# On objective weights for additional train timetabling

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## 1 Introduction

Scheduling additional trains is an essential task of railway systems. Under the pressure of increasing demand for railway networks, academia has worked in recent decades on the modeling and solving of this task. To be truthful to reality, models must consider the involved stakeholders and account for technical conditions. Satisfying these different interests leads to several objectives. However, extensive studies on objective relations are lacking in the literature, especially for more than four objectives, while practitioners need to deal with larger numbers. As a first step to fill this gap, we study the correlation between pairs of eight objectives of the Swiss Federal Railways.

## 2 Method

We considered the following eight objectives: conflicting time and separation between two objects using the same resource, time supplement, blooming ride deferred to the end, path scores, runtime, operational stops, and earliness to allow reproducibility. We used the SBB microscopic timetabling tool to schedule additional trains.

## 3 Experimental analysis

Over a hundred instances were generated from 18 two-hour time windows over a day in each direction for three corridors: Thalwil - Sargans (TW-SA), Vevey-Visp (VV-VI), Olten Hammer - Neuchâtel (OLH-NE). Figure 1 shows the space-time diagrams and the topologies of the three case studies. The resulting solutions were plotted on correlograms to correlate all objectives in pairs. We considered linear correlations were the Pearson correlation was above 0.50, and confirmed visually.

## 4 Results

Looking at all three corridors together, no large correlation is consistent across all of them. However, each corridor has its own large correlations. The linear relation between the objectives Runtime and Deferment appears in the corridors TW-SA and OLH-NE, but in the corridor VV-VI, a cluster competes with the linearity.

# 5 Conclusion and future steps

As no general conclusion could be drawn, further corridors shall be analyzed to confirm the results. The next step of this research will be to vary the weights of the objectives. Constructing the Pareto fronts and using methods like PCA should allow to further understand the relations between objectives and their impact.

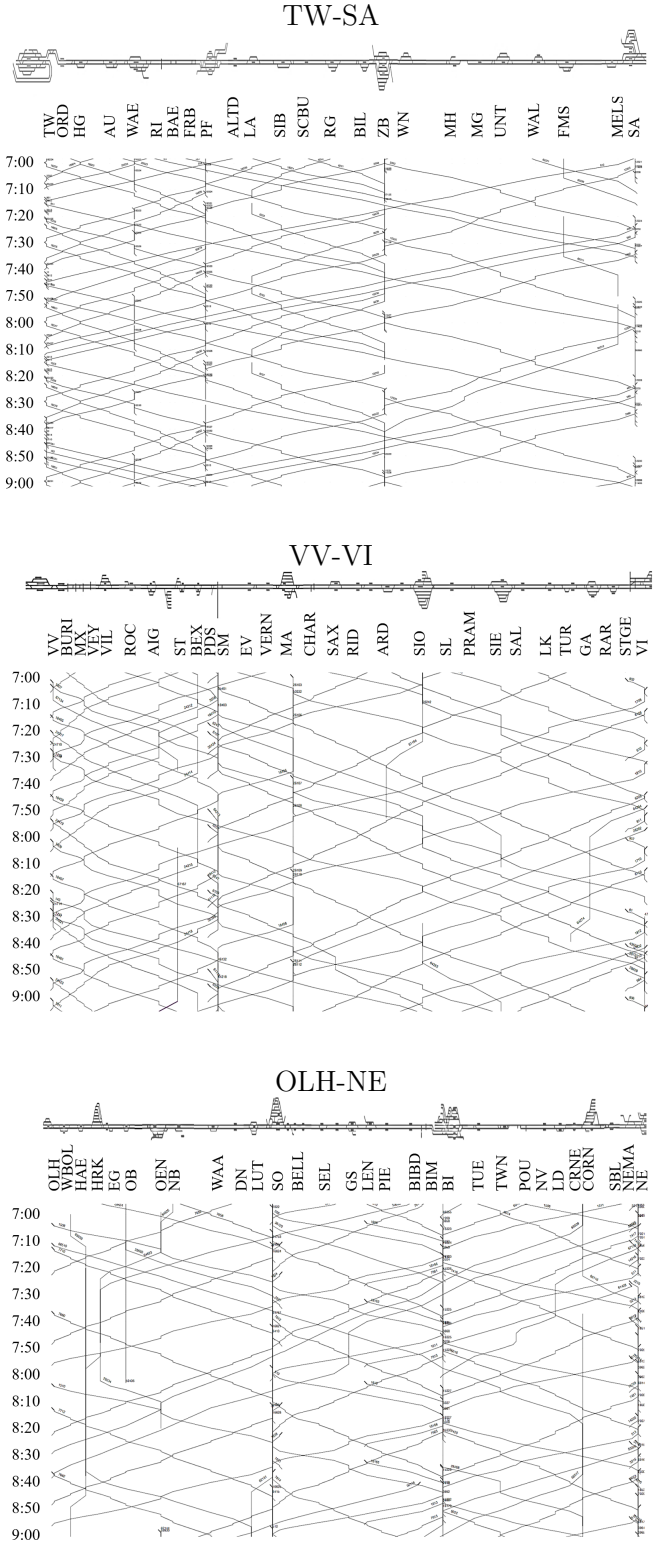


FIG. 1: Time-space diagrams of the three case studies of the Swiss Federal Railways