Rastatt Disruption and its Effects on the Swiss Railway System

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***Abstract*—A railway track near Rastatt, Germany lowered on 12 August 2017 and caused a blockage of a 20 kilometer long railway section which lasted until 1 October 2017. This track closure had dramatic effects on the freight and also on the passenger transport. The effects on the Swiss railroad network were investigated to assess its robustness using large amounts of actual data provided by the SBB. Basel was expected to be affected the most and therefore the delays at surrounding stations of Basel SBB were filtered out of large data sets and used to evaluate daily, weekly and yearly patterns of train delays. The results display a consistent improvement of punctuality during the disruption period. The fact that trains from Germany arriving at Basel SBB had significantly lower delays could probably be the root cause of the improved punctuality of the investigated delays at the respective train stations**

Keywords— Rastatt disruption, actual data, delay patterns

I. Introduction

The Swiss railway network is known for its high punctuality, reliability and robustness, the capability to successfully cope with potentially dramatic changes in its environment. On 12 August 2017, a track settlement occurred between Baden-Baden and Rastatt, a section of the Rhine-Alpine Corridor stretching from Rotterdam to Genoa, two of the most important harbors in Europe. The Deutsche Bahn (DB) had to take out of service a track section of around 20 kilometers. The operations resumed on 2 October 2017. Most severely affected was the freight transport. However, also the passenger transport was affected. Passengers travelling from Switzerland to Germany faced travel time increases of around one hour.

The goal of this thesis was to investigate potential effects of the Rastatt disruption on the Swiss railway system, and as such to assess its robustness. Delays were chosen as key variables to quantify these effects, since they are easily accessible. The investigations focused on daily, weekly and yearly patterns of delays during the pre-/post-disruption period, and during the interrupted period.

II. Approach

A. SBB actual data

The SBB publishes actual arrival and departure data of train, bus, tram and boat rides in Switzerland since December 2016 on their Open Data Platform [1]. These data of the size of around 60 GB were used as raw material for this investigation. The focus was set on the time table year 2017, starting on 11 December 2016 and ending on 12 December 2017.

B. Filters

Since Basel is the first entry point from Rastatt to Switzerland, trains travelling non-stop from Basel SBB to Liestal, Laufen, Rheinfelden, Olten and Zurich HB were selected for the investigation. Additionally, no regional trains were considered since they were not expected to be affected by the disruption as strongly as the long-distance trains.

After selecting these filter criteria, R scripts were developed to filter out the relevant data. The results were then stored in 24 files including data of extra, cancelled, and regularly operating trains (according to the official SBB time tables [2]) arriving at all selected stations, as well of selected German trains arriving at Basel SBB, Liestal and Zurich HB.

C. Groupings

For the purpose of statistical analysis, Liestal, Laufen and Rheinfelden were grouped into one station group, and Zurich HB and Olten into another. The assumption was made, that these former 3 smaller stations located nearer to Basel would have the same characteristics, and that Zurich HB and Olten would share another type of characteristics. Only domestic trains were considered for the first group, whereas all trains were considered for the second group.

Furthermore, the all data was grouped into 30 minutes intervals based on their planned arrival time in order to extract the average delay of a station group during each of these 30 minute intervals. Only trains arriving between 5:30 and 23:00 were considered for the investigations.

III. Results

A. Daily and Weekly Patterns

The daily patterns of both station groups showed a significant (on a 5% level), and throughout the day consistent improvement of median delays during the disruption period. In Fig. 1, the weekly pattern of delays in Zurich HB and Olten during peak hours are displayed. The weekend shows lower delays than other weekdays. Interesting is the fact that the punctuality on all weekdays was more or less similarly positively affected by the disruption. The significance of all days has also been shown by an applied Welch's t-test.

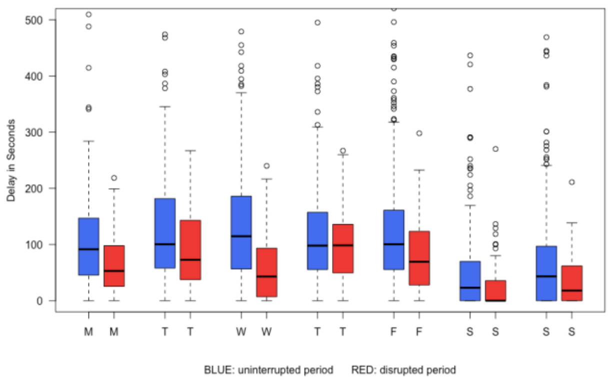

Fig. 1. Weekly patterns of delays in Zurich HB and Olten during evening peak hours (16:00-19:00)

B. Yearly Patterns

Fig. 2 shows the yearly pattern of median delays in Zurich HB and Olten. Here, a relatively clear trend of lower delays during the disruption period can be recognized.

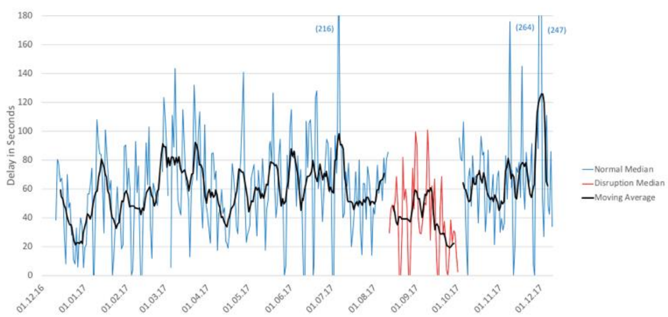

Fig. 2. Yearly pattern of median delays in Zurich HB and Olten

A placebo test, with the same applied rules, was then conducted with the train station Lausanne and three surrounding stations (see Fig. 3) to discover that this region did not indicate any signs of influence of the Rastatt disruption.

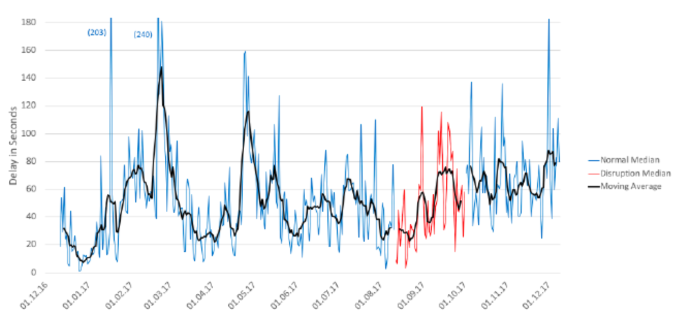

Fig. 3. Yearly pattern median of delays in Fribourg, Yverdon and Vevey

C. German Trains

Fig. 4 shows the daily pattern of average delays of all trains from Germany arriving at Basel SBB. This diagram was based on 30 train lines, most of which operated daily. Here the effects of the disruption period are very clear: One day after the disruption occurred, the average delays all of a sudden decreased and stayed stable at unusually low values. Then, as soon as the blockage was removed, the delays rose to ordinary values again. The reason for this is the fact that as soon as the corridor was interrupted, one part of the trains was deployed on the northern section of the train route and the other part on the southern section, what caused that these trains did not arrive in Switzerland with their potentially accumulated delays as they would if there were no interruption.

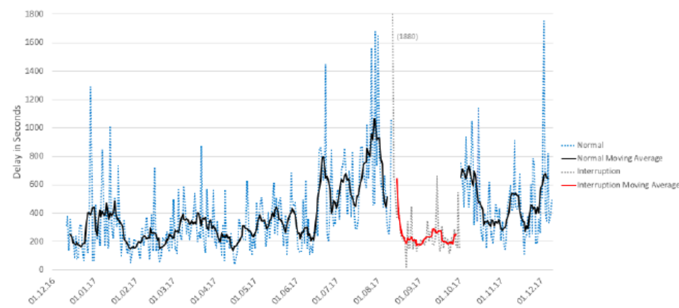

Fig. 4. Yearly pattern of average delays of all trains from Germany arriving at Basel SBB

IV. Conclusion

After considering these diagrams, it becomes clear that the Rastatt disruption did not degrade the punctuality of the Swiss trains from Basel SBB. By contrary, it even improved it. The daily and weekly patterns show a clear verdict that no certain time group or day of the week was specifically affected by the disruption. The long train section from the Netherlands and northern Germany to southern Germany, Switzerland and Italy was split into two, what caused trains to arrive in Switzerland with lower potentially accumulated delay. A further reason for the consistently lower delays is the secondary delay, that was reduced due to much more punctual trains arriving from Germany.

All these findings indicate that the SBB together with the DB were robust enough to spare Switzerland from negative effects in form of train delays.

References

[1] SBB, 2018, Swiss Public Transport Open Data Platform, https://opentransportdata.swiss/de/cookbook/ist-daten/.

[2] SBB, 2018, Official Time Table Switzerland, https://www.fahrplanfelder.ch/en/archives/timetables.html.