TramTrain in all sections of a planned network is of high importance.

Karlsruhe is certainly a good example of a railway (main) station at a distance to the city centre where through-running TramTrains result in a considerable gain in attractiveness. With a regional scheme however, involving several TramTrain-lines operating through the city centre, often in coupled units and with relatively heavy rolling stock, Karlsruhe is virtually witnessing the "return of the railway station" into the city centre after having moved it before WWI to the southern edge. At the moment it is planned to solve this new problem by an underground section of the network which would also mean taking out the "normal" surface trams from the pedestrian zone.

Nevertheless Karlsruhe's passenger number increases have proven the usefulness of through running in the case of medium-sized cities owning a remote railway (main) station or the benefits of a centrally located railway station.

- Kassel: shows specific features on the Baunatal and Helsa single mode track sharing lines to deal with the interface problem of light rail vehicles only 2.3m wide. The real TramTrain (RegioTram) scheme involves both electric/electric and diesel/electric (diesel tram) features. However TramTrain is currently not planned to penetrate the pedestrian zone where nearly all other tramway lines pass.
- Ile-de-France: first project using TramTrain for tangential transport tasks did contain Aulnay-Bondy, which is a conversion project as TrainTram operation.
- Mulhouse: the first example of the "original" Karlsruhe-model in France. Although the mixing of heavy rail passenger trains and TramTrains is limited (peak hours), the whole railway route to Kruth is electrified with 25kV (dual mode operation) and freight operation also stays.
- RijnGouwelijn: test operation on a section of heavy rail only (Gouda-Alphen); through running in the city of Leiden is planned.

- RandstadRail: this new system has been disconnected from the national railways. Dual mode vehicles are the last TramTrain trace.
- Chemnitz: has built one line, but has more gone forward with light rail conversion and improved DMU operation than classic TramTrain. The future of real TramTrain operation on other lines is still under discussion, but full accessibility is a big issue...
- Geneva: uses light rail rolling stock in a purely segregated heavy-rail or metro like operation (RER).
- Aachen: original scheme became a TrainTram scheme and has been developed successfully.
- Rostock: took up the TramTrain case again 10 years after the first study could not come to a recommendation (see 2nd generation).

- Glasgow: missed the "window of opportunity" associated with ScotRail rolling stock replacement. Less ambitious options for single routes are likely to be reviewed again.

Institutional Context

TramTrain projects are complicated and therefore they need a strong and high quality regulation. Almost all of these projects cover regional corridors, so some regional government or body, or at least a sustainable form of regional co-operation and tough political support is an absolute necessity for success.

- Powerful regional and local government
- Existing regional and local support

Planning processes associated with creating transport infrastructure are complicated without exception, for TramTrain even more. For this reason success is almost synonymous with a streamlined planning process. Moreover, justification of many TramTrain proposals is strongly interconnected with considerations of urban planning and land use. Therefore integration of urban planning generally and land-use particularly is highly recommendable.

- Approach to planning process
- Degree of integration of land use and urban planning
- Step by step implementation
- Complementary to existing/adapted public transport network
- Quality and capability of public transport authority, both formally and functionally, to integrate responsibility for the entire network
- Distribution of responsibilities

Generally construction and operation of public transport infrastructure are financed from various sources. The money needed to build and operate TramTrain infrastructure should be balanced as much as possible on the local and regional level, as this type of public transport is important locally and regionally. In this respect local and regional funding sources are of great importance and state government contributions should not be decisive.

- Methods to cover construction and operating costs
- Local/regional financial balance and sources

TramTrain utilisation presupposes the use of heavy rail infrastructure. The responsibilities for railways are usually under national authority as legal powers are. In many countries the National Railways are very powerful. Therefore success of a TramTrain project is highly dependent on the degree in which national legal and functional competences are used efficiently for local and regional purposes or delegated to local/regional agencies.
TramTrain projects become more transparent and easy-going when heavy railway infrastructure is used which is under the control or even better owned by the local/regional authority. Another option is a private control and ownership of the railway. Germany for instance has an ongoing private railway tradition.

- Necessary legal powers
- Control/ownership of heavy rail infrastructure
- Local and regional possibilities

TramTrain use implies more than average safety problems, as trams mix -to some degree- with heavy trains. Addressing this problem requires technical solutions as well as an adequate safety approach of regulatory bodies. Too formal/heavy approaches tend to jeopardise TramTrain projects. Current safety standards are grounded on bases of general rules, pragmatic and qualitative like in Germany, or on the contrary, on cases, containing severe quantitative risk assessments, as in the UK, France and The Netherlands.

- Safety approach of regulatory bodies

Urban and Regional Characteristics

Historically the selection of sites for the new railway main station was quite problematic in many cases in the late 19th century. Due to this historical fact (or later re-locations) many main stations are in a remote position from the actual city centre. The distance varies from city to city. Basic argumentation for introducing TramTrain is bridging the gap between main station and city centre. To make this worthwhile the distance involved should be at least around 1000 metres, or a walking distance of circa 10-15 minutes.

- Distance main station to city centre (km.; walking min.)
- Other relevant distances (km.; walking min.)

Within the urban area a TramTrain-corridor is needed, between main station and actual centre (and possibly in other areas). Is such a corridor available? Other questions are related to several qualities of the available corridor(s), regarding size, use, aesthetics, etc. The dimensions of the corridor should allow fitting in a tramway, with regard to all technical parameters. Conflicting use, tramway versus other functions, could mean a real threat. A trade off between existing use or renewed/new use should be possible, some way or another. All kinds of uses are at stake, like the use of the corridor by other traffic, including pedestrians. But also use related to generic urban functions like living and working. The use of amenities within the corridor is particularly relevant. TramTrain could jeopardise, or on the contrary, boost the use of shops and other urban facilities.

- Availability, profile and aesthetics of centre corridor
- (New) uses of corridor
- Possible (positive and negative) impacts

Many city centres are of historic nature. They serve as a source of true cultural heritage. TramTrain within such a historic context meets both limitations and opportunities. For example, the existence of a historic townscape could restrict the use of overhead power supply. However the tracks of a tramway offer opportunities to keep historic street surfaces intact (unlike buses, trams don't need an overall flat surface).

- Conditions historic townscape

The city centre layout of economic activity nodes (offices, centres of retail, educational establishments, etc.) determines the usefulness of TramTrain. If these nodes are located near, or even on top of the main station, a TramTrain through service could be difficult to justify. However, a common characteristic of many cities is the remote situation of many important economic activity nodes in relation to the site of the main station. If the nodes at a distance from the station have a strong regional social-economic relevance TramTrain is more justified. Nodes outside the city centre, in the urban conurbation or in the region itself can add value.

- Centre locations of economic activity nodes and their regional meaning
- Economic activity nodes inside or outside TramTrain's catchment area

The importance of the city as a regional centre is of great importance for TramTrain. A regional through service is justified at best in case of a classic region-centred city, that is, a strong city among a hinterland which is connected to this city both economically and socially.

If regional centres and nodes are spread over the region as a whole, TramTrain becomes less favourable or may be reduced to tangential function.

- Regional meaning of central city
- Degree of regional centre's spread

Urban and Regional Figures

Generally TramTrain use requires a minimum population size of city and region. But the maximum is also relevant, since TramTrain is generally not suitable for heavy metropolitan uses. Minimum and maximum figures should also be taken into account while considering the potential transport corridor or the proposed catchment area.

- Minimum and maximum sizes of city and region
- Size of corridor's catchment area

The demands of many TramTrain services are highly dependent on potential passenger flows due to various types of destinations, including the spatial spread of these types generally and their centre-locations particularly. Relevant types of destinations are work (offices mainly), school/university, shopping, and leisure. TramTrain success heavily depends on strong flows into the city centre - additional sub-urban poles of activity passed on the way increase success.

- Identification of the share of city/city-centre oriented flows for all user groups

Public Transport Characteristics

TramTrain/TrainTram in principle is a tool to avoid interchanges on a passenger's way towards the city. This means that there is no or very little place for such a scheme in a city which already has a high quality rail scheme linking into the city centre, e.g. by a S-Bahn/RER type system coming from the region and running underground in the city.

- Competing rail modes into the city-centre
- Other targets then the city-centre
- Share of the total rail-bound operation in a region for TramTrain
- Complete take over of operation versus remaining heavy rail passenger services

Under favourable conditions the linking of an urban and regional infrastructure is very easy (and cheap!) and opens access to a large regional network which allows a transfer of operation to TramTrain. The opposite scenario would be to face high investments to create such infrastructure but gaining little access.

- Ratio of new-built infrastructure compared to accessible regional network

Some agglomerations may have a need for TramTrain but not with regard to city centre access. Here a tangential link of regional or sub-urban centres may help reducing flows on radial commuter routes into the centre and also take interchange pressure from certain central hub stations.

- Tangential transport demand
- Street-running extensions in sub-urban centres useful/feasible
- Additional catchment by using existing tangential infrastructure

Existing interchange quality between urban and regional rail services is another issue. The more difficult interchanging is at a main station the more passengers would be attracted by direct services or easier interchanges at a tram style stop.

- Existing/achievable interchange quality between railway and urban system

In some cases historic tramway routes from the suburbs need a lot of time to the city centre and to introduce priority/segregation is difficult. This may cause long travel times for a TramTrain service from such a sub-urban link to the city centre. If those conditions meet however with a centrally located railway station then it might be an option to introduce "fast trams" who use the faster railway sections to the main station from some point.

- Comparison of travel times

Technical Issues

Experience has shown that nearly all technical issues of a TramTrain scheme can be solved; however there are more favourable (easier) conditions and more complicated (difficult) ones. The non-existence of an urban infrastructure is not automatically a disadvantage as it gives more planning freedom and eases full accessibility solutions.

- Existing tramway's technical parameters
- Metro operation (tunnel)
- Easy versus difficult (cheap versus expensive) linking of tramway and railway

Regarding the railway infrastructure it is important to distinguish between electrified or non-electrified infrastructure being accessed and the ratio between those in order to go for an all electric or diesel-electric vehicle solution or a mix of both (example Kassel). Certain types of urban heavy rail infrastructure may tend towards TrainTram-solutions.

- Electrified/non-electrified regional railway infrastructure
- Track-sharing versus conversion
- Existing (urban) freight railway infrastructure

To achieve full accessibility also for a TramTrain-scheme as well as for any other light rail project is a real pre-requisite to allow success of this type of rail operation in the future. Compromises as in Karlsruhe are already or will be unthinkable in the future.

- Platform heights of (regional) railway routes
- Full accessibility

4.7 Costs and Cost Comparisons

The assessment of options or the contents of cost-benefit-assessments are handled differently. Comparisons of different options are not enforced in Germany - normally it is enough to show a positive benefit-cost-ratio of the politically preferred option. Such comparisons are however important or even obligatory elsewhere.

A comparison of costs and benefits between TramTrain and other modes, some of which may need to draw upon interchanges to a larger scale, is necessary especially for more regional parts of a TramTrain-network at the borderline to "normal" heavy rail operation. TramTrain costs/km should not only be compared with the more expensive alternatives as new tramways or even metros, but also with alternatives as DMU (EMU) operation. If it can be proven that the latter show a cost-benefit ratio worse then TramTrain, the economical viability of a TT-project is definitely increasing. The ratio alone is not deciding, as 100 divided by 50 is the same as 10 divided by 5, which means that politics have to decide in such a case whether they want more benefit for more costs, or less benefit for less costs. Even more critical this decision will become when a comparison might come out with one option having 80% of the benefits of the other, but only 50% of the costs.

- Comparison of modes
- Political decision vs. evaluation
- "Tenderability" of TramTrain-scheme

Rolling stock design is another feature and one has to find the right ratio between a conservative "reliability" and a progressive "design is everything" policy. Despite all the technical extra requirements of a TramTrain-vehicle - it will not be acceptable to run an "ugly duckling" alongside attractive "normal" trams. This is definitely one of the problems that has arisen in France, where most schemes have been developed from scratch in a very high design quality context, which one did not want to diminish for a later TramTrain-scheme.

The dimensions of TramTrain rolling stock are also a less obvious design feature, as many (old and new) tramway schemes present limited options for platform lengths and/or vehicle width. On the other hand a TramTrain-scheme will depend in most cases with regard to the economic issues on the complete replacement of existing train services which means that a high capacity is needed which requires longer and wider vehicles and also coupled units. This is definitely a contradiction in many cases.

If the share of total rail-bound traffic which TramTrain might achieve in a region is very low such a complex solution may not be worthwhile (however, TrainTram could be an alternative in some cases).

Another lesson is to avoid a "one scheme with one mode and one vehicle" policy. As Kassel is now showing, it is feasible to operate both all-electric TramTrains and diesel trams together and to use them as the existing network requires it. This takes also a lot of financial pressure away from rural, non-electrified railway routes without reducing attractiveness. A number of early TramTrain studies had already proved the need for such technology. The Chemnitz Citybahn shows an intelligent symbiosis of electric light rail and diesel heavy rail operation within one operating company. Flexibility is recommended!

One cannot assume that using two existing infrastructures result in a cheap combination of the two automatically. Main cost factors are possibly regional electrification, safety and detection installations, physical links of railway and tramway infrastructure, or even creating the tramway infrastructure from scratch and the necessary adaptations of the existing networks (which can turn out to become a city centre tunnel as in Karlsruhe).

Second generation projects as Kassel, Nordhausen, Chemnitz or Zwickau have brought serious innovation to TramTrain by adapting and widening of the original Karlsruhe idea. This will give scope for further studies or a review of older approaches. To find an ideal TramTrain city has at least become easier.

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