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Infrastructure Projects enjoy a very high priority in all South East Asian countries. Public transport is trendy and new railway lines are built everywhere, but what are the driving parameters to plan such a new railway line?

In this article we are looking into new regional, national, or international lines, usually with mixed service, i.e. express and commuter services, plus freight trains all sharing the line. A new line will have to cater for all the types of services and planning it has to take into account all the different requirements, which includes the different speeds of the services.

A key role in planning such a line is the timetable proposal, a strategic timetable concept. Only this type of concept can show the facts and figures about the transport capacity and the services provided on the railway line, or the network being planned.

Planning can be done with different focuses.

- With capacity in mind
- With a service concept in mind

In common to all types of planning approaches is, that the line will be planned based on a foreseen traffic demand (number of passengers and/or tons of freight). The demand figures are usually provided by economic planning units in the relevant country. Forecast data is usually available for up to 30 years into the future. Simply dividing the passengers, or freight load by the maximum load capacity of the respective trains, gives us the minimal number of trains. Unfortunately, this does not take into account that, for example, more passengers want to travel during rush hours (Capacity in mind), but while rush hour trains will be full, off peak trains will have much fewer passengers (Service in mind).

Planning a Network or planning a line.

When planning a rail network consisting of several lines, not only the lines on their own, but also the connection Hubs (or Nodes) have to be taken into account. If trains arrive at a specific time, their timeslot in the next line has to be appropriately matched.

Capacity Based line planning

When planning a line only according to the capacity required, the timetable concept would plan trains in a way that makes

maximum use of the line. The infrastructure would then have to be planned accordingly (e.g. overtaking loops, stations tracks). When looking into the operation of a whole network, it is particularly important to look at the hubs, where trains leave one line and continue on another. Planning a line "stand alone" would give longer waiting times at the hub and greatly reduce the interchanging comfort for passengers changing from one train to another.

UIC Codex 406 provides a standard approach to calculate the theoretical capacity of a line. This is done by shifting the train paths in the timetable closer together until they reach a theoretical maximum for the trains possible on a line. However, it has to be noted, that by doing so, train timing arrangements will focus purely on the capacity, so train service and train connections will no longer be taken into consideration.

Important Service Concepts

Capacity is not the only criteria to consider when planning a line. A good service concept makes it easier to attract potential customers to use the train. Looking at the example of Switzerland, the following three aspects are the key points considered:

- **Regular and frequent Trains**

Mobility requirements and expectations have changed. Passengers expect regular and frequent trains.

- **Clock Phased Timetable**

In a clock phased timetable trains always leave at the same time of the hour. Passengers don't need to consult a timetable to know when their next train is available. Services may be hourly, half hourly or quarter hourly, but always on the same minute of the hour, throughout the whole day. A Clock Phased Timetable provides equal service through the whole day. Trains in peak hours might be overcrowded and trains in off peak hours could be partially empty. This leads to a higher requirement in the number of trains.

- **Hub Concept**

In a railway network that consists of a mesh of railway lines, a good hub concept is important. Passengers will need to interchange from one train to another. A timetable with a good hub concept ensures that the trains stop at interchange hubs in

a way that means; passengers don't have to wait long and if possible, connecting trains are located on neighboring platforms.

Combining a Hub Concept with a Clock Phased Timetable brings additional requirements. For example, a train leaves one hub at its assigned time, in a clock phased way, let's say on the hour, but when it arrives at the next hub, the arrival time has to match the assigned time of that particular hub, possibly on the hour as well. This means that the running time between the hubs has to be adjusted accordingly.

Planning with a Service Concept in mind

Planning a timetable with a service concept in mind will add many requirements, which need to be taken into account. Just to list some:

- Required service headway
- Maximum travel time
- Mixed service (passenger and freight)
- Different services have different speeds
- Trains need to start and arrive in the hubs at specific times.
- Adequate number of platforms to allow passenger interchange
- Political requirements

With this approach train times can no longer be freely shifted to achieve better usage of the line. The number of trains on the line may be considerably lower than in a pure capacity-based approach. Some lower priority trains might have much longer waiting times in the network hub, as their entry time into a different section of the network is dictated by the services on the next section.

Very often local politics require a specific level of service (e.g. minimum number of trains during a day, or even by hour). This brings additional service requirements, which are in addition to the capacity based, minimum service requirements.

If the exact running time becomes a parameter for the service concept (Hub and Clock Phase), the infrastructure has to cater for this. Converting an existing line to allow for a given running time usually requires line improvements, speed increases, or even additional tracks, flyovers or tunnels. On the rolling stock side, additional or different train-sets might be required.

Capacity v Service

Comparing a capacity focussed timetable and a service focussed timetable shows the following:

Planning with Capacity in mind:

- Higher number of trains

- Trains are fully loaded (passenger and freight)
- Longer interconnection times at hubs

Planning with Service in mind:

- Higher customer friendliness
- Non optimal usage of the line
- Non optimal usage of rolling stock

Different Stages of Timetable planning

Planning for a new railway line falls into the area of "Strategic Planning". Strategic timetables and their computer based simulation are usually done with a macroscopic or mesoscopic granularity of data (fewer details). The fact that not much input data is required for this type of planning, should make the decision to choose a strategic timetable concept for the new line easier, but planning the timetable, service, infrastructure and rolling stock always go hand in hand. Making changes in one of these areas usually requires changes in the others.

In planning teams (e.g. feasibility study) a constant interaction between the planners of the different disciplines is required. Considering that it takes a long time for the construction of a new line and/or the procurement of new rolling stock, it is clear that strategic planning has to be done up to 20 years in advance. If new tunnels are part of the project, then this planning period might be even longer.

A good summary on "how a timetable is born" was published by Swiss Federal Railways and can be downloaded under https://stories.sbb.ch/en/wp-content/uploads/2014/11/A2_Plakat_Fahrplan_Infrastruktur_e_Web.pdf

Conclusion

When planning a single line, or a line in a mashed railway network, different aspects need to be taken into account. The complexity of planning a timetable in a mashed network is considerably higher and Timetable, Service, Infrastructure and Rolling Stock always go hand in hand. Good planning should allow the railway operator to move forward from "what service can I give with what I have" to "what do I need to do to be able provide the service I want to provide".

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