Information availability during disruptions in public transport

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***Abstract*—Disruptions in public transport systems have a huge impact on the passengers' satisfaction. During disruptions, passengers regard on-time information as essential in order to make decisions on how to react to the complications due to the disruption. The information availability during disruptions in public transport and its improvement is closely regarded in this thesis with respect to existing approaches. It is found, that early, precise, understandable and consistent information are one of the key parameters to improve the disruption management with respect to passenger information. Further, it is seen, that the amount of present information plays an important role as well, as too much information can lead to confusion and stress since it first has to be processed from the passengers in order to take decisions.**

Keywords—public transport, disruptions, information, delay estimation

I. Introduction

Disruptions in public transport are one of the most common reasons for reducing the passengers' comfort and thus the passengers' satisfaction. During disruptions, passengers have need for information since the normal, planned trip often has high risk of being changed, or even impossible. Passengers thus need to adapt their behavior and plans to the new situation, where information plays an important role. Therefore, the analysis of the information availability as well as the information flow during a disruption in public transport could lead to a reduction in the passengers' discomfort. Further, the information availability has a high influence on the passengers' behavior, which in turn has an impact on the passenger flows during disruptions, which is one of the challenges of the public transport operators [1].

II. Single steps of the information flow

The single steps of the information propagation during a disruption in public transport systems are not precisely definable. However, one can consider different steps with respect to the impact of disruptions, disruption phases when regarding the network performance, and the passenger information.

A. Impact of disruptions

The impact of a disruption depends on the disruption occurrence and the disruption severity. Operators have the task to both keep the severity of a disruption low as well as the occurrence of a delay. The disruption occurrence is mainly influenced by network redundancies and the timetable robustness, which for example can be enlarged with longer headway times. The disruption severity can be reduced on the side of the public transport operators by creating disruption management protocols as well as disruption timetables in advance. Disruption timetables define, how to keep up parts of the services during a disruption in a certain area. On the other side, the felt disruption severity from the viewpoint of the passengers can be reduced, by providing information which helps passengers to react on the disruption and the related stress [2].

B. Disruption Phases

Disruptions can be divided into three phases. Each phase has its own characteristics and challenges. Figure 1 shows the different phases of a disruption with respect to the network performance. The first phase starts with the disruption beginning, where the network performance is drastically sinking. The main challenges are to receive precise information about the disruption, estimate the length of the disruption as well as decide to adjust the predefined disruption timetable if present. Further, the disrupted area should be isolated, in order to keep the consequences on the network as low as possible. The second phase is described with a low and more or less constant network performance. This can be explained by the fact that the operators at this point implement a disruption timetable. The remaining disruption length is estimated and the transition phase, where the network is going back to normal schedule, is prepared. During the third phase, the cancelled services are reinserted, and the original timetable plan is restored [3].

C. Passenger information

The public transport operators can inform passengers via several channels. Depending on the information channel, the provided information can be personalized or not. For example, platform displays and announcements, on-vehicle displays, social media channels, and newsletter, provide information towards a high number of passengers, but cannot personalize the information. On the other hand, hotlines, internet-applications and offices can provide customized information, which can help passengers even better, since the information is most often already filtered.

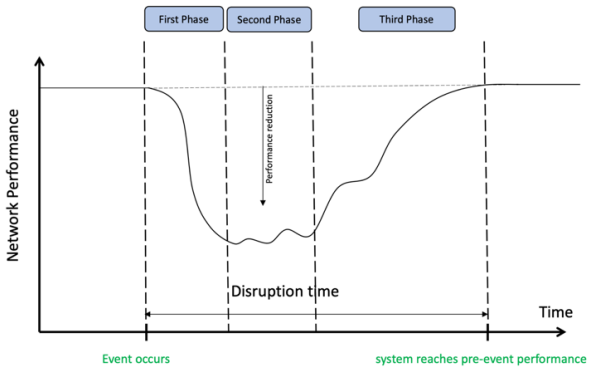

Figure 1: Different phases of a disruption

The spreading of social media and especially smartphones leads to new possibilities, since a high number of users can be informed fast, and, in the case of mobile apps, also information can be personalized. Moreover, passengers now have a simpler way to also give feedback towards the operators. This can lead to additional information about the disruption and its affected people [4].

D. *Passenger choices*

The passenger choices rely on the amount of information they have received about the disruption. Further, the choices also depend on the time, information about the disruption found its way towards a passenger. Alternative possibilities of bypassing an affected area or choosing an alternative transport mode disappear, if the passenger is already in the disrupted area or on a train. The passenger choices are affected by the following aspects [4]:

- The information that the passengers have available before and during disruptions
- The perceived quality of information
- The passengers' trust in the perceived information
- The passengers' ability to use the information

III. ESTIMATION OF TRAIN DELAYS

The estimation of train delays plays an important role, since both passengers and operators rely on an accurate estimation of the disruption delay. Therefore, many approaches exist about this estimation, which can be categorized into three classes by their methods of delay estimation. First, there are analytical models, which use probability distributions of train delays or other incoming data with information on train movements. Secondly, multiple regression models exist, which are defined with several variables that influence a delay by means of variables which correlate with the type of delay (e.g. punctuality with the number of passengers, occupancy ratio etc.). The last approach is performed with the help of machine learning, where available, present data is used to learn general patterns about disruption occurrence on the network [5].

Overall, one can say that the best results are gained, when historical data about train movements and delays contributes into the estimation.

General information requirements from the passengers' view are [4]:

- Reliability, which says whether the information describes the actual situation on the network well or not.
- Consistency, which means that the provided information from the public transport operators includes the same information on all different information channels.
- Comprehensibility, where passengers can understand the provided information, as well as the origin of this information.
- Earliness, which gives passengers more alternative possibilities in case of early information about a disruption and its length, as for example detours or other transport modes can be chosen.

Information about train delays, which are lower than the punctuality definition, should not be communicated towards the passengers, since these delays nearly affect any people. On the other hand, if people miss officially proposed connections, the operators should inform the passengers so that they can adjust their trip plan. If delays are communicated, it should be in intervals of 5 minutes. Further, information about the duration of the disruption should be specified in hours and not more precisely.

IV. CONCLUSION

The aspect of information availability during disruptions is especially in public transport systems essential, since disruptions are mainly responsible for passengers' discomfort. Disruptions should be well-managed from the side of the operators. Already defined disruption plans as well as management protocols, help to minimize the disruption severity. On the other side, timetable planning and network works can lead to more robust systems, which can lead to less frequent disruptions and further lower the impact propagation throughout the network.

The estimation of the delays on the network has a high importance for the operators, in order to plan further actions to lower the disruption impact on the network, and also on the passengers' comfort and satisfaction.

Regarding the information providence, the operators have the task to inform as many people as possible, but on the other side as personalized as possible, in order to best satisfice the passengers' demand for a pleasing trip. With the age of smartphones and mobile data, operators on one side get more easily access to information about the passenger behavior. On the other hand, the information can be delivered faster towards the end costumer with the help of the internet.

Finally, the last years have shown a huge step towards more information channels, which not only lead to more helpful information, but also wrong information. The goal is, to filter the right information and provide it comprehensible, accurate, consistent and timely towards the passengers. Informed passengers lead to less crowded situations during disruptions, as well as better train occupancies. In the end, this also helps operators to run their network efficiently during disruption.

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