“Apologies for any inconvenience caused”

A better public bus traveller experience: Improving traveller information during disruption.

TU Delft | RET | Graduation report | Anne-Minke Bottema

“Apologies for any inconvenience caused”

A better public bus traveller experience: Improving traveller information during disruption.

By

A.M. Bottema

at

RET NV.

in partial fulfilment of the requirements for the degree of

Master of Science
in Civil Engineering
Track: Transport & Planning

at the Delft University of Technology,
to be defended publicly on Friday December 13, 2019 at 3:30 PM.

An electronic version of this thesis is available at http://repository.tudelft.nl/.

Supervisor:	Prof. dr. ir. S. Hoogendoorn	TU Delft
Thesiscommittee:	Dr. ir. N. van Oort	TU Delft
	Dr. E. Özcan Vieira	TU Delft
	Dr. S. van IJperen	RET NV.

Acknowledgement

Available in hard copy only

even

het leven duurt
maar even.

dus

het kan nooit
écht lang duren
als je staat
te wachten
op de bus.

r.o.

r..o. is Rene Oskam a Dutch poet, this poem is cited from the colelction of poems “Safari door de Kosmos” (2017).

Summary

Currently, transport accessibility is under pressure in urban regions where the demand for mobility is large and ever growing. Within this system, public transport has the ability to deal with negative transport consequences such as traffic congestion, traffic accident and air pollution (Ngoc, Hung, & Tuan, 2017) and simultaneously contribute to the 5xE; effective mobility, an efficient city, economy, environment and equity (social cohesion) (van der Bijl, Maartens, & van Oort, 2016). In order to fulfil this role successfully, public transportation needs to satisfy traveller needs to a high standard. In the Netherlands, the "OV-klantenbarometer" is the main customer satisfaction survey for regional public transport. It is a national opinion survey of travellers in urban and regional public transport (CROW-KpVV, n.d.). Although overall appreciation of public transport has risen over recent years, the travel information provision in the event of disruptions has fallen in the eyes of the traveller. In 2019, travellers only scored 55% satisfactory on travel information provision during disruptions, where the RET scored below the national average with a 53% score (CROW-KpVV, 2018). The RET is the public transport operator in the metropolitan region Rotterdam where this research has been conducted. The RET business plan stipulates that one of their objectives is to achieve an overall score of 80% by 2021 in the "OV-klantenbarometer" (RET NV., 2019). A specific element in achieving that is to increase the score on traveller information during disruption from 53% in 2019 to at least 70% by 2021. Currently RET struggle with a lack of insight in the traveller experience during disruption, which has therefore been the starting point of this research. In order to link the RET information provision during disruptions to the impact on the traveller experience, a different kind of research requirement arose than traditional quantitative research. The next part of this summary will briefly describe the setup and approach of this research followed by the main insights, conclusions and recommendations.

This research will focus on bus passengers only, because of my personal interest for the bus services. This interest comes from the fact that the bus operates in free traffic and in urban areas where it has to deal with many different interferences, which makes it a challenging mode of transport. Furthermore, it is often seen as a subordinated modality to trains, subways and trams, both in practice and in science. In most public bus transport related research, the bus is merged with other modes of transport, such as the metro and tram. This results in limited insight in the group of bus travellers and their specific experiences, behaviours and needs. Disruption is a negative experience by definition, but it appears that both in practice and in research very little is known about the holistic experience of travellers during disruptions and influence of traveller information on this. Therefore this research has been set out to study the traveller experience from a holistic perspective during disruptions of RET bus traveller, specifically focussing on the role of information provision. The focus of this research will be on assessing the current traveller information provision process and the role of the different actors involved. The overall goal is to identify a set of opportunities for the RET to improve the traveller experience through the use of traveller information provision during disruption.

This has led to the following main question for this research:

"How can RET use traveller experience insights and traveller information provision to improve the bus traveller experience during disruptions?"

Research methods

The research consists of three main sections: literature research, context research and user research to collect data and findings. Focusing on the main aspects of traveller experiences, information provision and RET internal processes. The literature study is used to gain background information on; traveller information needs during a regular and disrupted situation, the disruption handling from a traveller's perspective, and what determines the travellers experience, perceived service quality, and satisfaction.

The context research was conducted using RET internal documentation, working instructions and the RET business plan. This contributes to gain insight into the RET's vision on traveller experiences, the different actors involved in the disruption handling process, and how these actors contribute to the traveller information provision. The insights gained from this will be valuable at a later stage of this research as they can be used as a benchmark for insights gained during the user research.

The user research consists out of two kinds of research; a field user research on the bus traveller and a field user research on the other actors involved in the disruption handling and traveller information provision (the traffic controller, traveller information and bus driver). For this research qualitative (design) methodologies were applied. The field user research on the bus traveller included; context mapping, in-depth interviewing, a social media case study, and in-depth case study. These methods are used for their ability to unravel the traveller experience from a holistic perspective and highlight how travellers perceive information and how that influences their experience. Additionally, the customer journey mapping technique helped to the visualise and describe travellers' actions and emotions during disruptions. It is showing how the current service affects the traveller experiences. The case study is an in-depth analysis of an unplanned disruption followed from different perspectives (Traveller, Bus Driver, Traffic controller and Traffic informant) and via various traveller information channels. Which helped to expose the specific pain points for the traveller and at a later stage supports the RET recommendations for improving the traveller information provision. For the field user research on the traffic controller, traveller informant and bus driver observation and in-depth interviews are used to gain insights into their working environment, role during disruptions and contributions to the traveller information provision.

Through analysing and interpreting each section separately some main findings on the topics were established. However, by combining all three pillars through an inductive approach called synthesis, enabled this research to retrieve the value from the raw data, by identifying important patterns and themes. The key insights are related to following themes: traveller experiences in regular and disrupted situations, traveller information needs during disruption, the traveller information provision process, perceived quality of traveller information during disruption, workload and communication interfaces and systems. These themes are listed under the following elements: the traveller, the traveller and RET (this is where the transfer of traveller information takes place) and the RET itself. In the last stage, opportunities are derived from the key insights and presented in the form of a roadmap for RET.

This research has an exploratory character by looking at the human aspects through design methodologies in the field of public transport engineering, which is typically characterised by quantitative research set-ups. Design methodologies were specially selected because they can reveal the deeper layers of traveller needs, behaviours and emotions by studying them in a naturalistic environment. Furthermore, this research includes the RET system, giving it a co-design character, which matches with the philosophy of design methodology. This research contributes to getting the public transport engineering field acquainted with qualitative design methodologies, which are helpful methods to gain insights in a specific context, problem by in-depth and extensive understanding of the reality and helps to understand needs, wishes and the motivation of the users of the system. The is valuable to the research field because social-technical systems such as public transport are better served when user-centric (qualitative) and techno-centric (quantitative) research methods are combined. Hopefully, this research contributes to the further development of interdisciplinary research set-ups. Whereas more of these exploratory research is desirable to explore further and established this new field.

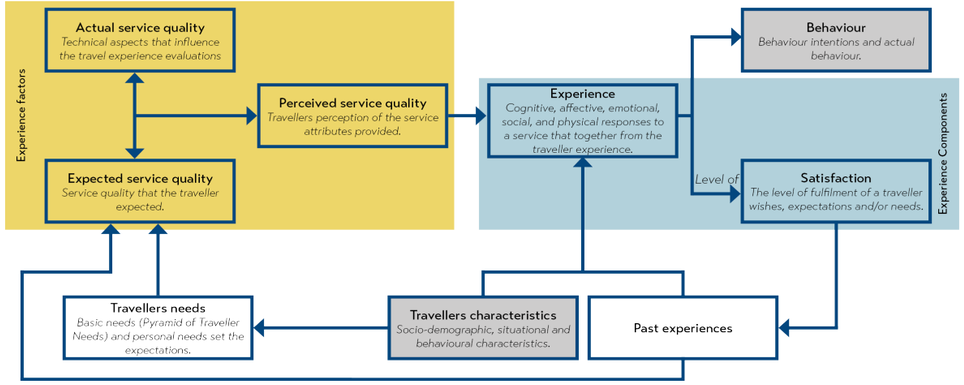
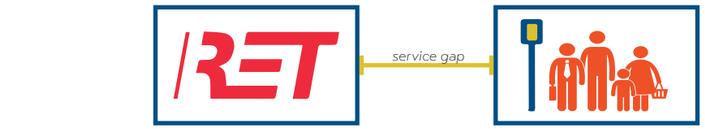


Figure I .

Key insights and conclusions:

At first, the Literature research has shown that traveller experience is strictly personal and includes cognitive, affective, emotional, social, and physical responses to a public transport service (Gentile, Spiller, & Noci, 2007)). The traveller experience is influenced by different components such as; perceived service quality, past experiences and traveller characteristics. The perceived service quality is the difference between the actual service quality delivered by the operator and the expected service quality. Which are determined by traveller needs which consist out of two aspects; basic traveller needs (Peek & van Hagen, 2002)(Peek & van Hagen, 2002) and personal traveller needs related to the traveller characteristics. The experience ultimately determines the level of satisfaction, which can be seen in the traveller satisfaction model, Figure I on the previous page. A service failure or perceived service gap occurs when a traveller's experience does not match their expectations (Liljander & Strandvik, 1997). An adequate response to a service failure leads to lots of 'goodwill' amongst customers, sometimes even more than when the service is delivered in line with expectations right away. This is also known as the service recovery paradox (McCollough & Bharadwaj, 1992).



Situation 1: The regular situation

Situation 2: The disrupted situation.

Situation 3: The disrupted situation and current traveller information provision.

This research revealed a phenomenon that appears during disruptions in public bus transport. First, the regular situation is taken as a baseline, where the perceived service gap between RET and the traveller is not that wide, underpinned by the 75% traveller feedback score (situation 1). Although, even without disruptions, the travellers experience some negative emotions, but they are in general quite positive about their journey. This resulted from the field user-research, presented in a customer journey, shows the emotion curve of five traveller during various phases of a regular bus trip (Figure II). The positive peak moments are when sitting on the bus (=personal time) and arriving at the destination. However, the peak moment of sitting on the bus can be negatively influenced by other factors such as the cleanness and climate in the vehicle, behaviour of other passengers, etcetera. Negative emotions of stress, frustration and worry are triggered by previous experiences; such as buses leaving earlier than planned, or uncertainty on leaving the bus at the right stop.

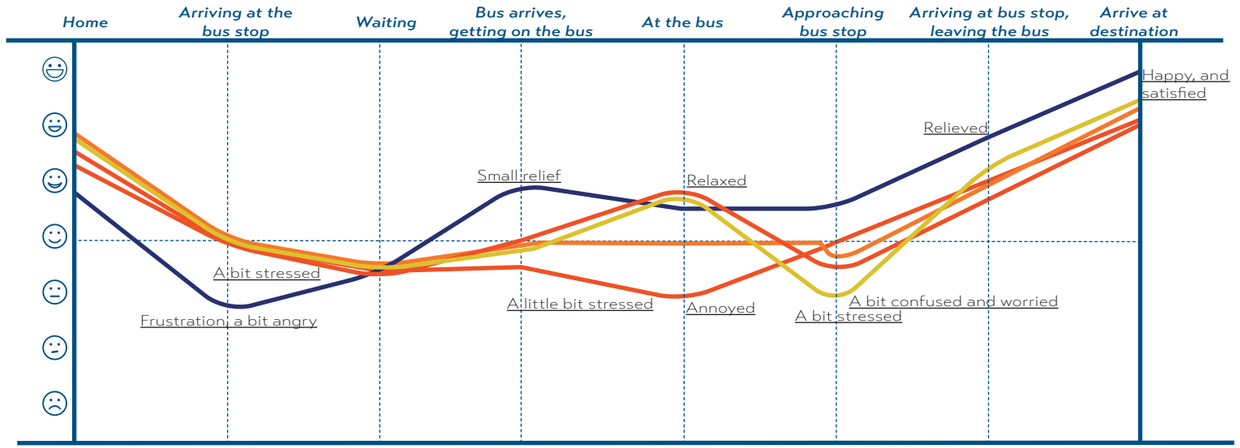


Figure II. Customer Journey Map of the five bus travellers for a regular trip based on the user research.

However, when a disruption occurs (situation 2), the gap instantly widens because the expected service of the traveller is diverging further from the actual service delivery by RET. The increase of the service gap is influenced by how RET handles of the disruption (red arrow). At that point, the traveller needs change because of the uncertainty the disruption brings. In general, disruption is perceived as a negative experience for most travellers. As shown by the field user research, a disruption can trigger emotions of stress and anxiety because the traveller ends up in an uncertain situation. The uncertainty is triggered from the moment the bus should have actually arrived but is not there yet. A disruption can also trigger other emotions like frustration, and something even anger as travellers are no longer in control of the situation. The extent of the impact, size of the gap, is dependent on factors like personality and travel motives. Which might strengthen the negative impact even further (orange arrow).

This study has revealed that there is a third aspect which can increase or decrease the perceived service gap during disruption, and that is the provision of traveller information (situation 3). Because when a traveller is notified on what is happing, they are empowered to make practical decisions and reduce the level of uncertainty. The RET specific insights concluded that discrepancies and inefficiencies in the system, combined with peak workload for the traffic controller and traveller informant, currently increases the gap between the desired traveller information provision and the actual service delivered. The different travel motives, personalities and characteristics of the traveller will influence the gap of the perceived service.

When zooming in on situation 3, the traveller information provision during disruption can be linked to the product-service model as presented by Tomiyama (2001). This model consists of five elements: a provider, receiver, service, product and system. The provider shares a service via a product with the receiver, supported by a system. The products & service received by the traveller (receiver) result in an experience, which is a cognitive, affective, emotional, social, and physical response to this product & service (Gentile et al., 2007). This experience defines the valuation of the products & service. When the valuation is not in line with the expectations of the traveller, a perceived service gap occurs. Figure III, visualises the RET product service model, as defined by this research. What this research has shown is that experience research can be a powerful tool to gain insight into the traveller perceived service quality and the valuation of the product & service. The receiver is often not in direct contact with the system, but the system is providing the input to the product and service. This means that the traveller experience and valuation of the service can also be used as indirect feedback on the system.

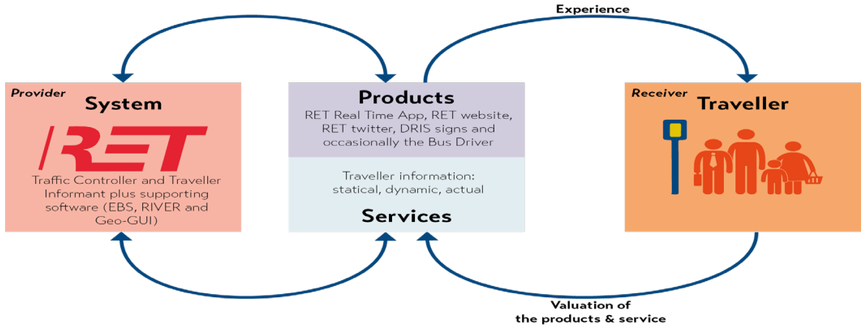


Figure III. Overview of the RET product service model.

This research has shown that essential and highly valuable information for the traveller during an unplanned disruption are; the cause "(O), an estimated impact on journey time, the scale and duration of the cause (G, P), and alternative options (A). So-called 'OPGA-information'. At the same time, this information should be shared timely, transparently and honestly. Furthermore, this information should be consistent and accessible for travellers across various information channels. Currently, however, RET service failures lead to a dissatisfying valuation of the information provision during disruptions by travellers, as can be seen by the score of only 55% satisfactory on the customer satisfaction survey (CROW-KpVV, 2018). This research, among other things, discovered which attributes contribute to this dissatisfaction of the traveller. Through the field user research and the in-depth case study on an unplanned disruption, this research has revealed that the main service failures related to traveller information are: The inconsistency of traveller information across various channels, the inconsistency in the 'OPGA-information' provided or the complete lack of 'OPGA-information'. Furthermore, service failure occur due to inaccurate timing and out-dated information provided. These service failures result in different emotional experiences, such as frustration, confusion and anxiety, which lead to a valuation of the product and service as being unreliable and untrustworthy. These service failures and experiences are ultimately caused by inconsistencies and inefficiencies in the underlying system.

The insights from a system perspective are divided into three categories; Operational, Technical and Cultural. Where Cultural aspects are underlying and (can) influences both the technical systems as well as the operational procedures. Some of the main-insights are elaborated below. The technical systems can be seen as supporting the operational procedures. One of the main aspects that cause in the inconsistency between various channels is triggered by the current protocol on channels (products) usages by the Traveller Informant for the different types of disruption. Furthermore the lack of clear guidelines of the 'OPGA-text messages' and the wide selection of predetermined texts for the Traveller Informant makes that there is inconsistency of the 'OPGA-information'. Another main insights is caused by the communication interface by phone between the Traffic Controller and Traveller Informant, due to the peak workload of both, this creating a hurdle to share information and therefore missing on certain problems or updates for the bus network. Resulting in lack of 'OPGA-Information' and, or causing delays and decreased up-to-datedness. The peak workload of the Traffic Controller is determined by the geometrical nature of the bus service operations, the operational procedures and practices and the experience and specific knowledge of the individual. The peak workload of Traveller Informant is determined by the responsible for the traveller information of three mobilities, the competence & knowledge, and some limitation in the support software. A main technical aspect is the difference in automatic and manual generated information, leading to a delay in communication. Automatically generated information provides actual information on departure and arrival times. there is information that is automatic sent when the Traffic Controller makes adjustments on the bus service planning. However this does not consist of 'OPGA-information' which is currently only generated manually. The information that is of the highest value for the traveller during disruptions is a manually created by the Traveller Informant and takes longer to reach the traveller than automatically generated information. Which results to the service failure of timing and up-to-datedness of 'OPGA-information'.

Also some cultural aspects have been found that negatively influence the system of traveller information during disruption. The hierarchical company structure and the (unwritten) modality hierarchy of first the metro, then tram then bus, Results in the bus not always getting the attention it needs from the Traveller Informant. This in turn, resulting in lack of 'OPGA-information' and,or up-to-datedness of the information. Furthermore, the negative reinforcement culture caused by the financial fines from the concession agreement with the MRDH and the silo-thinking culture results in operational limitations for the Traffic Controller, which makes thinking from the traveller's perspective more difficult during disruptions.

The research insights clusters in operational, technical and cultural, are translated into opportunities for RET whereas they are divided in the main pillars of: standardisation, travellers intimacy, improved efficiency and embracing digitisation. Figure IV gives an overview of the recommendations for the RET.

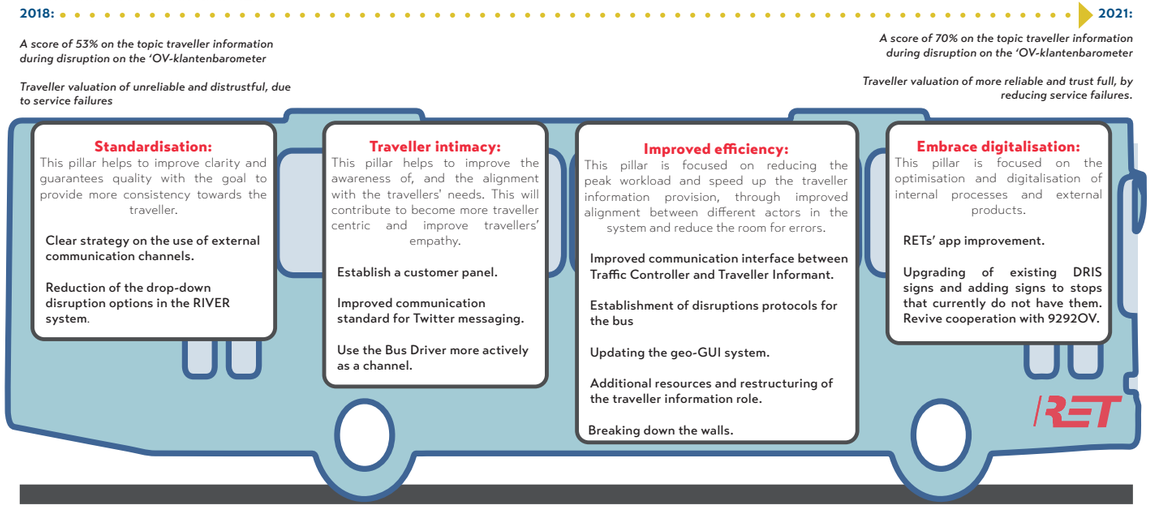


Figure IV. Overview of the RET recommendations

Recommendations further research + practise.

For further research three main topics can be pointed out, namely on the data gathering, the methodology and research extension. They will be described in further detail below. This research consists of a raw dataset of mainly qualitative data. As an example, quantitative research methodologies can be used to gain more insights into the channel (product) use of travellers and their preferences. Combined research would be valuable to gain more insights into the relationship of service failures, recovery, travellers needs and their behaviour on a more generalised level. These further researches contribute to the validation of this research. By adding to the triangularity, and transferability and application of this research in other settings. This research has explored applying design methodologies such as context mapping in the field of public transport engineering. Further research into how design methodologies could be made more fitting with engineering design would be interesting. This will contribute to enhancing interdisciplinary research from the beginning, by the development of new, and adjustment of current methodologies to make them applicable in such research setups. Research extension could go in two ways, first by using different samples and target groups to provide a better understanding of the traveller experience from a broad perspective. The second part is to progress further through the double diamond design principle, whereas steps could be taken further from the ideation phase to 'design things right' related the product & service side. Which will be a valuable addition to the current recommendations focussing on the system side.

Table of content

Opening

First of all, welcome to the master graduation thesis ‘Apologies for any inconvenience caused’ – A better public bus traveller experience: Improving traveller information during disruption, for the faculty of CITG – TU Delft. To start off, the first section of this thesis will provide a general introduction on the motivation for, and relevance of this research. This will include how this research fits into the overall vision and goals of the RET where this research was conducted. This will be followed by a general introduction on the topic of the pyramid of traveller needs. Which in combination with the research motivation sets the objectives for this research out, of which the research questions were deducted. In addition to the research conditions and constrains are briefly mentioned. Followed by the research approach and general thesis outline.

1. Introduction

1.1 Motivation

Since the year 2019 the transport accessibility is under pressure in urban regions where the demand for mobility is large and growing fast. Public transport has the ability to deal with negative transport consequences such as traffic congestion, traffic accident and air pollution (Ngoc, Hung, & Tuan, 2017) and simultaneously contribute to the 5xE; effective mobility, an efficient city, economy, environment and equity (social cohesion)(van der Bijl, Maartens, & van Oort, 2016).

The level of customer service in public transport can and should be better. As in practice, it appears that public transport companies do not always approach travellers as customers and insufficiently place themselves in their position(Grotenhuis, Wiegmans, & Rietveld, 2007). Processes are often designed from the perspective of the operator instead of the travellers(A. L. Durand, van Oort, & Hoogendoorn, 2018). The public transport sector should therefore become more market-oriented and competitive (Lai & Chen, 2011). This requires a clear understanding of travel behaviour and consumer needs and expectations, to be able to improve the service quality which is needed (Beirão & Cabral, 2007). A lack of consciousness for the perceived service quality and missing quality management systems are negatively influencing the customer satisfaction, passenger demand, investment decisions and revenue (Barron, Melo, Cohen, & Anderson, 2013). Furthermore, it is the leading cause of the rapid growth of individual motorised traffic in cities (Ngoc et al., 2017). During a service failure as a disruption is it is essential for the operator to respond adequately. Not giving this the right priority has a severe impact on the loyalty and satisfaction of travellers, where an adequate response leads to a lot of “goodwill” among customers, sometimes even more than when service is delivered right away (Hart, Heskett, Sasser Jr, & Sasser, 1989). During disrupted situations, passengers will experience waiting times and services differently. By responding well to a disruption, any inconvenience is perceived as less inconvenient (van Hagen & de Bruyn, 2012) and the perception of reliability and robustness rises significantly as the uncertainty reduces (Bruglieri et al., 2015). Therefore, it becomes essential to measure the level of service to identify the potential strengths and weaknesses of public transport systems (Beirão & Cabral, 2007).

In the Netherlands, the ‘OV-klantenbarometer’ {PT-Customer satisfaction survey} is the customer satisfaction survey for regional public transport. It is a national opinion survey of travellers in urban and regional public transport (CROW-KpVV, n.d.). Monsuur and Idzenga (2016) analysed the results of the ‘OV-klantenbarometer’ for bus travellers from 2007 to 2014. The results indicate that for bus travels the quality aspects ‘speed’, ‘frequency’ and ‘punctuality’ are the most important factors in the overall assessment of bus transportation. Followed by ‘customer friendliness of the staff’ and ‘driving style of the driver’. Less well-scoring quality aspects, such as the fare and the information during disruptions, weigh less heavily on the travellers overall opinion about public transport. The advice for public transport operators and authorities was not to give these aspects the highest priority. The question is, however, was this the right advice? If the occurrence of disruption is almost inherent to services (Wilson, Zeithaml, Bitner, & Gremler, 2016) and a disrupted situation is an important issue for travellers, public transport operators and infrastructure managers (Yap, van Oort, van Nes, & van Arem, 2015). Figure 1, provides a graph with an overview of the public transport customer barometer grades for the bus since 2006 (excluding 2012 & 2013). It presented the grades, nationwide and for RET specific, about information at the stop/station and information about delay/disruption.

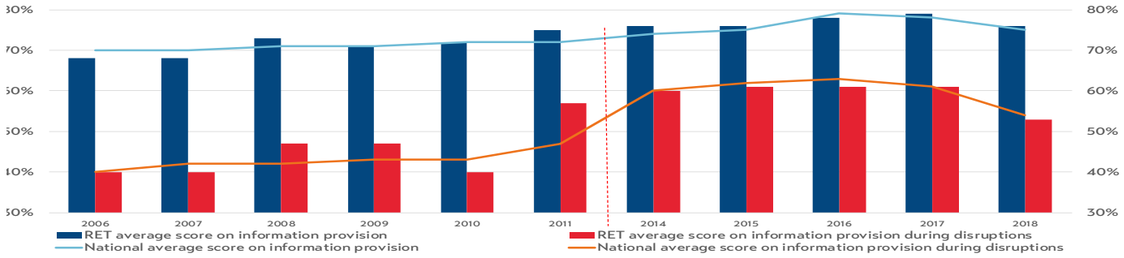


Figure 1 . Yearly average ‘OV Klantenbarometer’ scores on the information provision since 2006 (CROW-KpVV, n.d.).

The results of the ‘OV-klantenbarometer’, for the period from 2014 to 2017, still show that after the fare the information during disruption had the lowest overall score (CROW-KpVV, 2018). Overall the appreciation of public transport has risen however in the past few years, travel information in the event of disruption has fallen in the customer judgment. Travelers now onlyscore 55% for this and the results of the RET are even below the national average with a 53% score (CROW-KpVV, 2018). Not for nothing, that for years, information about disruptions has been at the top of the list of points for improvements mentioned by the travellers. Striking, because there are more and more means to provide the traveller with up-to-date information over the past few years, real-time information signs have been positioned at many stops and in vehicles. Also, various travel-apps provide more and more real-time information. The grow of use of real-time information services will continue. Although, these facilities appear to meet the customer needs in normal operation. Still, it turns out that there is a different kind of need for information during disruption.

This research will focus on bus passengers only, driven by my personal interest for the bus services. This as it operates in free traffic and in urban areas where it has to deal with many interferences, which makes it a challenging mode of transport. Furthermore, it is often seen as a subordinated modality to trains, metros and trams in practice and science. However, bus transit services have an underestimated value in the public transport network, however they are a fundamental aspect of implementing integrated and sustainable transit solutions (Morton, Caulfield, & Anable, 2016). Moreover, bus services are often the only option when lack of space limits laying more asphalt or tram rails as a possibility, and the subway expansion is costly, complicated and time-consuming. In most public bus transport related research, the bus is merged with other modes of transport, such as the metro and tram. For these reasons I have decided to commit this research to bus passengers only.

1.1.1 The RET aim

One of the RET’s objectives is to score an 8 out of 10 by 2021 in ‘OV-klantenbarometer’ (RET NV., 2019). When making a journey more comfortable and accessible, it turns out that traveller information during disruptions is an essential part of it. Therefore, it has been a key point since 2012 and it is included in their business plan ever since. Their aim is to increase the score on traveller information during disruption from a 59% to at least a 70% score Also, the principle of the RET the ‘Metropolitan region Rotterdam Den Haag’ (MRDH) stated in the concession requirements that they expect RET to actively inform travellers about connecting forms of transport that are relevant to them. The efforts of the RET must lead to travellers increasingly appreciating the quality of the travel information. This should result in 2020 in a rating for the travel information in general of at least a 75% and for travel information in the event of delays at least 65%. The results then should increase by at least 0.1 points every three years (MRDH, 2016). However, lack of insight into customer needs limits RET in the interaction with the customer. Moreover, the interaction with the customer does not always meet his needs. The number of disruptions has risen slowly in recent years, and the travel information in the event of disruptions is not in line with their ambitions for customer satisfaction. This research will help to get more insight in the customer needs and provide a set of (practical recommendations) which can contribute to achieving their goal.

1.2 Pyramid of travellers needs

In the sector of public transportation, the pyramid of traveller needs is used to define the quality of customer needs in different hierarchical layers (Peek & van Hagen, 2002). The pyramid is analogous to the Maslow pyramid that hypothesised that within every human being there exists a hierarchy of needs (Maslow, 1943).

The pyramid of traveller needs, figure 2, is divided in a lower section; the dissatisfiers such as safety, reliability, speed and ease and the upper section; the satisfiers such as comfort and experience. Dissatisfiers are components that must be sufficient met or otherwise lead to dissatisfaction. Satisfiers against this, do contribute to more satisfaction, but its absence does not necessarily lead to dissatisfaction (Peek & van Hagen, 2002). A comment on the figure of the pyramid of traveller needs. The experience aspect is at the top of the pyramid and is therefore assumed to be the least important, and this is not correct. Studies using in-depth interviews and associative techniques found that enhancing the qualities of the satisfiers is far more important than passengers themselves realise (e.g.: Anable & Gatersleben, 2004; van Hagen & Bron, 2014; van Hagen & van Oort, 2019). Besides, experience occurs in all layers of the pyramid, because every quality aspect has an objective and a subjective component. Experience is, therefore, not the correct name and can lead to confusion.

Figure 2. The pyramid of traveller needs, including the aspects of the "OV-klantenbarometer" (Peek & van Hagen, 2002) (CROW-KpVV, n.d.).

Traveller information about disruptions is a 'dissatisfier'. This information is so fundamental nowadays that insufficient information leads to dissatisfaction. However, traveller information has interfaces with more layers of the pyramid. Travel information could ease the journey and improve the travel experience, by creating positive perceptions of waiting times, higher customer satisfaction and image about public transport, and sense of security (e.g.: Beecroft & Pangbourne, 2015; Brakewood, Barbeau, & Watkins, 2014; Cats, Koutsopoulos, Burghout, & Toledo, 2011; Papangelis, Nelson, Sripada, & Beecroft, 2016). This certainly also applies to traveller information in the event of delays. A proper disruption handling and information provision also contribute to a better experience. This puts information at the top of the pyramid. A disrupted journey with proper disruption handling, could result in a more memorable experience than if they had a smooth journey. However, this positive effect on the experience will only be achieved if all other needs in the pyramid have been met (Rijkswaterstaat, 2009). Until the 21th-century public transportation research mainly focused on components related to improving factors such as availability, efficiency, reliability, safety, and comfort (Schweiger, 2003). These hard quality characteristics are more straight forward to investigate using well-known research methods in transport engineering and are better measurable for public transport operators. The operators have focused on improving the hard quality characteristics (bottom of the pyramid) resulting in overall satisfied travellers as the overall satisfaction of public transport has stabilised around the 75% mark (CROW-KpVV, 2017a). To be able to improve traveller satisfaction further attention should be paid to the top of the pyramid, more soft quality characteristics. Travellers quality perception is based on both hard and soft quality characteristics and the role of the soft qualities in the top of the pyramid is far more important than passengers themselves realise (van Hagen & Bron, 2014; van Hagen & van Oort, 2019). This indicates how important it is not to ignore the upper part of the pyramid. It provides opportunities for both research and the public transport sector to focus more on these soft factors, especially the experience of customers. Eventually, this leads to higher customers satisfaction and a more attractive public transportation service in the future (Cairns et al., 2004; van Hagen & van Oort, 2019).

However, there are some difficulties as this pyramid gives a general indication. Customer needs can be hard to define because often customers do not even know what their needs are as well as on an individual level. The needs can be not as deterministically ordered. In public transportation there are many different groups of customers [different; ages, gender, travel purpose, economic status,...] whom all have different needs and expectations (Beirão & Cabral, 2007). Thereby, going upward in the pyramid the size of the group that considers it of interest decreases, and there are more and more differences between people concerning their wishes (Rijkswaterstaat, 2009). This entails a direct challenge for public transport operators and the research field.

1.3 Research objectives and questions

As stated above; by improving the information provision during disruptions in public transportation, a lot can be gained . Especially with regard to customer satisfaction and loyalty, which requires a clear understanding of travel behaviour, needs and expectations (Beirão & Cabral, 2007). This reflection leads to the aim of this research which is to improve the understanding of travellers experiences and information needs during disruptions in public transportation, to be able to take traveller-centric operational action that contributes to a better experience.

The research will be conducted for the RET, department 'Centrale Verkeersleiding (CVL)' {central traffic control}. The RET, The Rotterdam Electrical Tram NV. is a Dutch transport company that is active in urban transport in and around the city of Rotterdam. Public transport is carried out by tram, bus, metro and ferry. The CVL is responsible for the daily operations and supervision of the execution of the exploitation.

The research contributes to the need of narrowing the gap between scientific research and practical needs. This is done by investigating the importance of service quality attributes in public transportation from a travellers point of view. The current theoretical gap on the holistic traveller experience of (bus)-travellers in the regular situation and disrupted situation. A goal also is to contribute a better understanding of traveller information provision and how the current service gap occur on traveller information during disruption. Furthermore this research contributes to the theoretical gap of apply design (qualitative) research methods in the field of public transport engineering research. From the point of view that public transport is a social-technical system and that the traveller (user) is an important part of it, and needs to be put at the centre. Various design research methodologies offer this possibility, The research contributes to the practical gap at RET, to define the opportunities for improving their service experience of the bus-service and information provision during disruption from a traveller perspective. The insights and opportunities could be of practical relevance to other public transport operators and authorities.

Given the mentioned theoretical and practical gap and overall goal of RET, the main research question is as follows:

"How can RET use traveller experience insights and traveller information provision to improve the bus traveller experience during disruptions?"

To answer the main research question, the following sub-questions have been defined on the three topics:

Traveller (information) needs during regular and disrupted operations:
- *What are the traveller needs?*
- *What are the traveller information needs during, a regular and disrupted situation?*

Traveller experience during regular and disrupted operations:
- *What determines the traveller experience?*
- *What is RET's vision on traveller experience?*
- *What is the experience of travellers in public transportation? And how does this change during disruption?*

The role of RET in the disruption handling and traveller information process:
- *What does the disruption handling process look like? And which actors are involved?*
- *What does the traveller information provision process look like? And which actors are involved?*
- *What is the perceived traveller information during disruptions for public bus travellers?*

1.3.1 Conditions and constraints

This thesis will focus on urban public bus transportation. Trains, metros and trams are not part of the research scope. The primary source of data used in the research is qualitative dataset. Theoretical research will be performed to identify and describe the theoretical background of travel information (needs), disruptions and the perceived service quality and traveller experiences based on current literature. Internal RET documents are used to describe the context, disruption handling process and information provision process. To check the theoretical context with the practise in nature a field research is conduct by interview with, and observation on the Traffic control, Traveller Informant and Bus Driver as they play an important role during disruption and in the information provision. To understand the traveller needs, field user research is required to identify the experiences during the regular and disrupted situation, and the perceived service quality of traveller information. Service design methods apply to this, as they are holistic, customer-focused approach that uses design principles and processes to develop better services. This incorporates the needs and motivations of the employees and customers involved in the service. The travellers experiences and needs are gained by field user research applying context mapping methodology, which has its origin in design research. Because of the theoretical gap of applying design (qualitative) research methods in the field of public transport engineering research this research has an exploratory character. The research only focusses on the RET and their travellers, other public transport operators will not be considered. Digital exclusion, and social disadvantage of travellers are not included in this field user research.

1.4 Research approach and outline

The research is divided into several successive phases: Opening, Background, Context, Research, Insights and Closing. The approach in each these phases is described below, Figure 3 gives an overview of the research outline.

Background
The background phase consists of literature research on previously performed research. The following literature subjects will be elaborated on: traveller information, disruption handling and travellers perceived service quality, experience and satisfaction. This section is closed out by a literature summary and conclusions.

Context
The purpose of this section is to explain what RET does, what their mission is and where they currently stand. This section will describe the overall context in which this research was conducted by describing RET, disruption and the traveller information context. This will contribute to the insight into RETs vision on traveller experience, the different roles involved in the disruption handling process, and how the roles contribute to the traveller information provision. Information is obtained by studying RET internal documentation, working instructions and business plans.

Research
The research phase consists of three elements; the methodology description, the field user research on the bus-traveller, and the field user research on the other actors (Travel Informant, Traffic Controller and Bus Driver). The methodology description includes a comparison between traditional and design research, a general introduction to design research and a description of the methods applied in both field user research. The field user research consists out of context mapping, in-depth interviews, social media study and an in-depth case study. All to gain understanding and insight into the experience of bus travellers in the regular and disrupted situation how they perceive traveller information and what determines their experience. The first findings of the research are stated in this section plus a customer journey map including the emotion curve of a regular and disrupted trip are presented here.
The field user research for the other actors consists out of observations and in-depth interviews. Travel informant, Traffic controller and Bus driver are the subject of this field user research due to their active roles during disruption and in the information provision process. Observation and in-depth interviews are used to gain insights into their actual working environment and roles during a disruption in the information provision process. The first findings of this research are also presented in this section.

Insights
In this phase, the results from the previous phases are analysed, interpreted and combined by using the 'analysing on the wall' technique. The key insights are divided into different themes; traveller specific insights, traveller/RET interface related insights, RET specific insight and finally a set of overarching insights. Hereafter all of these insights are combined and mapped in a model that will describe their relationships, which will reveal the main contributing factors to a service failure during disruptions. These insights and their relationships will be the basis for the next phase, the closing.

Closing
This phase consists of two elements, the conclusions and further research recommendations. In the conclusion, the gained insights reveal a phenomenon that appears during disruptions in public bus transport. Which will be explained in detail before the main conclusions are summarised. Based on these conclusions, a set of recommendations will be provided, which will answer the main research question. The recommendations are visualised in a roadmap including four pillars of improvement. The final part of this section will reflect on the research and will recommend further research and practices.

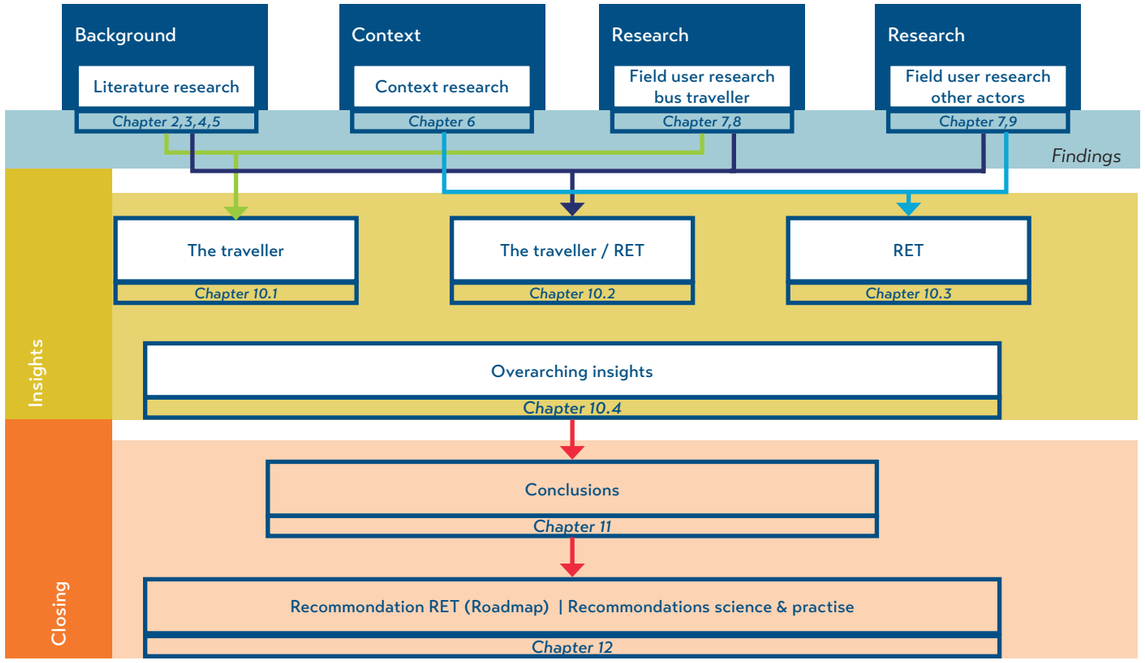


Figure 3. Thesis outline

Background

The introduction chapter shows the need for better understanding of traveller behaviour, needs and expectations. The objective of this research is to improve the understanding of travellers experiences during disruptions and unravelling their information needs in public transportation. This, to be able to take travellers-centric operational action that contributes to a better experience and lead to an overall higher travellers' satisfaction. To achieve this it is important to understand what earlier research points out. This section elaborates on existing literature, on the topics traveller information, disruption handling and travellers perceived service quality, experience and satisfaction. Every topic is addressed in a different chapter, but as there is a strong relationship between these topics some overlap is unavoidable. The final Chapter 5 provides a summary and conclusion on the findings from the literature study.

2. Traveller information in public transport

Traveller information is aimed to improve traveller satisfaction. Although an understanding of the term 'traveller information' seems obvious, further investigation quickly reveals that it reflects a vast field of problems. The information relates to different modes of travel, different choices about departure times and routes. These choices are related to countless information about time, cost convenience, security, etcetera. Traveller information can assist in the planning and execution of a trip, it can be relevant before and/or during a trip, it can be historic, schedule-based or real-time, it can be generic or personalised, it can be there in all different formats (text, graphics, audio) and it can be obtained via different channels. This diversity underlines both the scope of traveller information, but it also increases complexity (Lyons, Avineri, Farag, & Harman, 2007).

This chapter focuses on what has already been found out about the information needs of travellers in a regular situation and during disruptions. Firstly, in sub-chapter 2.1 an explanation is provided about the types of traveller information in public transport. There at the importance of actual traveller information also explained. Furthermore is looked at what is known about the traveller information needs of travellers in the regular and disrupted situation. Traveller information systems and working methods of the information system will be discussed in the Section Context with focus on the case at RET.

2.1 Types of travel information

As the introduction made clear traveller information can take many different forms. For travel time information a distinction is made in literature between static, dynamic and current information. In literature, these terms are often used interchangeably (A. Hendriks & Egeter, 2013). The difference between static and dynamic is clear however, the difference between dynamic and actual traveller information is not, as can be read below.

The following definitions are generally used:

- **Static information:** is the planned timetable, a route description; retrievable and insightful information about departure times, arrival times, routes, travel times, distances etcetera. Information about the regular situation.
- **Dynamic information**: is the situation confirming the planning and information about planned deviations from the timetable. The refresh rate of the information is generally not high.
- **Actual information:** is traveller information that includes unforeseen changes and deviations, such as an accident, traffic jams, malfunctions, etcetera. It is dynamic traveller information with the highest refreshment rate

Furthermore, a distinction can also be made between individual and collective information. Individual traveller information is specific for an individual traveller and for his / her journey. Collective information is general, generic information that is intended for everyone (Ministerie van Verkeer en Waterstaat, 2003). The value of static information is relatively low. If information is dynamic or actual the value of traveller information increases, see Figure 4. This is in contrast to most consumer products which show a diminishing marginal return when an additional unit of consumption are added after basic needs are satisfied. The value of information starts to become very high and actual usage of the information increase if it is multi-modal, personalised, reliable, intelligent, up-to-date, easy to access, etcetera. So when traveller information is close to perfect the valuation starts to increase exponentially. As a result, every aspect of traveller information should be of a very high standard before it would be trusted and is seriously considered (Chorus, Molin, & van Wee, 2006).

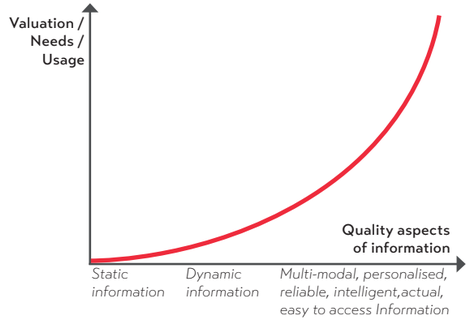


Figure 4. Utility function for traveller information (Chorus et al., 2006).

However, high-quality information could be a prerequisite of a successful transport service provision (ENEA, 2004). From a passenger's perspective it is not unreasonable to expect from an operator to provide high-quality information, especially in response to disruption. Idem from an operator's perspective transport, as with any other good or service, will not sell itself. High-quality information offers the potential to unlock latent travel demand (Papangelis, Nelson, et al., 2016).

The growing amount of technological options make it easier to consult traveller information, with the emergence of the smart-phone, mobile internet and Wi-Fi hotspots, in particular, making a significant breakthrough. This makes it possible to consult the most up-to-date traveller information at any time. The impact and importance of actual traveller information on travellers behaviour will be discussed next.

2.1.1 The importance of real-time travel information

For actual traveller information, different terms are used like; advanced passenger information systems (APIS), real-time information (RTI), real-time transit information (RTTI), and real-time passenger information (RTPI) (Brakewood & Watkins, 2019). In this research now on the term, real-time passenger information (RTPI) will be used. The applications of RTPI were introduced from the mid-1980s.

Despite the complexity of RTPI, providing it prior and during journeys is extremely valuable for travellers (see Figure 4). Actual traveller information could influence the travel behaviour, ease the journey and improve the travel experience, by creating positive perceptions of wait times, increased willingness to pay, higher customer satisfaction and image about public transport, and sense of security (e.g.: Beecroft & Pangbourne, 2015; Brakewood et al., 2014; Cats et al., 2011; Ferris, Watkins, & Borning, 2010; Papangelis et al., 2016; Zhang, Shen, & Clifton, 2008).

Figure 5, shows the decision-making process of passenger choice impacts of RTPI. Theoretically, RTPI impacts a travellers decision on making a trip (travel choice), mode of transportation (mode choice), the specific route (route choice), the boarding stop (boarding stop choice), and the time of departure to arrive at that time at that final stop (departure time choice) (Brakewood & Watkins, 2019).

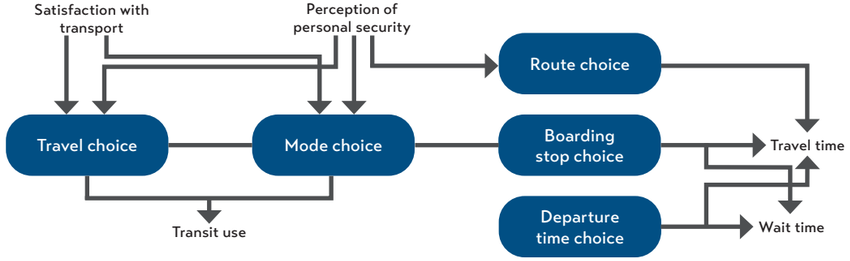


Figure 5. The decision-making process of travellers and relationship with real-time travel information (Brakewood & Watkins, 2019).

Waiting time is an important component that contributed to the quality experience of travellers, and greatly affected the overall satisfaction (e.g.: Beirão & Cabral, 2007; Dell'Olio, Ibeas, & Cecin, 2011; St-Louis, Manaugh, van Lierop, & El-Geneidy, 2014). Several research studies are dedicated to understanding the impact of information on travellers' wait time. All these studies show comparable results; that RTPI reduces the perceived wait time but also the actual wait time. The actual wait time is only reduced as travellers are informed of RTPI before arriving at the bus stop. So the traveller has the opportunity to optimise their bus stop arrival time and reducing time spent waiting at the bus stop (Caulfield & O'Mahony, 2007, 2009; Dziekan & Vermeulen, 2006; Watkins, Ferris, Borning, Rutherford, & Layton, 2011). Interesting about these research results is that it shows the impact of RTPI on wait time is travel mode-specific. Especially for bus passengers, the experienced wait time is significantly reduced when using RTPI. The exact reason for this is not entirely known, but an answer may be found in the results of Mascia (2003). She found that RTPI bus stop displays would potentially reduce wait time but only for low frequent services. Bus services are more likely to be low frequent service than other modes of transport.

Positive psychological effects are mainly related to the perception of control, feeling of security, reduction of uncertainty and increase in ease of use (Schweiger, 2003). In an event of a disruption, RTPI makes it easier to look at journey alternatives and in therefore provides more flexibility in unexpected situations. It is clear that such RTPI systems can be a benefit for travellers although such systems increase complexity for the service provider and the operator. Such information systems require a comprehensive system-wide network for gathering data on vehicle locations. While at the same time the apps that provide the RTPI should be well maintained (Corsar et al., 2015). The following sub-chapter elaborates on the information needs and requirements for traveller information in regular and disrupted situation.

2.2 Traveller information needs

Although public transport is a collective good, travellers have many individual wishes. The demand for information is therefore diverse. Travellers require different types of information pre-journey, en-route, and post-journey (Grotenhuis et al., 2007). Pre-journey activities, such as planning, require information about available modes of transport, routes, timetable, and cost. Closely before and during the journey, information relating to estimated arrival time, delays, network disruptions, and schedule changes are desired (Papangelis, Velaga, et al., 2016). Several general wishes and behaviours can be formulated (Adviesdienst Verkeer en Vervoer, 2002).

The traveller wants:

- accurate information or the most reliable prognosis.
- the information that is as specific as possible.
- customization.
- to be taken seriously and approached.
- freedom of choice.
- wants a total story.
- it as simple as possible and thinks in terms of what they already know.

Also, different personal characteristics and circumstances influence the extent to which people need traveller information. The choice travellers, people who would and could travel by car and public transport, are more tending to consult traveller information than people who only travel by car or public transport (van Beynen de Hoog, 2004). The need for traveller information is also greater for non-regular journeys, because, for less frequent journeys people are less familiar with, for example, the route or the journey. Frequent travellers needless information before the trip and more information during the trip. Less frequent travellers, on the other hand, have a greater need for information for the full end to end journey (Chorus et al., 2006). Older travellers mainly need personal contact when requesting information, while young people prefer telephone and electronic information (Hendriks, 2012). Travellers with an arrival time-sensitive trip induce a higher willingness to acquire information and if the weather conditions are bad travellers consult more often information (van Beynen de Hoog, 2004).

These are all fairly generic findings Still, it appears that in general little is known about the actual requirement of the traveller in terms of traveller information. A large part of the knowledge about the need for traveller information is based on ex-post evaluation research. Innovations in the field of traveller information are usually first marketed on a limited scale. Afterwards, it is investigated whether the traveller is satisfied with the new product and whether large-scale introduction is desirable/possible. This “supply-oriented” approach provides much valuable information but does not provide a clear picture of what information travellers need. At the moment, a clear vision from the demand side is missing. An essential question in the further development of traveller information services is: “where is the real pain of the traveller and how can the services be sharpened in such a way that they respond better to perceived urgency among the travellers” (Tertoolen, de Vries, & Otto, 2015). The next sub-chapter zooms into a situation where the pain is high for travellers.

2.2.1 Traveller information needs during disruption

The need for traveller information is the highest in disrupted situations where the traveller benefits from fast and reliable information. However, during these circumstances, it is most difficult to provide reliable traveller information. The paradox is that travellers indicate that the ability to take note, comprehend, retain and process the information during disruption is low and the ‘mental costs’ to derive the right course of action is high. However, they also indicate that the reliability of the information is at its worst. This is often caused by previous bad experiences that distrust them the information issued or advice given. As a result that during circumstances, traveller information is at its worst as it should be at its best (Cheung, 2010; Chorus et al., 2006).

Much research has been conducted on an individual basis on the following topics: RTPI, disruption, and travel behaviour and experience in public transportation. However, only a few kinds of research have focussed on public transport RTPI requirements during disruptions. Papangelis et al. (2016;2016) is one of these and has focused on the experience and information needs of rural passengers during public transport disruption. This has been done through qualitative research with a series of interviews and structured focus groups of public transport passengers, transport operators and government agencies. The results of this study are relevant for this study as it combines the topics of traveller information and disruption which are also main topics of this study. Some results are shared here.

Traveller information needs are related to different phases of the journey also for disruption a distinction into different phases can be made. A disruption consists of different phases from pre-disruption to recovery. Different information is required in each phase. Figure 6 and Table 1, gives an overview of the different phases and their information requirements following from the research of (Papangelis, Velaga, et al., 2016). Papangelis et al. also found that bus travellers employed a copping strategy to encounter disruption by having a “time buffer”. A time buffer is extra time a traveller will assume they need to still arrive at their destination at the desired time, also in case something goes wrong.

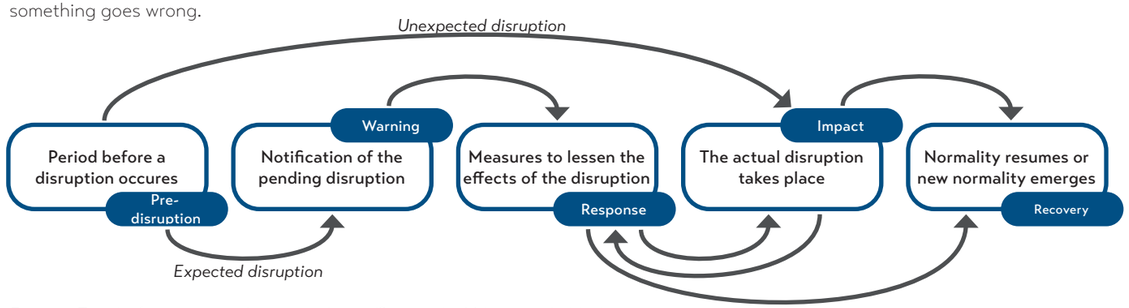


Figure 6. Travel information per disruption phases (Papangelis, Velaga, et al., 2016).

Table 1. Travel information requirements per disruption phases (Papangelis, Velaga, et al., 2016)

Phase	Traveller information requirements
Pre-disruption	*Timely accurate and personalised (TAP) information about the upcoming service, as well as information about upcoming or current (planned) disruptions.*
Warming	*Pre-trip: TAP notification regarding planned and ongoing disruptions.* *In-vehicle: information about own vehicle disruption, connecting services disruptions, and how these will affect the passengers’ journey.*
Response	*TAP provision of information regarding alternative modes/routes/arrangements. The information is required during pre-trip, at the boarding point, and in-vehicle.*
Impact	*TAP updates on the current situation, planning facility and prediction of how long the disruption will last.*
Recovery	*TAP information similar to pre-disruption phase or tailored to maintain the new travel behaviour or encourage particular options.*

Disruption is a negative situation by definition and traveller can develop highly negative feelings. Each individual experiences disruption differently, depending among other things on personality and previous experiences. The provision of RTPI during disruptions, however, has the potential to significantly improve the passenger comfort level, decrease anxiety levels and influences their travel behaviour (e.g.: Brakewood & Watkins, 2019; Papangelis, Velaga, et al., 2016; Politis, Papaioannou, Basbas, & Dimitriadis, 2010). Even though the number of RTPI-systems has significantly increased its role in supporting travellers during service disruption is poorly understood. Public transport operators provide everyone with general information (Brakewood & Watkins, 2019). That works well if there is no disruption. However during a disruption many people have different expectations from the public transport system (Ministerie van Verkeer en Waterstaat, 2003).Besides, the response to disruption is influenced by many factors from demographical, to social to specific personal and psychological components, see Figure 7.

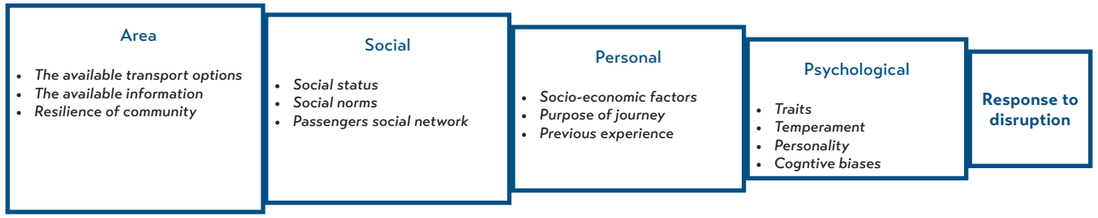


Figure 7. Factors that influence the traveller response to a disruptions (Papangelis, Velaga, et al., 2016).

2.3 Traveller information channels

There is very little recent research in the public transport sector on the usage of traveller information channels in the Netherlands. Due to the rapid technological developments of the last decades, the rise of the mobile phone and mobile internet, there is a change in the use of traveller information channels among travellers (Barbeau, Borning, & Watkins, 2014). As a result, older studies are quickly becoming outdated due to the emergence of these new channels.

In 2011, RET (RET NV., 2011) did a sample among of its 200 travellers in order to gain more insight into which channels travellers use in a regular situation, for example to get information about the timetabling and preference in the case of a delay or cancellation/diversion. Table 2, shows the results of this study. A gap in this RET study is that mobile applications are not included. This could explain why the DRIS signs are mentioned in the first place because this is the only digital information channel at the stops. Moreover, station and in-vehicle announcements are indicated as a suitable way to reach the traveller during disruption. Personal contact with a RET employee on site is also appreciated. Interesting is to see that Twitter already takes on the 6ste place as preferred channel. Chapter 3.2.2 elaborates more on the role of social media in public transportation nowadays.

Table 2. Overview of the prefered information channels (RET NV., 2011).

	Regular timetable	Delay	Cancellation/diversion
1	9292OV website	DRIS	DRIS
2	RET website	Station and in-vehicle announcements	Station and in-vehicle announcements
3	DRIS	RET website	RET Employee
4	9292OV by telephone	9292OV website	RET website
5	RET service point	RET Employee	9292OV website
6	RET customer centre by telephone	Twitter	Twitter

3 Disruption and handling from a travellers perspective

Disruption is 'a disturbance or problems which interrupt an event, activity, or process' (Oxford Dictionary of English, 2010). Disruption is an important issue for passengers, public transport operators and infrastructure managers (Yap et al., 2015). For a traveller, disruptions is a disturbance or problems which interrupt the smooth travel experience of a passenger. So there is a difference between the actual disruption (operational disruption) and the perceived disruption by the travellers. Besides, the traveller may experience a perceived disruption even in cases when there is no actual disruption.

- **Actual disruptions (Operational disruptions):** Disruptions when there are bus delays, route diversions or cancellations. They can be caused by internal and external factors. Internal factors like; technical failures, staff shortage, material shortage. External factors like; traffic situation, weather, accidents
- **Perceived disruptions:** Disruptions that occur when a fundamental traveller expectation is not met, like not having a seat, uncleanness of the bus, impolite Bus Driver, and others. The perceived disruption is linked to the perceived service quality. This is explained in the next chapter.

The occurrence of disruptions is almost inherent to public transportation service and unavoidable. In this research, the scope has been set to include only negative critical incident, defined as disruptions that dissatisfy the traveller that is related to an actual disruption. This chapter focuses on literature that deals with customer-oriented handling of disruptions, and the role of staff and social media

3.1 Disruption handling from a travellers perspective

Travellers have certain expectations about their travel experience. A service failure occurs when their experience does not match their expectations (Liljander & Strandvik, 1997). Service failure is the opposite of customer satisfaction (Smith, Bolton, & Wagner, 1999). Not giving service failures the right priority has a severe impact on the loyalty and satisfaction of travellers, where an adequate response leads to a lot of 'goodwill' among customers, sometimes even more than when service is delivered right away, more about this can be read in the next Chapter 4. However, this indicates how important it is not to neglect disruption and get an understanding of the situation to be able to respond accurately to have a good service recovery. By responding well to a disrupted situation, the perceived inconvenience will be experienced as less inconvenient (van Hagen, Govers, & de Haan, 2012). In the research field of transportation, the view of the traveller towards the service during disruptions is often neglected as it is usually operator and technical oriented (Barron et al., 2013). This is contradictory as public transport is a service product and it would, therefore, be logical that the management of consumer service would be widely studied as in the research field of economics and marketing for all other types of consumer products and services (Mouwen, 2015). However, in the last decade the perspective is changing as few studies consider customer-oriented handling during disruption. This is partly due to the use of smart cards such as the public transport chip card, as more and more passenger data is available and it, therefore, becomes easier to study disruptions from the perspective of the traveller.

Durand (2017;2018) compared different strategies to tackle disruptions and their impact on travellers. The impact consists of, for example, longer waiting times, longer travel times, extra transfers and longer experienced travel times due to crowds. To be able to compare the strategies they have been translated into a monetary travel time valuation and added to additional generalised travel time costs. This approach has been applied to a case study for the RET. The developed framework delivers a tool which gives insights into the performance of different strategies, showing trade-offs between the supply side (timetable, crews, and vehicles) and passenger side during disruptions. The research mainly shows the advantage for travellers of regularity control over punctuality control.

Durand's and other studies consider customer-oriented handling during disruption and provide a guide for operators to adjust their pre-planned protocols. Also, the RET acknowledges that the passenger perspective has never been formally considered in the design of these pre-plans. These studies focus very much on the operator and what is going on there. The purpose of this research is to be at the interface between the operator and the traveller. Traveller Information provision via website, app, twitter and staff is part of this interface.

3.1.1 The role of staff

Travellers have certain expectations about their travel experience. A service failure occurs when their experience does not match their expectations (Liljander & Strandvik, 1997). Service failure is the opposite of customer satisfaction (Smith, Bolton, & Wagner, 1999). Not giving service failures the right priority has a severe impact on the loyalty and satisfaction of travellers, where an adequate response leads to a lot of 'goodwill' among customers, sometimes even more than when service is delivered right away, more about this can be read in the next Chapter 4. However, this indicates how important it is not to neglect disruption and get an understanding of the situation to be able to respond accurately to have a good service recovery. By responding well to a disrupted situation, the perceived inconvenience will be experienced as less inconvenient (van Hagen, Govers, & de Haan, 2012). In the research field of transportation, the view of the traveller towards the service during disruptions is often neglected as it is usually operator and technical oriented (Barron et al., 2013). This is contradictory as public transport is a service product and it would, therefore, be logical that the management of consumer service would be widely studied as in the research field of economics and marketing for all other types of consumer products and services (Mouwen, 2015). However, in the last decade the perspective is changing as few studies consider customer-oriented handling during disruption. This is partly due to the use of smart cards such as the public transport chip card, as more and more passenger data is available and it, therefore, becomes easier to study disruptions from the perspective of the traveller.

Durand (2017;2018) compared different strategies to tackle disruptions and their impact on travellers. The impact consists of, for example, longer waiting times, longer travel times, extra transfers and longer experienced travel times due to crowds. To be able to compare the strategies they have been translated into a monetary travel time valuation and added to additional generalised travel time costs. This approach has been applied to a case study for the RET. The developed framework delivers a tool which gives insights into the performance of different strategies, showing trade-offs between the supply side (timetable, crews, and vehicles) and passenger side during disruptions. The research mainly shows the advantage for travellers of regularity control over punctuality control.

Durand's and other studies consider customer-oriented handling during disruption and provide a guide for operators to adjust their pre-planned protocols. Also, the RET acknowledges that the passenger perspective has never been formally considered in the design of these pre-plans. These studies focus very much on the operator and what is going on there. The purpose of this research is to be at the interface between the operator and the traveller. Traveller Information provision via website, app, twitter and staff is part of this interfa ce.

3.1.2 The role of social media

The staff are an important part of the perceived service quality. Monsuur and Idzenga (2016) analysed the results of the 'OV-klantenbarometer' for bus travellers from 2007 to 2014. The results indicate that for bus travellers, the quality aspects 'speed', 'frequency' and 'punctuality' are the most important factors in the overall performance of bus transportation. It is followed by 'customer friendliness of the staff' and 'driving style of the driver'. Research from the aviation sector showed that there is a considerable difference between the ways passengers and staff perceive the causes and handling of a service failure Edvardsson (1992). Moreover, the staff is not aware of the importance of clear and correct information when disruption occurs (Bejou, Edvardsson, & Rakowski, 1996). A conclusion is that companies should train their staff in communication techniques and how they can relate to the customer when a disruption occurs. The follow-up research of Edvardsson (1998) focused on the public transport sector and the Bus Driver was included in their research by interviewing them about what in their view creates customers dissatisfaction and are the shortcomings in quality for passengers. Results show that Bus Drivers do not know which important role they have during disruption and how their conduct and way of informing can contribute to better customer experience.

Hutchinson (2011) gives an important counterweight to the many publications that have urged management to ensure that staff (Bus Drivers, in particular) who interact with passengers do so appropriately politely, helpfully, informatively, etcetera. However, this can also be turned to that the management should ensure that passengers do not often need to interact with Bus Drivers. As the main task of the Bus Driver is to drive, not to provide about fares, routes, timetables and where to catch other buses as the information provision is properly a management responsibility. As answering passenger's query causes delays. The management strategy should be to ensure the passenger has all the necessary information before stepping on to the bus.

4 Traveller perceived service quality, experience and satisfaction

The final topic of this literature review is travellers perceived service quality, experience and satisfaction. The previous chapters have shown that traveller information (about disruption) is fundamental for the traveller. Travellers satisfaction is closely related to the quality of information provided to traveller during disruptions (2009; 2010). Insufficient information leads to dissatisfaction. On the other hand, high-quality information (e.g. multi-modal, personalised, reliable, intelligent, actual) and a more customer-oriented disruption handling can contribute to higher perceived service quality and therefore better experience with leads to higher travellers satisfaction.

The terms, service quality, experience, satisfaction, are used interchangeably in the literature which makes a clear understanding confusing. The literature identifies this conflicting nature of the empirical results. However, researchers have also failed to agree on what the conceptual nature of the service quality and satisfaction relationship should be (Taylor & Baker, 1994). In public transport research, there is also no clear definition of these terms. As mentioned in the introduction the term experience is sometimes used 'incorrectly'. Therefore, the definition of the terms as interpreted in this research are stated here:

- **Service quality** is a quality of how well the service level delivered suffices customers' expectations. The dimensions underlying quality judgements are rather specific and do not require experience with the service (Bitner & Hubbert, 1994).
- **Experience** is as holistic, strictly personal, and construct of a multidimensional; cognitive, affective, emotional, social, and physical responses to a service (Gentile, Spiller, & Noci, 2007).
- **Satisfaction** is the fulfilment of a person's wishes, expectations or needs, or the pleasure derived from them, associated with affective judgments. Satisfaction can result from any dimension whether or not it is quality related and require experience with the service (Kotler, 2000).

This chapter examines travellers perceived service quality and the role of experience in service. Part of the sub-chapter about experience is the customer journey which illustrates the customer experience and the emotional journey. The last sub-chapter is about traveller satisfaction.

4.1 Perceived service quality

Travellers have certain expectations about their travel experience, and service failure occurs when their experience does not match their expectations. In public transportation, negative experiences such as delays, no seats available and lousy driving have more impact than positive experiences. This in contrast to other services providing markets, such as restaurants and entertainment (Backhaus & Bauer, 2001). Not giving this the right priority has a severe impact on the loyalty and satisfaction of travellers. An adequate response can lead to a lot of 'goodwill' among customers, sometimes even more than when service is delivered right away (Hart et al., 1989).

The University of Karlstad (Sweden) is one of the only research institutes that has researched the impact of service failures (critical incidents) on the perceived service quality, satisfaction and experience of travellers in public transportation. The Technical University of Delft has focused more on the technical side with various research into quantifying the impact of unreliability and disruptions on passengers (e.g.: Cats & Jenelius, 2014; Cats, Yap, & van Oort, 2016; van Oort, 2016; Yap, van Oort, van Nes, & van Arem, 2018). In this research the focus is more on the service quality, satisfaction and experience of travellers during disruption from a holistic perspective and therefore the research under the supervision of Edvarsson (1992; 1998) and Friman (Friman, 2004; Friman, Edvardsson, & Garling, 1998; Friman, Edvardsson, & Gärling, 2001a, 2001b; Pedersen, Kristensson, & Friman, 2011) and recently the work of Allen et al. (2018) and van Hagen & van Oort (2019) are more relevant and are cited.

One of the first investigations that looked at service failures in the transportation sector, in terms of dissatisfaction, is the work by Edvardsson (1992) into service breakdowns at an airline. This research showed that delays are the most frequent causes of service failures. Dissatisfaction arose because insufficient information was given about the delay. There is a considerable difference between the ways passengers and staff perceive the causes and handling of service failures. Moreover, the staff is not aware of the importance of clear and correct information when a service failure occurs. For the passenger, it is essential to know why there is a problem and what the likely outcome is as this allows the passenger to be able to influence his/her own situation.

In 1998, Edvardsson repeated this research but now for public transportation. In this research, 12,5% of the reported service failures were information-related and were primarily a matter of lack of information about delays. Edvardsson (1998) also included the role of the Bus Driver in this research by interviewing them about what in their view creates customers dissatisfaction and are the shortcomings in terms of quality for passengers. Results show that Bus Drivers are not fully aware of the importance of their role during disruption and how their actions and way of informing can contribute to better customer experience. Studies of service failures conducted in transit research before have either focussed on customers' or employees' perceptions. However, including both is important because the driver is the employee to whom the customer is most frequently exposed, and the majority of the complains related to employee behaviour (Edvardsson, 1998).

The research group of Friman et al. emphasises that the impact of negative critical incidents has more impact than positive critical incidents on the overall experience. The majority of the travellers encounter negative incidents as 'inappropriate treatment of customers by employees (e.g., willingness to serve, knowledge, and competence); unreliability of the service (e.g., existence and frequency of delays); failure to provide adequate information (e.g., vagueness and inaccessibility of departure and destination information); and inadequate design of vehicles, equipment, and stops (e.g., stops without shelter or little space in the vehicle)' in public transportation (cited (Friman et al., 1998)). This indicates the importance to investigate which measures can contribute to reducing the negative experience of travellers. The article also expresses interest in new information systems, that can hopefully, reduce negative experiences or inaccessible information. Provided that technical equipment and its management plans also need to be improved (Friman, 2004; Friman et al., 2001a, 2001b; Pedersen et al., 2011).

Allen et al. (2018), have analysed written complaints and information from interviews with travellers. This research also confirmed the importance of precise and rapid information. This emerges as an important source of customers perceived quality during a disruption. Furthermore, it shows that in public transportation negative experiences, such as delays, no available seats and lousy driving have more impact than positive experiences.

Van Hagen and Van Oort (2019) combined two elements, namely the actual level of service and the perceived quality to gain insight into customer satisfaction. With looking from traffic engineering and the psychological perspective they are one of the first in the field of public transportation. Results show that the qualities of the satisfiers (top of the pyramid of traveller needs) are far more important than was thought before. This is partly because other research techniques (qualitative) are needed to really understand what is essential for a traveller.

4.2 Travellers' experience

The consumer experience gets a more prominent role in nowadays society. As our society has reached such a level of prosperity that there is a gradual shift from consumption of commodities to goods, services and experiences (Jain, Aagja, & Bagdare, 2017). It is labelled as the experience economy, introduced by Pine & Gilmore (1998) as the next economy after the most recent service economy. An economy in which an experience is a key, associated with a product or service. This makes it a difference with a service economy in which a product or a service is key (Pine & Gilmore, 1998, 1999). Generation Einstein (born after 1980), attaches great importance to information and experience value.

Schmitt (1999) was one of the first researchers that accentuate the importance of customer experience. He took a multidimensional view and identified five types of experiences: sensory (sense), affective (feel), cognitive (think), physical (act), and social identity (relate) experiences. In general, researchers and practitioners agreed on this. Customer experience is defined as holistic, strictly personal, and construct of a multidimensional (cognitive, affective, emotional, social, and physical) responses to a service (Chakravorti, 2011; Gentile et al., 2007; Schmitt, 1999; Verhoef et al., 2009).

In this decade, the importance of holistic customers experiences also penetrated the transportation sector. Travellers are no longer seen as a user, but also as a customer. Not seen solely as a rational being, but rather as emotional too (Gentile et al., 2007). The importance of

comfort and experience, the top layers of the pyramid of customer needs as in Figure 2 is seen. The transition to a more customer-centric approach starts, and is mentioned in the strategy presented by Dutch transportation operators like KLM (KLM, 2015), (NS, 2016) and RET (RET NV., 2016a).

KLM has set its goal to become "the most customer-oriented, innovative and efficient network carrier In Europe". Since 2015, they invest in the 'customer journey' and tackle the customer experience with all employees of all departments with focus pillars on customers solutions, process and contact.

NS has a strategy note, "Spoorslags beter" (translated Back on Track) for the period 2016-2019. Where the passenger as our first, second and third priority. The strategy consists of a comprehensive review of our role and activities, improvements to the services we provide for passengers. Passengers will appreciate this and make even greater use of our services, which will, in turn, benefit our business objective.

RET strives for perfectly organised and executed public transport with the highest quality for the traveller and is currently 'Aardig onderweg' (translated: nicely on the way). We go for comfortable and carefree travel, a reasonable price and service with a smile. With the traveller central to the operation of the company.

Customer experience, in general, has received increasing attention within the academic literature although it is seen as one of its most important research challenges in the coming years (The Marketing Science Institute, 2014). Because of the complexity and increasing number of customer touch-points. However, customer experience research from a holistic perspective in public transportation is scarce. Transport engineering studies mainly focus on which elements, and in what order they influence the customers' experience based on passenger cognitive expectations and perceptions (e.g.: Dell'Olio et al., 2011; Lai & Chen, 2011; Stuart, Mednick, & Bockman, 2000; Susilo & Cats, 2014).

The limited research on this topic is likely since the other experience components; affective, social and physical, results from a complex physical and individual psychological process (Merkert & Pearson, 2015; Oliver, 1977). Although, it is essential that also the affective components related to transportation are evaluated with respect to experience and so fully understand and manage customer experience (Ettema, Friman, Gärling, & Olsson, 2016; Jain et al., 2017; Oliver, 1996). Because it helps to increase the attractiveness of public transport, by reducing the negative experiences and thereby increase rider ship (van Lierop & El-Geneidy, 2016).

Van Hagen (behavioural scientist) published different studies on travel experience in public rail transport in the Netherlands. He was one of the first European researchers that studied the subject from a behavioural perspective that heretofore was firstly mainly studied from a technical perspective by transport engineers. His results on the (emotional) evaluation show the importance of each phase in the total trip. A higher intensity of positive emotions leads to higher customer satisfaction, and higher satisfaction leads to higher loyalty. Thought-provoking is that dissatisfiers are less weighted when travellers are in an excellent mood (van Hagen & Bron, 2013, 2014; van Hagen & de Bruyn, 2012, 2015)

Verhoef et al. (2009) developed a generic experience creation model showing how different experience factors (EFs) and experience components (ECs) form the customer experience, see Figure 8 on the next page. EFs can be defined as customer perceptions of all aspects of a product or service that contribute to the customer experience (Patrício, Fisk, & Falcão e Cunha, 2008). This includes the actual service quality and perceived service quality. ECs can be defined as internal customer responses to the service provided and are driven by customer EFs. These ECs result from a complex physical and psychological individual process (Oliver, 1996) and consist of a cognitive, affective, emotional, social, and physical) responses to a service including the level of satisfaction.

Carreire et al. (2013;2014) build on those concepts of EFs and ECs and defined the important EFs which influence ECs for travellers. This was done by using in-depth qualitative approach that consisted of observations, semi-structured interviews. The important EFs following from this research are included in Figure 8. Carreire et al. (2013) also identified that it is crucial to gain more insight into the specific passenger emotional responses to public transportation to be able to obtain a holistic understanding of travel experiences. Also they noticed the lack of research on the particular negative emotions of travellers. The travel experience is more complicated than traditional transit service quality it extended in time and it concerns all interaction moment through multiple channels from the past to now.

In this research, the focus is to get a better understanding of the traveller experience during disruptions, the moments they are having negative emotions. As more holistic conceptualisation of customer experience is still scarce and have not been adapted to the transportation context yet. Traveller information is one of the EFs that contributes to the traveller experience and is known as an important EF. In this research is looked at the (support) role during these negative emotions and contributes to the research gap on this subject. Because understanding is important to better plan transportation policy, vehicle design and service management.

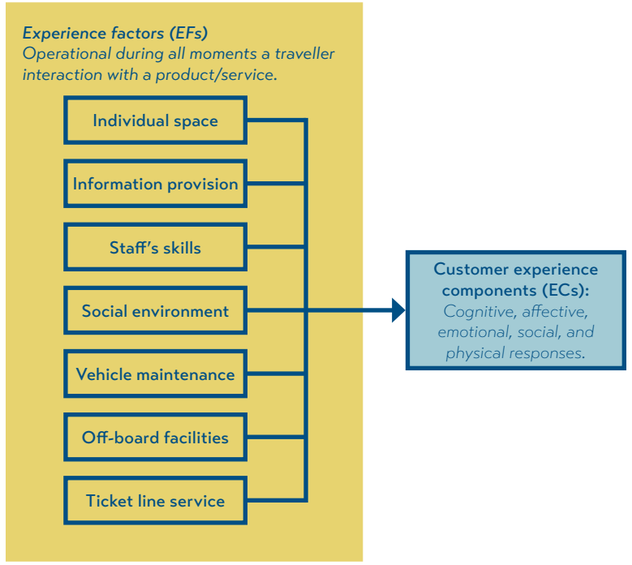


Figure 8. Overview of traveller experiment factors and experience components (Carreira et al., 2013; Verhoef et al., 2009).

4.2.1 Customer Journey Mapping

Customer journey mapping (CJM) is an increasingly popular strategic management tool that is praised by both academics and practitioners. Because of its usefulness in understanding a customer experience with a service (Rosenbaum, Otalora, & Ramírez, 2017). A Customer Journey is a schematic representation of the services of a company from a customer perspective consisting of various episodes, including associated contact moments (touch-points). When this is mapped out, it is relevant to find out what the experience of the service is during the various episodes of the Customer Journey (van Hagen & Bron, 2014). The emotions of customers for each episode in the Customer Journey are mapped and then the perceived value of the in the form of an emotion curve can be plotted. When having a look at the emotions of public transport travellers, positive emotions of happiness, excitement and relaxation, and negative emotions of stress, fear, sadness, anger, annoyance, frustration, boredom are experienced (Carreira et al., 2013; van Hagen & Bron, 2013). Public transport traveller experience more negative emotions and fewer positive emotions than other travellers (Gatersleben & Uzzell, 2007). The emotion curve provides insight into the peak and off-peak moments in current service provision and provides insight into where there is potential for improvement based on the needs of the customer. It is not necessary that all experiences during the customer journey show a peak, a positive experience. The trick is to prevent the valleys (negative emotions, such as stress) and to achieve a number of peaks from the more neutral moments, with a positive experience at the end, the so-called "peak end rule" which is further explained in sub-chapter 4.3.

The CJM of KLM, NS and RET will here be explained in succession. These CJM's are relevant as later in this study a CJM will be made about the bus passenger and their experience with the service of the RET (during disruption).

KLM

The KLM has made a CJM in alignment with their new Customer Intimacy direction, together with Born05 (design studio) however this document is not publicly available. However, Kasti's research on 'improving passenger experience with disruption handling through proactive information design' for KLM contains a CJM based on the research results related to ten frequent flyers members of the SkyTeam (Kasti, 2017). Kasti published in her research different CJM for different types of disruption. The CJM in case of a smooth journey and the one with a delay at the gate is shown here (Figure 9). These CJM are relevant in a later stage of this research to compare with the CJM of the research on the experience of bus travellers (during disruption). In the research of Kasti a delay gives the most negative experience. A cancellation is seen as a manageable situation. It is a solid fact and the next steps taken are clear for a passenger. Whereas, delays are causing more frustration, stress and anger because it is an unstable situation where the passenger is not in control (Kasti, 2017). Delays are also often encountered by Public transport traveller which makes comparing the results of Kasti's research with this research at a later stage possible.

Key insights from this CJM are:

- The information passengers need is the following: The fact of disruption, the reason of the problem, the steps that KLM is making towards the solution, the steps the passengers should take, options, alternatives and any available services at the airport while they are waiting.
- Passengers do not trust the announcements because they think the airline is not honest or is giving false information on purpose. Transparency, accuracy and honest information is a very important value.
- Disruption is a negative experience which triggers the basic instincts of the people. Cultural and gender differences will become visible when dealing with the disruption.
- Passengers are more patient with technical errors than with human errors.

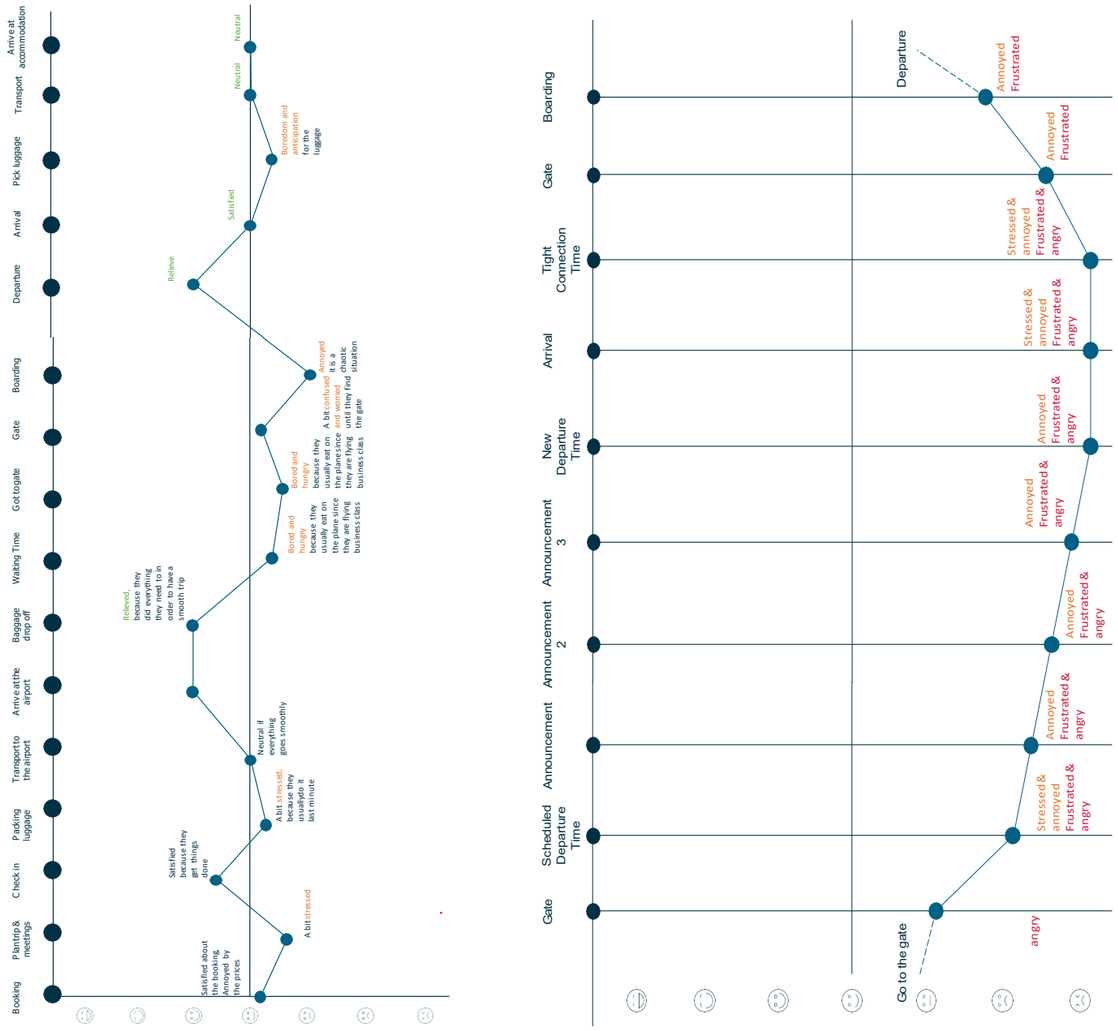


Figure 9. Customer Journey Map KLM, journey without any disruption, and during a delay at the gate (Kasti, 2017).

NS

NS used CJM to seek on the customers' deeper desires and motivations to be able to focus on those elements that enhance customer satisfaction. The CJM shown in Figure 10, was developed using qualitative research based on in-depth interviews to explore the (unconscious) needs, wishes, associations and motives of travellers. A total of 27 participants were in-depth interviewed. Besides that, the input is used from 65 customers (lust and must passengers) which observe their own journey through photos and quotes during an intensive five-week period (van Hagen & Bron, 2014).

This study distinguishes between lust and must passengers. Lust travellers are those who have a social or recreational motive. They travel 1-3 days a month (or less) by train and often at the weekend or in off-peak hours during the week. Must travellers are those who commute to school or work. They travel almost daily (on weekdays) during peak hours (van Hagen & Bron, 2014). The CJM show that the emotional curves of lust and must travellers are mostly in sync. However, the curve of the must traveller is in its entirety shallower. This can be explained by the fact that this journey is a routine, he/she knows what to expect and will react less emotionally to certain (unknown) situations. The only peak in the CJM is sitting on the train. As having a seat means that the time spent on the train can also be considered as valuable time (= personal time). Ensuring that travellers have a seat is essential for the perceived value of the train service.

Another touch point is when travellers arrive at the station, the curve shown that they do not feel welcome. The station environment and its amenities are insufficient appealing to the travellers' desire to feel welcome. Improving this by personal attention from employees can play an important role here and would result in a more significant emotional bond between the traveller and NS (van Hagen & Bron, 2014).

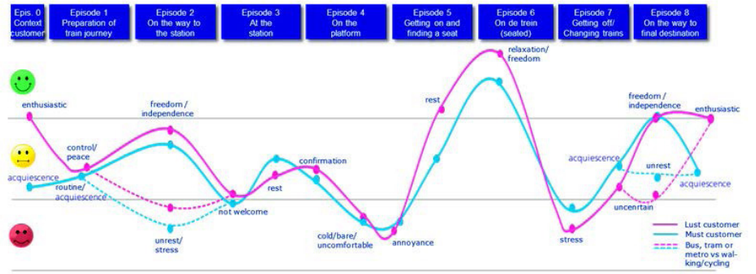


Figure 10. Customer journey map train travel (van Hagen & Bron, 2014)

RET

RET asked Altuiton to carry out a study to Gain in-depth insight into the emotional travel experience, incentives and motives for the choice traveller (RET NV., 2016b). The choice traveller is the largest target group of the RET however little is known about this group. In total 15 travellers participate in an experience in-depth interview. Based on the in-depth insights of the choice travellers RET wants to segment effectively and offer a tailor-made service to choice travellers. In this research a distinction is made between three groups of choice travellers; the experienced choice traveller, the average experienced choice traveller and the inexperienced choice traveller. Each group is about the same size. The experienced choice traveller is familiar with the various travel options and likes to use public transport. The average experienced choice traveller is familiar with the travel options of certain routes. The inexperienced choice traveller is unfamiliar with the travel options.

The journey is divided into seven episodes and the emotion curve for the three groups is shown in Figure 11. The emotional curves for the three groups of choice travellers are almost parallel. Where experienced choice traveller experience much more positive emotions than the inexperienced choice traveller. The episodes are really high level the whole journey from making the decision to travel until arriving at the destination is mapped in seven episode. It is therefore hard to define what is behind the peak and off-peak moments. The findings are therefore also high level and it is hard to translate them to goals.

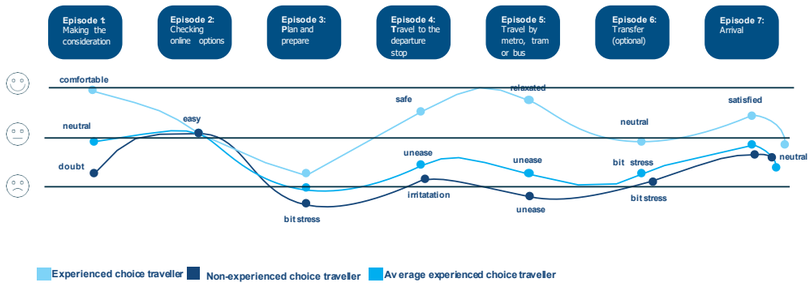


Figure 11. Customer Journey Map RET, for choice traveller with different experience levels (RET NV., 2016b).

Findings from this study are:

- A choice traveller takes more margin while travelling, which means that on average they wait more, which in turn has a negative impact on travel perception.
- They are experiencing stress due to the unknown of travelling by public transport and are having difficulty accepting dependence on public transport.
- They are more likely to opt for public transport by bad weather, which in turn often results in negative experiences due to the crowds.
- Conclusion is that the combination of the above points, lower knowledge and experience are added up and there is a danger that the choice traveller will 'get stuck' in a vicious circle.

4.3 Travellers satisfaction

Travellers satisfaction has become a more important factor in evaluating the performance of a public transport system. The goal of a public transport operator is satisfied travellers and in the concession agreements are made about a threshold. Therefore, among other things, the results of the 'OV-klantenbarometer' are used. Fines or bonuses are given to the operator when the overall customer satisfaction falls below or rises above the set threshold (MRDH, 2018). In the Netherlands, the 'OV-klantenbarometer' is a research set up by Goudappel Coffeng and conducted under the supervision of CROW. The set-up of the 'OV-klantenbarometer' has changed over the years, which is not strange when looking at the perception of customer satisfaction over the years in research. This is due to change due to more research in the composition of the EFs as mentioned in the last sub-chapter 4.2. And the changes in the hierarchy of the EFs to the overall traveller experience as Van Hagen and Van Oort (van Hagen & van Oort, 2019) showed that the qualities of the satisfiers (top of the pyramid of traveller needs) are far more important than was thought before.

Throughout the years, the view on how the overall traveller satisfaction is determined has changed. Some examples are, (Koopmans, 1960) suggesting that the satisfaction with each touch point simply adds up to the total utility of an experience. Supposing the independence of the touch point. Bolton and Drew (Bolton & Drew, 1992) advocates a conflicting view and suggesting that the first service encounter has the greatest impact on customer evaluations of service performance.

Kahneman et al. (1993) defines the peak-end rule which is a psychological phenomenon. The rule says that the evaluation of the experience (level of satisfaction) during a period of time is predominantly by two memories: during the peak and at the end.

- The peak is the moment people experience the strongest emotions, which may be positive or negative.
- The end is experience/emotion at the end is important for the overall assessment of the experience in its.

Friman et al. (2001a) proposed a model that explains how negative critical incidents affect customers satisfaction. The model stated that the source of cumulative attribute specific satisfactions it the frequencies of remembered negative critical incidents. Both have direct effects on cumulative overall satisfaction. In a follow-up study by Friman et al. (2001b) is confirmed that attribute satisfaction is a function of the frequency of negative critical incidents, and the overall satisfaction is a function of attribute satisfaction. However, there is a variance in consequence of the frequencies of different types of negative critical incidents on overall satisfaction varied (Friman, 2004a). This emphasises the impact of negative critical incidents (e.g. delays) on experience or travel as they have more impact than positive critical incidents. Thus, it is of importance to investigate which measures can contribute to reducing the negative experience of travellers. These negative incidents can be indicated as a service failure what is defined as service performance that fails to meet a customer's expectations. Service failure is the opposite of customer satisfaction (Smith et al., 1999). As mentioned earlier an adequate response by a service leads to a lot of 'goodwill' among customers, sometimes even more than when service is delivered right away. This is known as the service recovery paradox. McCollough and Bharadwaj (1992) stated that the satisfaction of the service is more highly after the company has corrected a problem with their service, compared to how they would regard the company if non-faulty service had been provided (Figure 12). The reason behind the service recovery paradox is that a successful recovery increases the assurance and confidence from the customer.

Awareness of these principles contribute to a better understanding of customer satisfaction. The studies do emphasise the need for the public transportation sector to carefully understand, design and manage the travel experience from a holistic perspective. This requires an integrated product-service approach. Recent work by van Hagen and Van Oort (2019) confirms the above-addressed results of the studies. In their research, the current insights into customer satisfaction from two perspectives, namely the traffic engineering and the psychological perspective are combined. A lack of consciousness for the perceived service quality and missing quality management system are impacting customer satisfaction, passenger demand, investment decisions and revenue (Anderson, Condry, Findlay, Brage-Ardao, & Li, 2013).

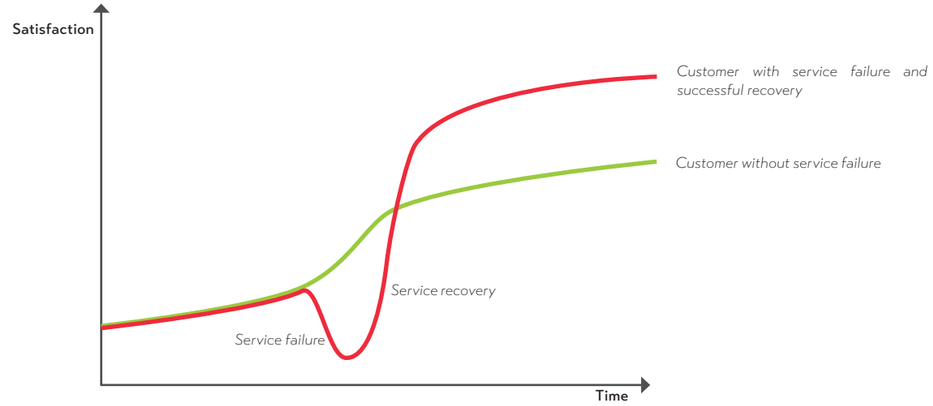


Figure 12. Service failure paradox (McCollough and Bharadwaj, 1992).

5 Literature summary and conclusion

The literature research on traveller information, disruption and traveller experience in public transportation has led to lessons learned and the identification of a few opportunities to improve the existing practise.

Travellers information:
There are some basic traveller information needs which apply like; accurate, timely, up-to-date, honest, and transparent information. The value of information starts to become very high and actual usage of the information increases if it is multi-modal, personalised, reliable, intelligent, up-to-date, easy to access, etcetera. However, this requires a lot of work from the system. Besides, different personal characteristics and circumstances influence the extent to which people need traveller information. This requires a kind of customisation from the system. The non-availability of information that meets the needs of the traveller can have an impact on satisfaction of the public transport system as a whole and affects various factors from the pyramid or traveller needs such as comfort, security and reliability.

Big steps already have been made in the provision of real-time traveller information, but due to the exponential curve in the value versus quality aspects of information, the final steps to success cost a great deal of effort. With a view to the further steps that should be taken to get a clear picture of the real travellers information needs and pain-point. Because only then the services can be shaped in such a way that they respond better to perceived urgency among the travellers. This means that for further research a demand-oriented approach is desired instead of the supply-oriented approach that is practiced now.

Disruption:
The occurrence of disruption is almost inherent to services and a disrupted situation is an important issue for travellers, public transport operators and infrastructure managers. Disruption is a negative situation by definition and traveller can develop highly negative feelings (anxiety, stress, frustration, anger). Each individual experiences disruption differently, depending on personality and previous experiences and expectations. Traveller information during disruption has the potential to significantly improve the passenger comfort level, decrease anxiety levels and influences their travel behaviour (Brakewood & Watkins, 2019). However, there is a paradox. The ability to take note, comprehend, retain and process the information during disruption is low and the 'mental costs' for the traveller to derive the right course of action is high. But they also indicate that the reliability of the information is at its worst. Besides that Public transport operators provide everyone with general information. That works well if there is no disruption but during a disruption many travellers have different expectations and needs. Resulting in the fact that during disruption traveller information is at its worst as it should be at its best. This is also reflected in the low score of traveller information during disruptions in the public transport customer barometer.

Important is the notice of the service recovery paradox, which actually shows that there are opportunities for the operator to turn the negative situation into a positive situation. However, this is where the gap is, in both practise and research. In addition to the great scarcity in research and knowledge of the holistic experience in the regular situation, the scarcity is even more in the field of the disrupted situation in public transport. This is partly because the holistic approach requires different research techniques than those previously used in public transport engineering. An interdisciplinary approach is needed with other fields where there is more knowledge about service failures, recovery and customer needs and behaviour.

Traveller experience
Our society has shifted from consumption of commodities to goods, services and experiences. Experience takes place on different levels: sensory (sense), affective (feel), cognitive (think), physical (act), and social identity (relate) and it is holistic and strictly personal. An experience is a cognitive, affective, emotional, social, and physical responses to a service and product, which makes it a complex subject to investigate as a whole (Gentile et al., 2007). Figure 13, is a combined and simplistic created rendering of the traveller experience and satisfaction process combining previous models and researches (Friman, 2004b; Friman et al., 2001b; Gentile et al., 2007; Smith et al., 1999; Verhoef et al., 2009). The model show the relationships between needs, service quality, experience and satisfaction and indicating what is part of the experience factors (EFs) and experience components (ECs).

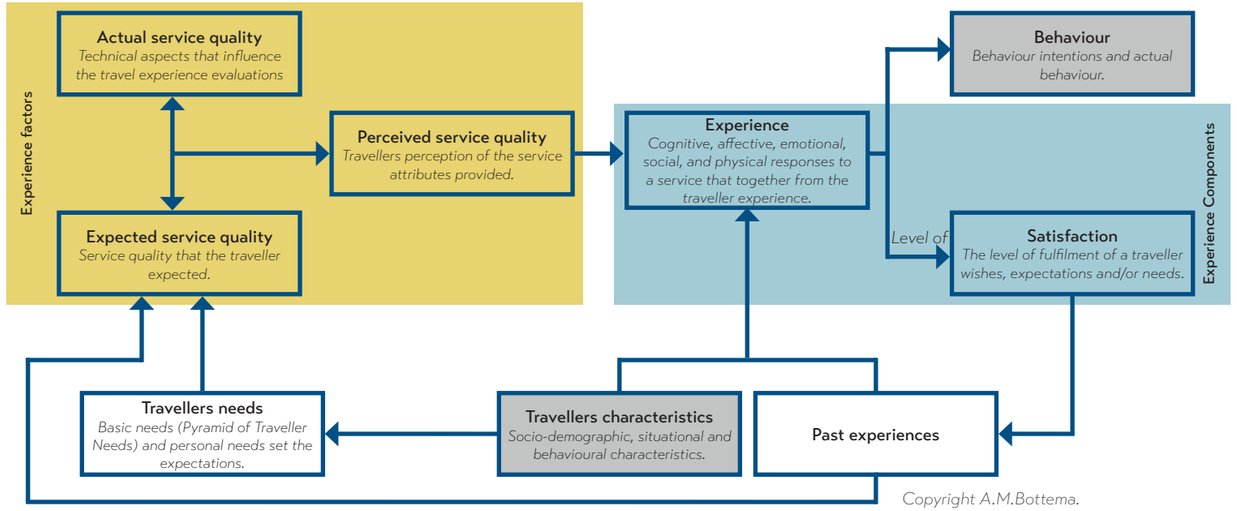
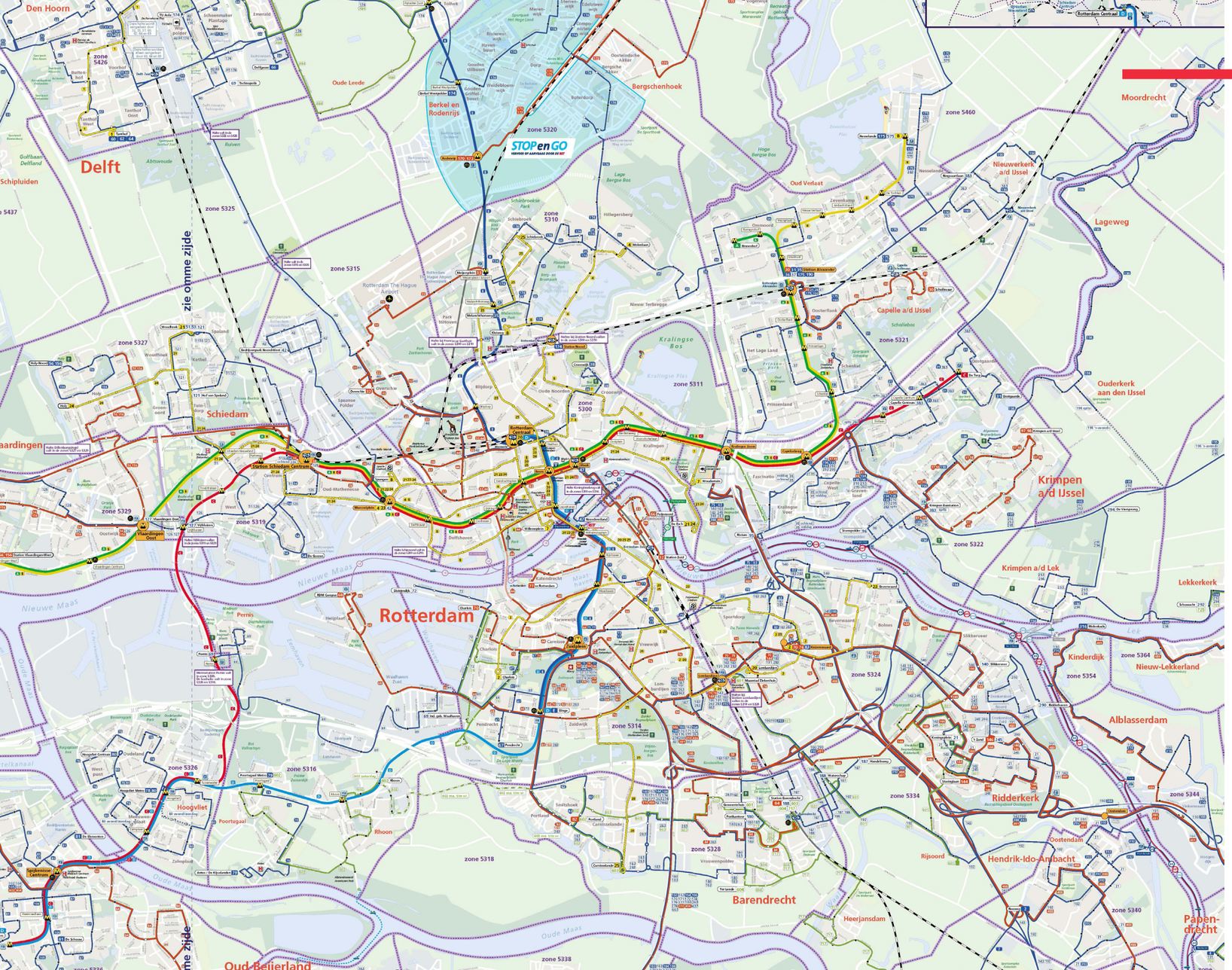


Figure 13. Traveller satisfaction process and experience model - copyright A.M.Bottema.

In the field of public transportation the focus was mostly on technical aspects of the service (actual service quality). However, recently a shift is seen to more emotional and social aspects of the service experience (perceived service quality). Although, this is still in its infancy certainly compared to others service fields. There is a lack of research into mapping the entire process of the journey and the associated touch-points. This process can be mapped by creating a customer journey map (CJM). The RET and the NS have taken their first steps but these CJM are still very high-level. The passenger experience extends to the moments before, during and after the journey. The travel experience is driven by factors, some of which are not in control by the operator. Further research is needed for a full understanding of the travel experience from a holistic perspective, both in terms of travel EFs and ECs from the whole chain of before, during and after the journey in both the regular as a disrupted situation. This ensures that the public transportation becomes really customer-centric and that all systems contribute to supporting the traveller and the experience.



Context

This section will describe the overall context in which this research was conducted by describing RET, disruption and traveller information context. The purpose of this section is to explain what RET does, what their mission is and where they currently stand. This is done based on their business plan, internal documentation and working instructions. The first part of this chapter will present the RET mission and strategy and how they plan to increase their travellers experience and satisfaction. This is followed by the disruption context which will look at the different types of disruptions and at which frequency they occur. Additionally, the other main actors are introduced, which will focus on their role in the disruption handling process. The following part will elaborate on the traveller information process within RET and will describe the related traveller information systems. The final section of this chapter put things in broader perspective by looking at the traveller information provision of other operators

6 RET, disruptions and traveller information

6.1 RET NV. : Rotterdamse Elektrische Tram NV.

The history of the RET goes back to 1878 and started with the transportation of travellers by horse trams. Nowadays they transport around 600,000 travellers each day with more than 3,500 employees, 270 buses, 110 trams, 160 subways and 1 Fast Ferry.

RET has been providing bus transport in Rotterdam since 1928. First as a municipal service of Rotterdam but since 2007 as an independent NV, with the municipality of Rotterdam and the Rotterdam The Hague Metropolitan Region (MRDH) as the sole shareholders. MRDH is a collaboration between 23 municipalities in the Rotterdam- The Hague area. In 2012 they acquired the bus concession lasting until 2019. In May 2017 the client, the MRDH, announced that for the period 2020 - 2034 the Rotterdam Bus concession would also be assigned to RET. The concession includes bus transport in the municipalities of; Albrandswaard, Capelle aan den IJssel, Rotterdam, Schiedam, Vlaardingen, Barendrecht, Krimpen aan den IJssel, Lansingerland, Maassluis and Ridderkerk.

In January 2012, RET Bus BV. established. This company is a subsidiary of RET NV. and was established to participate in the tender competition for the concession 2012-2019. RET Bus BV. carries out the concession for its own account and risk. It is a company in which the operation and maintenance of the buses is carried out. RET Bus BV. functions as a recognizable unit within RET NV.. The Bus manager is responsible for 'staff and equipment' and this staff is employed by RET Bus BV. In addition, RET Bus makes use of the knowledge and experience of the different parts of RET NV. For this market conditions and rates are applied. This knowledge and experience, and also continuous renewal and adjustment of working methods, are anchored within RET NV..

See Appendix 1, for the organogram of the RET NV., the Bus BV..

6.1.1 RET's mission, vision and strategy on traveller experience

Referring back to the pyramid of travellers need (section 1.2) the lower sections like punctuality, frequency, cleanliness, safety etc. have been improved in recent years. This is appreciated by the travellers as the customer satisfaction level has increased from around 73% to 77% in the past 10 years for the bus. To be able to reach their goal of an 80% score, further improvement of the experience and attractive requirements need to be added otherwise the customer satisfaction level will stabilise around 75% when only the hard quality characteristics are optimised (CROW-KpVV, 2017a). To achieve this, the RET has formulated a mission, vision and strategy.

RET'S mission statement is: 'De perfecte reis' (translated: The prefect journey): perfectly organised and executed public transport with the highest quality for the traveller of today and the future. RET communicates its mission and vision on its website, in the annual report and internal documents.

RET'S vision statement stated in the annual report of 2018:
Our goal is to travel from door to door in the Randstad within one hour in collaboration with our partners. RET accomplishes this as mobility manager for the Rotterdam The Hague Metropolitan Area and covers its entire concession area. As a mobility manager, RET connects all mobilities that are part of the door-to-door journey. RET strives for perfectly organised and executed public transport with the highest quality for the traveller and is currently 'Aardig onderweg' (translated: nicely on the way). We go for comfortable and carefree travel, a reasonable price and service with a smile. With the traveller central to the operation of the company.

RET wants to achieve growth in the number of passenger-kilometres and to increase its market share in the total mobility requirement. It is driven to innovate and invest in excellent infrastructure, modern equipment, more and better facilities and knowledgeable and service-oriented staff and implementing innovations continuously.

RET wants to distinguish itself as a sustainable social enterprise, which contributes to the social functioning of the Rotterdam region through improving mobility in the Randstad in particular. RET is a social connector of the city of Rotterdam. This is reflected in active collaboration on many areas between the RET, the City Region, the municipality of Rotterdam (RET NV., 2018b).

RET's strategy has a comprehensive strategy to accomplish the set goals. The strategy is determined by a combination of MRDH imposed regulations and its own organisational goals. They are presented in their business plan 2019-2021 (RET NV., 2019). Their 5 strategic pillars for 2021 are:

- **Customer satisfaction:** the ambition to achieve a score of 80% by 2021 in "OV-klantenbarometer in 2021.
- **Employee satisfaction and employability:** RET strives for satisfied employees and customers. That is why the ambition is to achieve a score of 80% on employee satisfaction in 2021 as well. Due to the shortage in the labour market and the increasing demand for (technical) personnel, the RET wants to present itself as an attractive employer with modern working conditions and excellent career opportunities.
- **Return:** to remain competitive in the current and future market conditions, they want to achieve minimum returns of 5 million Euros per annum.
- **Sustainability:** reduce the amount of CO2 emissions per passenger kilometre by 75% compared to 2017. This was 154 CO2 / gr passenger km for the bus, 91 CO2 / gr passenger km for the tram and 68 CO2 / gr passenger km for the metro in 2017. Furthermore, using sustainably generated energy, work sustainable and take corporate social responsibility (RET NV., 2018b).
- **Safety:** grow a more pro-active culture where safety leadership and values are the driving force behind continuous improvements.

They achieve this by implementing four, partly coherent, strategic priorities and associated initiatives: promises to the traveller, promises to the employee, promises to the region and a healthy organisation. This research contributes to the pillar customer satisfaction and is related to the strategic priority promise to the traveller. See the text-box for the translation of this promise. They are achieving higher customer satisfaction by improving the reliability of the timetable. By reducing the number of disruptions, the timetable will become more accurate and trustworthy. Another way RET wants to achieve higher customer satisfaction is to improve the customer experience. This is done by anticipating the emotional aspects reducing stress moments and increasing happiness moments. One of the projects that relates to the top of the customer pyramid is the deployment of experience elements at the stations. This is done through scent, light, music and decoration of the stations. For the coming years, it is planned to implement this at as many stations as possible.

Promise to the traveller

"You are our first priority and we promise you to go from good to even better. Your convenience and (social) safety are central. You will experience a pleasant journey through our service-oriented and customer-friendly approach. As you know, you can count on us for a safe and comfortable journey in which we strive for you to travel door-to-door within an hour in the Randstad. In the unlikely event that something goes wrong, we will provide you with good information and transfer options. We listen to your wishes and needs in the future. You can count on us to continue to look for innovative solutions in the field of mobility, payment methods and information provision. We promise to make an active contribution to a better society and make an effort to jointly look at widely supported solutions for social mobility problems. That is why you like to travel with us: RET as an urban transport operator with the highest customer satisfaction."

Translated and cited from "Bedrijfsplan 2019-2012" (RET NV., 2019)

Relevant for this research are their projects related to traveller information which is also part of the top of the customer pyramid. Known is that (unexpected) disruption ensures that travellers experience more stress during their journey. RET stated that internal processes are in order, the subject has priority, technical processes are optimised, they have employed full-time Traveller Informants, and travellers give us already a 5.9 out of 10. To improve that rating to 7 out of ten, RET sets themselves the goal of keeping travellers informed as actual as possible in the event of disruptions. A traveller needs to know what his alternative is as quickly as possible. Beside by continuous monitoring of the DRIMS, pilots with E-ink displays and develop new initiatives such as an RET alert, that provides the traveller in the RET Real Time app with alternative travel advice by disruptions can all contribute to better informing the traveller. In addition, there is also a focus on the human aspect by training drivers and drivers to inform travellers even more specifically if they are faced with detours and delays.

Also, the results of the research can be useful for the RET, due to the qualitative aspect of the research that can give them better insight into the experience of the traveller and their own internal processes. Currently RET is mostly depending on the quantitative response of the 'OV-klantenbarometer' or by calling in external parties for conducting qualitative traveller research, which is costly. As the RET currently does not have a customer panel to gain qualitative feedback. Beside RET state that their internal processes are in order and technical processes are optimised, whether this is indeed the case will be objectively examined in this study.

6.2 The disruption context

This research focuses on the unplanned disruptions, as information provision due to the unpredictability of the event is generally more difficult to manages. First some definitions of types of disruptions are presented before giving an idea of the amount of disruptions that taking place in the bus-service of RET by analysing IRMS-data (IRMS = Incident Registration Management System). The actors involved in the disruption handling context and their responsibilities are described. Then the traveller information provision context is elaborate on describing the process, actors and channels.

6.2.1 Types of disruption

Disruptions occurring in the exploitation of planned bus services can be classified in different ways, the below stated classification are used by the RET:

Disruptions occurring in the exploitation of planned bus services can be classified in different ways:

Planned vs. Unplanned disruptions:

Planned disruptions: This concerns scheduled and announced changes to the timetable, when the cause is known in advance and so the consequences are determined in advance. The transporter provides alternative transport or indicates how to travel around the planned disruption. The measures to be implemented by the operator are described in scenarios.

Unplanned disruptions: These are incidents that occur unexpectedly (and not planned) and lead to bus failures or ad-hoc changes to the bus service. The cause is determined at the start of the disruption, the consequences are then determined and the measures to be implemented are described in scenarios or are taken at that time.

Primary vs. secondary disruptions:

Primary disruption: Deviations in departure times with respect to the timetable (no trip outage).

Secondary disruption: Limited availability of equipment or infrastructure (resulting in a trip failure and/or detour).

Technical vs. Operational

Technical: Systems failures or Technical Issues. Within the RET BUS BV. the following subdivision is used (RET NV., n.d.-a)

- Class A: Safety at risk, or cannot drive in a technically responsible manner. Fault results in operating loss (DRU).
- Class B: Passengers and / or driver are seriously burdened or hindered.
- Class F: Passengers and / or driver are clearly burdened or hindered.
- Class C: Minor technical damage or complaint, which does not cause immediate danger or major nuisance.

Operational: Internal or External issues. Internal issues could be equipment and / or staff shortages. Examples of external operational issues are roadblocks, collision with third party, traffic and extreme weather conditions.

6.2.2 Bus disruption stats

Since April 2016, RET works with a self-developed Incident Registration Management System (IRMS). Every operational incident in the RET transport system is entered into the IRMS by Traffic Controller. The IRMS then supports the handling of the incident by determining the incident nature and class, alerting and informing the organisation, advising on the handling strategy and registering the measures taken. The introduction of the IRMS makes the handling of incidents more efficient and more structured and more data becomes available for analysis of the incident and process afterwards.

Within IRMS following different types of operational disruptions for the bus are recognised: **Accident, Disruption delay, Aggression, Equipment & infrastructure malfunction, Notification, Hazardous and / or environmentally harmful substance, Fire / smoke / explosion**. Per category there is a classification division from small to extra-large that are used to classify an incident. In Appendix 2, an overview of the IRMS categories and classification.

Classification

Small	Duration of Disruption < 1 hour, no media attention
Medium	Duration of Disruption 1-2 hour, possible media attention
Large	Duration of Disruption 2-4 hour, local/national media attention
Extra Large	Duration of Disruption >4 hour, national/international media attention

The following part will provide some more detailed insight into the overall disruption handling challenge at the RET's bus department. This will be done by analysing all entries in the RET Incident Registration Management System (IRMS) over the past two years (July 2017 – June 2019). Two statements in advance regarding IRMS are, that RET in the disruption reports mainly focuses on the duration and frequency of occurrence. However, this gives no insights in the number of traveller affected and the total travellers delay. Also the extent to which travels are inconvenienced is indeed not fully expressed by duration and frequency (Barron, Melo, Cohen, & Anderson, 2013). Barron et al. (2013) argued that managing a public transport system on the basis of the number of travellers affected and total traveller delays, instead of focus on incident frequency, leads to better insight of the impact of certain disruption and eventually leads PTOs to direct resources and investments in a way that benefits the traveller.

Firstly, the data confirms a general assumption that most incidents occur during the morning and afternoon rush hour period (07:00-10:00h and 16:00-19:00h), as can be seen in the graph in Figure 14, as 42% of all incidents are reported within these two 3-hour time widows. The overall size of the disruption challenge becomes imminent with an average amount of disruption of more than 4 per days, varying from 1 to 37. The duration of the delays incurred corresponding with these incidents is on average, around 60 minutes, although this number is slightly skewed upwards as only the relatively larger incidents are logged in the IRMS-system.

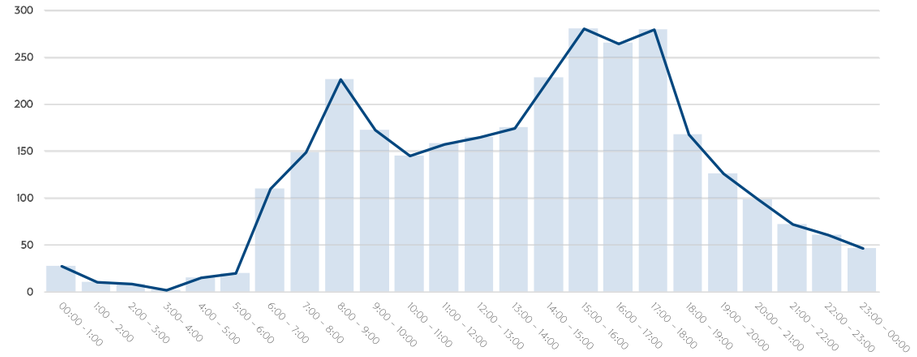


Figure 14. Overview of the average number of incidents per hour of the day for the period June 2017 - June 2019.

Another interesting observation is that the incident duration is not necessarily always shorter than disruption duration, which one might expect. There are quite some cases in which the incident duration is longer than the disruption, for example, in case of equipment failure on a bus, where travellers are then picked up by an additional deployed bus. Another interesting aspect to take into consideration here is that RET for some bus lines uses a principal called interlining. Which means that individual buses, on the same day, are used for multiple different lines. For example, the specific bus operating a certain line might at the end station of that line change to a different line to another destination on its next journey. This then automatically means that in case of interlining, an incident with a specific bus can have an impact on multiple and/or different lines. Which are not necessarily all captured as separate events in the IRMS System.

For tracking the data around all these different incidents, the IRMS-system uses seven different categories to distinguish the nature of the incident. These different categories are listed below and vary from hardware to interpersonal related incidents. As can be seen in the Figure 15 a pie chart, more than half of the incidents are a result of two different types of incidents; an accident or collision (32.4%) or equipment and/or infrastructure problems (31.5%). An additional interesting observation is that the 'other' category is used quite frequently, namely 255 of the times, while two other categories 'Dangerous Goods' and 'Fire' are hardly ever used. When diving a bit deeper in the dataset underpinning this graph, it can be concluded that the quality of the data entries in terms of classification could be more accurately registered. Additionally, it might be worthwhile for RET to reconsider the review the subset of categories based on historic frequency of occurrence.

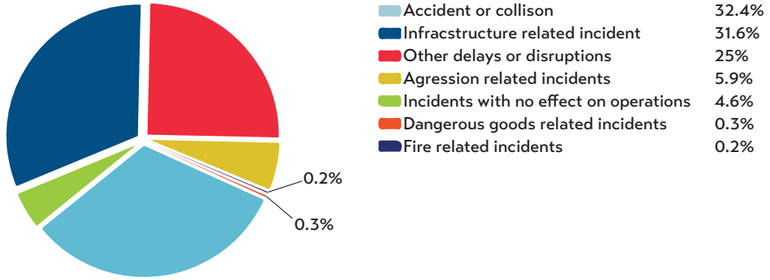


Figure 15. Distribution of different incident cause categories.

6.2.3 Disruption handling context

Within the RET different stakeholder are involved or could be involved by a disruption of the bus. The disruption handling is guided from the Central Traffic Control Centre (CVL). The CVL controls the transport processes of the metro, bus and tram. Timetables are carefully monitored and in the event of disruptions in the transport process, a Traffic Controller manages everything in the right direction. In addition, at the CVL the (social) safety of passengers and staff both at stations and on platforms are monitored with the help of cameras and assistance from station staff, ticket inspectors (COVs) and the investigation officers with special legal authority (BOA's OV). The two main actors involved in around the exploitation of the bus and related traveller information are the Traffic Controller BUS (VL) and the Traveller Informant (RI). Their primary responsibilities are described next. Figure 16 is a drawing of the floorplan of the CVL .

Figure 16. Drawing of current floor plan of the CVL.

Traffic Controller Bus (VL)

For the bus, there are two Traffic Controllers (Verkeersleiders – VL) between 6:00/21:30h responsible for their own area, buses and drivers. During peak hours 7:00h/9:00h and 16:00/18:30h there are around 230 buses in operations.

- **Bus Table North:** All bus lines departing from the garages Kleiweg and Krimpen, most operation at the north side of the Maas.
- **Bus Table South:** All bus lines departing from the garages Sluisdijk and Ridderker, most operation at the south side of the Maas.

After 21:30h and in the weekends one Traffic Controller is present and manages everything from Table South, this are around 65 buses after 21:30h and around 150 Buses in the weekend including 13 BOB-Buses operation between 0:20/7:40h on Friday and Saturday nights.

Together with the driver, the VL ensures that the timetable is maintained. In the event of deviations and irregularities, the VL adjusts to make the process run smoothly. This is often done in consultation with the driver. This is done by active monitoring, guiding and correcting the RET exploitation process & Bus Drivers and in the event of disruptions and calamities, take targeted action to prevent further escalation of the disruption. The exploitation is monitored in the Exploitation Management System (Exploitatie Beheer Systeem, EBS). The traffic control takes the necessary measures in EBS; takes bus partially out of service, cancels ride, changes vehicles, adds additional trips and assigns, de-registers and changes bus services. The Traffic Controller as the first focal point for Bus Drivers in case they have certain queries. Besides that, the Traffic Controller is also in direct contact with other authorities such as the municipality and emergency services. Also under his responsibility falls to inform the Traveller Informant by delays, unplanned deviations and cancelled bus trips. A provide the RI information about the impacted bus-line(s), direction(s), and expected duration.

Traveller Informant (RI)

There is one Traveller Informant (Reizigers informant-RI) at the CVL, present from 5:30h in the morning until 1:00h in the night. The Traveller Informant is responsible that the traveller information from the metro, tram, bus and ferry are quickly and clearly, according to the 'OPGA-principle' are broadcast for travellers and RET employees. For the Metro, the travel informant is also responsible for broadcasting audio messages at the stations.

The 'OPGA-principle' means that the traveller information message is composed of the Cause (O), a Prognosis (P), the Consequence (G) and when available an Advice (A). The advice is most of the times not given for unplanned disruptions. As an example:

"Due to a defective bus (O) a trip has been cancelled in both directions on line 97 (G). Take into account an extra travel time of up to 15 minutes (A)."

The Traveller Informant makes use of RIVER, ReisInformatie VERbeterd , translated 'Travel Information Improved', in this application, both unplanned and planned disruptions are recorded and distributed to various information channels. The working process and responsibilities for the Traveller Informant are:

1. Reports about unplanned disruptions arrive at the passenger informant, via the Traffic Controller or directly from the IRMS in which a Traffic Controller reports disruptions. Planned disruptions are sent in various forms and by various channels to the Traveller Informant.
2. The Traveller Informant draws up a text about the disruption according to the OPGA principle, in a choice menu, standardised text messages can be selected, see Appendix 3 for the text options.
3. The Traveller Informant may, if necessary, add additional travel information.
4. The Traveller Informant chooses the publication channels, for which agreements apply for which channel is used in which situation (See Table 3.)
5. The passenger informant can scale up the handling of the situation (= more channels) and reduce it (= fewer channels).
6. The Traffic Controller indicates when the situation is 'regular' again. The passenger informant ends the disruption as the last step of the dismantling, and this is automatically processed correctly in all systems.
7. At the end of the day around midnight the Traveller Informant, checks whether no outdated messages have been published, and closes any outdated messages.

It is for the Traveller Informant not possible to place directly from RIVER free-text messages on the DRIS signs outside at the stops. Here for the program Geo-GUI (Geographic User Interface) is used. Geo-GUI using a base map of the work area where the displays are located. Stops to which displays are linked can be grouped and selected, after which texts (traveller information) on DRIS can be published and maintained.

Table 3. RET travel informant protocol for channel use (RET NV., n.d.-b).

	Intranet	RET Real Time App	Website	Twitter	DRIS (Geo-GUI)	In-vehicle and station screens	EBS-bus (CoPilot)
<30 min delay *Frequency bus line 3 or more per hour*	X	X			X		
> 30 min delay *Frequency bus line 2 or less per hour*	X	X	X	X	X		X
Cancellation or diversion	X	X	X	X	X		X
Major disruptions or delay >1h	X	X	X	X	X	X	X
Receiver	*Employees RET*	*Travellers*	*Travellers*	*Travellers*	*Travellers*	*Travellers*	*Bus Driver*

6.3 Traveller information channels

This chapter helps to understand the context of the traveller information. Firstly addressing the traveller information process in case of an unplanned disruption including and which type of information, actors and systems are involved. In 6.3.2 presents an overview of the different types of information that RET provides to travellers through what channels.

6.3.1 The traveller information process

As mentioned in the literature review as well (Chapter 2), there is a difference between static, dynamic and actual travel information. In the public transportation sector the following classifications are used for the different types of information, see Table 4. Consisting of static information (KV1,KV9), dynamic information (KV4, KV7/turbo, KV15) and actual information (KV6, KV8/turbo, KV17, KV19). KV3, KV4 and KV9 are related to conditional prioritization at traffic sign and platform allocation, which are not relevant in this research. By further interested in the KV information process, Appendix 4 presents an overview of this system as a whole.

On the next page, a schematic simplified overview is presented of the traveller information process in case of an unplanned disruption. The different steps are explained and also some of the information streams from Table 4 are included. Below a short explanation of terms that are mentioned in the figure is given:

- **EBS:** Operation Management System, concerns the total of system components that are used to support the daily exploitation of the Buses.
- **CoPilot:** EBS on-board computer on the bus. The CoPilot provides all functions of EBS in the vehicle.
- **IRMS:** Incident Registratie Management Systeem, logging system for incidents of the RET transport system.
- **RIVER:** Travel Information system of the traveler informant, in this application, both unplanned and planned disruptions are recorded and distributed to various information channels.
- **Geo-GUI:** The interface to place free-text messages at the DRIS signs at stop.

- **NDOV:** Nationale Databank Openbaar Vervoer, translated “National Public Transport Database”. The task of NDOV is to provide a level playing field for the delivery of planned and current travel information, fares, public transport zones and stop accessibility.
- **DRIS:** Dynamic Travel Information at bus stops; collecting and publishing current bus departure times and traveller information messages from Geo-Gui.
- **HASTUS:** HASTUS supports the RET in the development, generation and optimization of timetables. The application generates transport solutions in the form of vehicle schedules, crew schedules and line timetables.

Table 4. Classification of different types of information used by the public transport sector (Kennisplatform Verkeer en Vervoer, 2010).

Class	Description
KV1	*Scheduled timetable and information about routes and stops for a specific period*
KV3	*Provides priority request to VRI (Traffic Control Installation) using KAR (Short Distance Radio). This makes the ‘conditional prioritisation’ for public transport vehicles at traffic lights possible.*
KV4	*Used for dynamic platform allocation. Combines information with planned and current travel information (kv7 8), and information from KAR, or VETAG/VECOM systems at a station.*
KV6	*Messages in which each vehicle reports at least every minute where it is located and his punctuality. The punctuality is defined in relation to the planned timetable, as communicated through KV1. Kv6 is highly route-oriented.*
KV7	*Scheduled timetable per stop post for a few days*
KV8	*Current departure times per stop based on vehicle position*
KV7/8 turbo	*A variant of KV 7/8 that efficiently sends the required information for internet and mobile applications for all stops. Consists of scheduled and current travel Information at stop level.*
KV9	*Data information from registration and de registration positions (for priority requests using KAR for VRIs). The road manager is responsible for supplying information about the traffic lights' entry and exit points.*
KV15	*Free texts or traffic control for screens at stops by diversion routes, disruptions and calamities in the service execution. Messages should be constructed follow the ‘OPGA-Principle’.*
KV17	*Mutations by Traffic Control (trip cancellation, shortening of trips, adjusted planned departure and arrival times or postponing departure at a stop).*
KV19	*The predicted departure times based on the actual service execution, defined with respect to the planned timetable, as communicated through KV1. Provide information about the expected arrival and departure times at all relevant stops. Almost the same information as KV6 however more stop-oriented. Kv19 can therefore also be used to communicate - to a limited extent - that one or more stops have been skipped, for example through a diversion.*

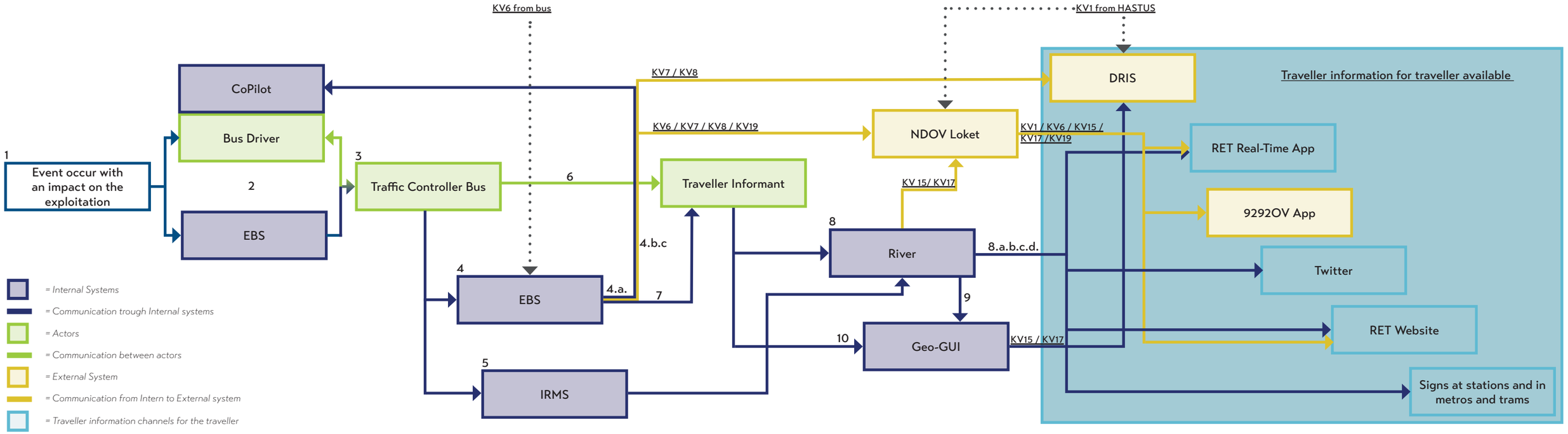


Figure 17. Traveller information provision process during unplanned disruptions.

Steps in traveller information process during an unplanned disruption:

1. Event occurs with an impact on the exploitation
2. Traffic Controller actively monitored EBS messages that indicate if a bus is too early, too late (>+3) or deviating from the route and / or is informed by the Bus Driver via the transceiver.
3. Traffic Controller assesses the situation and determine the intervention and inform the Bus Driver about the intervention measure.
4. Traffic Controller implements the measure in EBS. EBS is connected to:
   - 4.a. The CoPilot system in the bus, so the measure is visible for the driver.
   - 4.b. Via a converter to NDOV, who shares the open-source information with 9292OV, RET Real-time App, RET Website and other parties that requested for the information.
   - 4.c. Via a converter to DRIS, so by (partly) cancellation of the trip, the bus is no longer visible on the DRIS sign outside.
5. Traffic Controller creates a disruption report in IRMS. IRMS is linked to RIVER-system used by the Traveller Informant.
6. Traffic Controller informs the Traveller Informant by telephone about the event, the impacted bus-line(s), direction(s), and expected duration.
7. Traveller Informant also has access to EBS and can see the current status of the buses and any measures that the Traffic Controller.
8. Traveller Informant creates an event in RIVER. There are standard texts that can be selected to create a message that fits the situation. The texts are prepared according to the 'OPGA-principle' (Cause, Effect, Prognosis, Advice – principle). From RIVER it is possible to send the travel information message to different channels, see table... for the protocol on channel uses.
   - 8.a. With a delay < 30 minutes the message is sent to Geo-GUI, Real-Time App
   - 8.b. With a delay > 30 minutes the message is sent to Geo-GUI, Real-Time App, RET website, Twitter
   - 8.c. Trip cancellation or diversions, the message is sent to Geo-GUI, Real-Time App, RET website, Twitter
   - 8.d. Major disruptions or delays > 1 hour, the message is also sent the screens in the Metro and Tram and at the stations.
9. Traveller Informant can see the message from RIVER in Geo-GUI and assign the travel information text to the correct displays
10. Traveller Informant can create manually messages in Geo-GUI and assign them to the displays wanted.

When the exploitation is no longer impacted the Traveller Informant send a cancellation message via Twitter and unsubscribe all used channels in RIVER.

6.3.2 Traveller information channels

There are various different traveller information channels or touch-points that travellers interact with or could throughout their journey. These include information of departure states at stops and stations and maps of the line network. Digital information via websites, smart phone apps, DRIS signs, information screens at stations, in buses, trams and metro. Interpersonal via Bus Drivers, station service crew or other RET employees. Via the various channels and touch-point a wide variety of traveller information could be obtained.

Below an overview of the traveller information channels directly related to the RET, including the information that is relevant for bus travellers and the classification of the information (static, dynamic, actual) is provided.

Channels	*Information*	*Type*
RET Real Time App	• Multi-modal trip planner linked to 9292OV • Trip information as Duration, Price and CO2 • Detours per modality and elevator disruptions • Disruptions and diversions per line per modality • Departure time per line per modality (bus, tram, metro and ferry) per stop • Real time location of the bus Extra services: When making an account it is possible to make use of the notification setting in case of diversions and disruptions on favourite lines.	Actual Static Dynamic Dynamic Actual Actual
RET Website	• Multi-modal trip planner linked to 9292OV • Trip information as Duration, Price and CO2 • Detours information per modality and elevator disruptions • Disruption information • Departure time per line per modality (bus, tram, metro and ferry) per stop Extra services: Facilities per stop and add trip to calendar.	Actual Static Dynamic Dynamic Static
RET Twitter	• Disruptions per line per modality Extra service: Possibility to response to disruption message and ask questions to the web care-team.	Dynamic
DRIS sign at stops	• Departure time per line per modality • (Disruptions and diversions) ** not every DRIS sign is equipped with extra line space for free texts.*	Actual or Static * Dynamic
Screens in Bus, trams and metro	• Arrival time of the 5 next stops, next junction stop and final destination • Disruption information • Interchange information for the metros, trams, buses, trains and fast ferry Extra services: ret news and updates and sometimes information about (upcoming) planned disruption.	Actual or Static * Dynamic Dynamic
Screens at Stations	• Disruption information Extra services: ret news and updates and sometimes information about (upcoming) planned disruption.	Dynamic

Remarks to the traveller information channels are that it is for the traveller not always clear if the information provides is static, dynamic or actual. Also the channel broadcast protocol the Traffic Controller use is not communicated to the traveller, and is therefore unknown. There is a main of focus on digital mobile information provision. Digital mobile information has major benefits as is could be a fast an direct line of communication between the traveller and RET, and the mobile deviance are always with the traveller. However, there is also a settle back of mobile information, as battery constraints, it requires an internet connection, and not always everyone has access to mobile devices. The last point also related to the risk of digital exclusion meaning; the uneven distribution in the access to, use of, or impact of information and communication technologies (Durand, Zijlstra, & van Oort, 2019). Furthermore at the moment only the RET website provides digital information in English, although only about static information. The planned or unplanned disruption information is not available in English. The impact of digital exclusion and language exclusion is out of the scope of this research. Broadcast message in vehicle or at station also scores high as preferred channel in the event of disruptions (see chapter 2.3.). However, these installations are only located at train and metro stations. The Bus Driver has the option to broadcast a messages himself in the bus.

** Important notice is that the DRIS not always showing actual travel information, when they do not have connection with the bus or the bus in not yet in the connection range of the DRIS displays static information.*

** Important notice is that the screens not always showing actual travel information, due to connection problems with EBS.*

6.3.3 External analysis

Although the main focus is the RET context it is always wise to look to the competitors in the field and see how they operate. For this desk research, is looked and how the operators in Amsterdam (GVB) and Den Haag (HTM), the Dutch Railways (NS) score on the topic traveller information by disruption, their traveller support system and their traveller information channels. Furthermore, the traveller information channel 9292OV, which is a travel information group that provides OV Data on behalf of and on commissioned by the public transport companies.

Looking after the results of the public transport customers barometer of the past five years for bus transport, in the big cities; Rotterdam (RET), Amsterdam (GVB) and Den Haag (HTM). The results are very close to each other, for the overall grade around 77% and around 76% for traveller information at stops/stations. Some diversity is visible in the result for traveller information during disruption whereas the RET scores the best with a 60% on average and followed up HTM 57% and GVB 51% on average in the last five year (CROW-KpVV, n.d.). In the "OV-klantenbarometer" 2018 one topic fell out, namely traveller information during disruptions. The national average dropped from 59% to 55%, at the RET-Bus, the result dropped from a 63% to a 53% (CROW-KpVV, 2018). The reason given for this is that the expectations of travellers have increased: travel information in "regular" situations has become better and better (DOVA, 2019). The NS, on the other hand, which use their own customer satisfaction survey had a score of 82,5% on information of disruptions in the train and at the station (NS, 2018).

Interesting is that the RET, GVB and HTM have the precisely same outlining for the traveller information apps, only differences are the company branding and content. However, the NS app offers also a multi-modal trip planners which means that it can also be used by non-train travellers . Besides the standard info as; trip duration, price disruption information they have implemented a lot of "nice to have" features. Examples are; accurate maps with the location of stops and platform names, the possibility to state preferred first-mile modality for multi-model trips (Walking, Bike, Car or PT), train crowdedness information, weather information and information about stations and other services can be found in the app. Furthermore, within the NS app, it is possible to directly purchase tickets, where for the RET, GVB and HTM a separated app and registration is needed. Since 2018 the NS launched the app NS-Lab in which they test various new functionalities that can make the travellers journey better and more enjoyable. It is a smart way to include your traveller directly in your information provision innovations by getting feedback & value insights from them.

9292OV is a commonly used app, its features are described below. Whereas 9292OV has a cooperation with various operators, they do not have with RET. This means that 9292OV currently does not provide 'OPGA-information' about planned disruptions of RET services. In the event of unplanned disruptions, 9292OV is dependent on the open-source data provided by the NVOD.

Multi-modal trip planner	*Actual*
Trip information as Duration and Price.	*Static*
Planned and Unplanned disruptions and deviations information for NS, GVB, HTM, Arriva, Connexxion, EBS, Qbuzz, Keolis, Hermes.	*Dynamic*
Departure time per stop for all mobilities	*Actual*

Looking at the other traveller information channels used by other operators, every operator also has its website, app and twitter channel. RET stand-out due to the limited opening hours of customer service, only operation on working days between 9-17h. Compared to the GVB who are accessible between 9-19h Monday till Saturday. HTM with opening hours on working days from 7-22u, Saturday from 8-22u and Sunday 9-22u. The limited openings hours are noticed by RET, and it is being discussed to expand this (RET NV, 2019).

There are also various innovations in the field of DRIS sign. Where the RET currently uses the old-fashioned mono led signs there are also new graphical (tft) screens, see Figure 18. These new graphical screens are also used by the NS on their station. The screens have the possible to give more traveller information in a much better organized and readable way. Because DRIS Sigs are directly linked to the EBS-systems of the operator, making useful, fast and reliable traveller information to possible. The downside of DRIS signs is the high investment cost and maintenance cost of the system for both the operator as road authority.

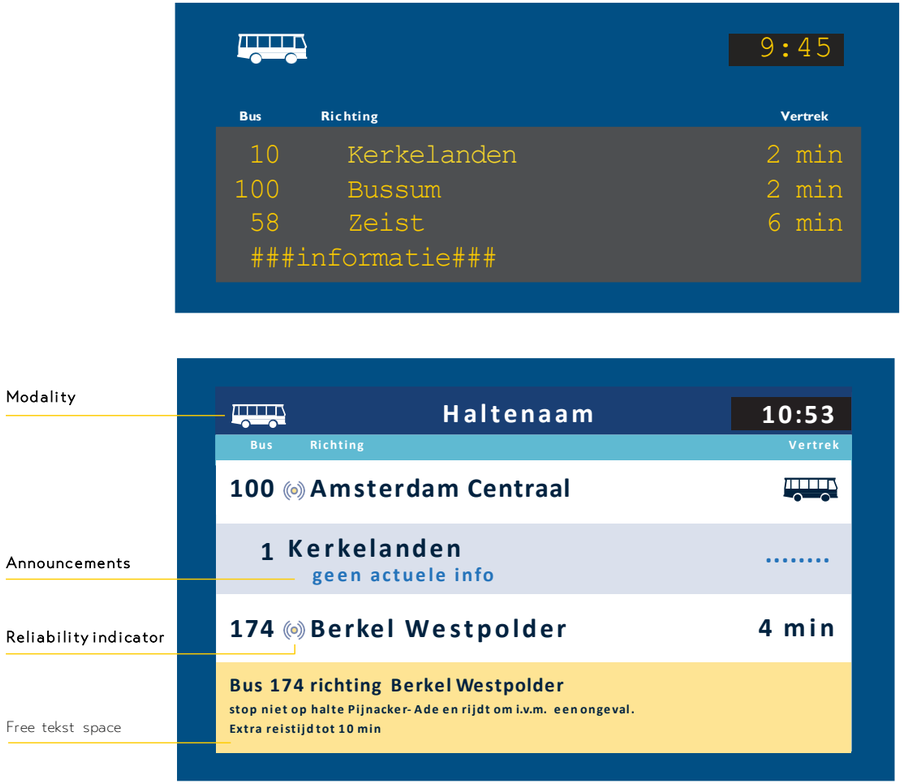


Figure 18. Currently used mono DRIS signs RET, and new graphical (tft) screens.

Research

After having introduced the context in which the research was conducted, the following section will focus on the user field research that was conducted. The emphasis will be on the bus travellers, however, to also provide a broader perspective, the insights of other stakeholders involved in the disruption handling process are included as well. These include the bus driver, the traveller informant and the bus traffic controller.

This section will kick off with providing a view on the applied methodology, stating some key difference between design research and traditional public transport engineering research followed by an introduction to designs research methodologies. The next part of this first chapter 7 will focus on the research that has been conducted, including the steps taken in both the field user researches; the bus travellers and other actors. The final part of chapter 7 will list the limitations that were identified for this research.

The following chapter 8 will present the results from the bus travellers research, divided in general findings, their experience during regular and disrupted trips. The results and findings of the other field user study are then presented in Chapter 9 where each other actor will be elaborated on separately to gain a better understanding of their main challenges during regular and disrupted operations.

7. Methodology

This section will start with a general overview of the difference between traditional public transport engineering research set-ups and design research set-ups. After which a more general introduction will be provided into the selected research methodology. The section thereafter will provide a more detailed view on how this methodology will be applied to this specific research and what other considerations were included.

7.1 Design research versus traditional research

Traditional public transport research is mainly characterized by quantitative research methods. Quantitative research is a research approach aiming at testing theories, determining facts, demonstrating relationships between variables, and predicting outcomes (van der Merwe, 1996) Quantitative research uses methods from the natural sciences that are designed to ensure objectivity, generalizability and reliability (Yilmaz, 2013).Traditional public transport research is analytic, more data-driven, and based on empirical or measurable evidence and principles of reasoning. It focuses on the understanding of objective and quantitative data.

Design research on the other hand is mainly characterised by qualitative research methods. Qualitative research is a research approach aiming at the development of theories and understanding involving an interpretative, naturalistic approach to its subject matter (Denzin & Lincoln, 2005). Qualitative research finds its origin in anthropology and sociology sciences. Design research is constructive, human-driven, and based on an exploratory process. Various design methods offer a way to collect and understand subjective and qualitative data. One of the key aspects of service design is that it should be user-centred co-design. The services should be experienced through the eyes of the customer. The persons who will eventually be served through the design process, is given the position of the expert of their experience and they play a large role in the knowledge development, idea generation and concept development (Sanders & Stappers, 2008).

In this study, a clear choice was made to apply service design research methods and related qualitative research techniques. Qualitative research techniques because they study things in their natural settings and help to collect empirical materials about personal experiences (Denzin & Lincoln, 2008). Qualitative methods can be used to obtain the tangled details about feelings, thought processes, and emotions that are difficult to extract or learn about through quantitative methods (Carreira et al., 2013) Moreover, it helps to develop specific insights and can turns individual experiences into usable data. That can be useful for practical application. The traveller is placed at the centre of this research and service design research methodologies are suitable as they are used to gain a deeper understanding of users' needs and desires by a user-centric set-up (Sanders & Stappers, 2014). Using service design research methods is a new playing field for the public transport engineer, which makes this research exploratory and unique. Figure 19, shows the double diamond principle that is commonly used as a framework in design research. It helps to understand the customers and their problems, and it helps to explore creative and in innovative ways to solve their problems and delight them in a structure manner. The models consist of 4 phases: Discover, Define, Develop and Deliver. It is a process from diverging and converging. In short, the four phases can be described as:

- **Discover:** Research— insight into the problem (diverging): Define research scope, methods and conduct primary (field) and secondary (desk) research.
- **Define:** Synthesis — the area to focus upon (converging): Understand and make sense of the research, lay out all research findings and cluster them in themes, find the insights and deduce opportunities and potential fields of action. State the 'How might we ...' question.
- **Develop:** Ideation— potential solutions (diverging): Generate as many potential solutions and ideas, evaluate these first ideas, set the design vision.
- **Deliver:** Implementation— solutions that work (converging): Prototyping, test and analyse, iterate and repeat, before build and release.

During the stages discover and define qualitative research techniques such as context mapping, user observations, semi- or un-structured interviews , and open-ended questionnaires are used. Only after the first diamond the specific research question the 'how might we...'(HMW)-question is formulated. These question makes a concrete statement of what is to be done or solved. In qualitative research it may be more appropriated to describe a research problem rather than pose a research aim or question. Opposite to quantitative research

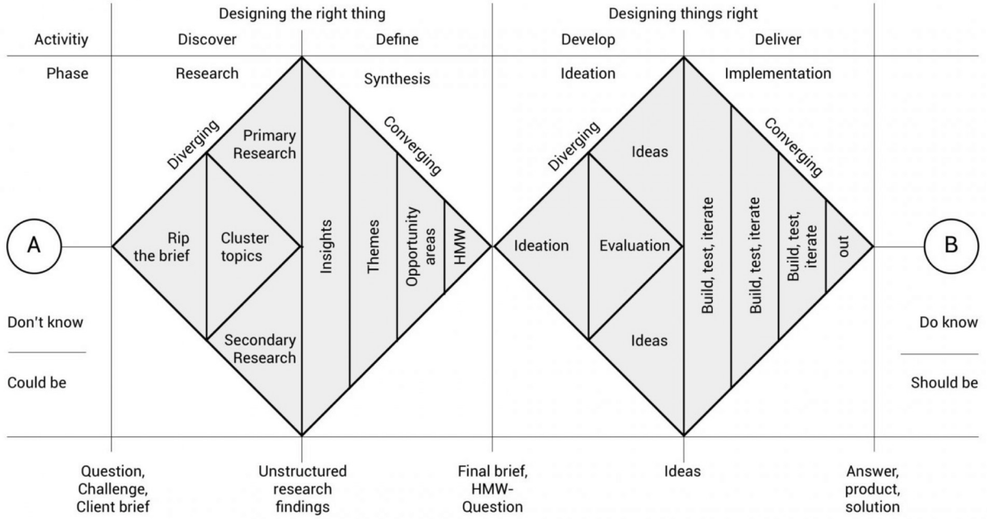


Figure 19. Double diamond (van Boeijen, Daalhuizen, & van der Schoor, 2014)

that defines the specific problem and question at the very beginning of the research. Hypothesises are often formulated an existing theoretical framework is chosen and subsequently collected data shows how the theory does or does not apply to the phenomenon under study (Allan, 2003). The researchers are mostly more converging in the process. Where often only in the end the results are put in a broader perspective, what can be seen as diverging. In the double diamond principle, the development of questions is part of an iterative process. Supported by the grounded theory that recommend to wait with fully develop research questions until on is in the field and collecting data (Agee, 2009). Design research is therefore more flexible and an iterative process. The design of the study can be adjusted or changed as it progresses. This iterative approach may conflict with proposal and dissertation requirement of research fields that are traditional focused whereas specific research questions and research set-up are more fixed from the beginning on.

In design research, the researcher is an integral part of the data, without the active participation of the researcher, no data exists (Grafanaki, 1996). Data is commonly collected in naturalistic environments, which makes the exhibited behaviours more credible because they occur in a real, typical scenario, a so called field study. However, there is also a danger of this to collecting and interpreting qualitative data exist qualitative research is strongly dependent upon the researchers' executive skills or orientation. The researcher decides upon the type of data gathered and the methods used to analyse those data. Herein lies the power and weakness of qualitative research (Biklen, 1992). Quantitative data and research assessment involves validation, reliability and generalization. However for qualitative data and research, due to the subjective nature of the and its origin in single contexts makes it difficult to apply conservative standards of reliability and validity as applied in quantitative research (Malterud, 2001). A suggestion is made in qualitative research to assess the trustworthiness of the method, coherence of results, and transferability and application of results (Hill, Thompson, & Williams, 1997). Trustworthiness of the method means that a clear and precise description is given of all methodological steps used, including the research

question, participant samples, themes under study, data collection and analysis (Morrow, 2005). The method, coherence of results are related to the trustworthiness of its interpretations and conclusions. When they are internally consistent, effective and reproducible they are considered to be reliable and coherent. Triangulation can help here, which mean data collection from multiple perspective and in different ways (Hill et al., 1997).The last assessment is on transferability and application of results, meaning how those interpretations may contribute to a furthering or even change in the current knowledge about the subject of study, providing an new understanding, perspective on the phenomenon. Application of the results is the extent to which the results and conclusions of a research can orient other occurrences and situations (Hill et al., 1997).

In design research, analysing is a process of synthesis. With the goal to identify patterns and themes from across the research. The overall goal in qualitative design research is to bridge the gap between research and design, and between present and the possible future. The bridge can take place on different layers related to the Data, Information, Knowledge, Wisdom (DIKW) scheme based on the Clevelands' DIKW pyramid (Cleveland, 1982). Where each layer adds certain attributes over and above the previous one. Figure 20, shown the DIKW scheme and below the different aspect are described (Rowley, 2007; Sanders & Stappers, 2014).

- **Phenomenon** is that which happens in the world, the object of the research
- **Data** are samples from the real world, which can be catch and keep. Data itself has no meaning.
- **Information** is the interpretation of a data item. Information contained the descriptions, answers to questions that begin with such words as who, what, when and how many.
- **Knowledge** is generalised, abstracted from of the individual data and information, and can be explicit or tacit knowledge. At knowledge level a theory is developed.
- **Wisdom** can be defined as theoretical wisdom and practical wisdom. The first emphasises on how to explore, explain, and understand the knowledge, the later on how to use the knowledge into practice.

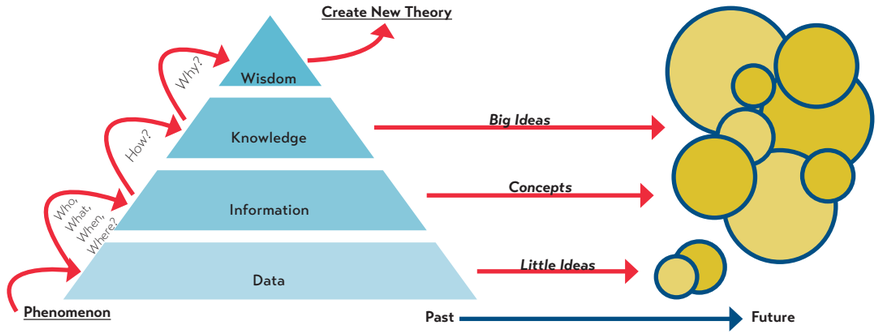


Figure 20. Data, Information, Knowledge, Wisdom scheme based on the Cleveland's DIKW pyramid (Cleveland, 1982)(Sanders & Stappers, 2014).

Synthesis helps to finds the value from the data and translated process and can be a simultaneous phases of data collection and analysis (based on the ground formal theory). It is an inductive approach to analysis, allowing the theory to emerge from the data (Cohen, Glaser, & Strauss, 1969). The key-component during synthesis is to establish specific themes and link the quotes and observation to them. This can be done by so called 'Analysing on the wall' which is working best with small sample sizes up to 6 participants. From the raw data the interesting quotes, notes are selected and parked under the related theme. During the process more themes can be added when need. It is a flexible and tangible method. For larger samples sizes or when there is a lot of data to be analysed the more heavy 'analysing with a database' could be preferred. However, this approach is much more time consuming because of the coding that needs to be done for every item. Disadvantage is also that the data become hidden inside the computer, however some advantages are the possibility to share the data base, easily scale it up, and easily apply sorting and filtering (Sanders & Stappers, 2014).

7.1.1 Collaborative strengths

Public transportation is a complex socio-technical system and a service product par excellence. Public transportation have a technology subsystem and components that are fundamental to performance of the function of the system. However, at the same time having a social, political and economic relevance as well. It extensive a complex interaction between humans, machines and the environmental aspects of the work system. Although the notion of the human involvement lies at the heart of a social-technical system in research there has been a disappointing uptake of user-centred methods in this field. Furthermore, even when these methods were used, user involvement was only used to assist in the development of a techno-centric system. Users were not seen as participants in the integrated systems development process (Baxter & Sommerville, 2011). However, social-technical systems are better served when user centric (qualitative) and techno-centric (quantitative) research methods are combined. Therefore public transport engineer should become more aware of the usefulness of the social sciences and qualitative user centric research methodologies. This research will be a small contribution to this process. In order to set up more collaboration between design and scientific research in the future a clear understanding of each other's working method is required. Design- and scientific research combined are an incredibly strong couple, as they complement each other's weaknesses. Together they are able to answer complex issues in the social-technical field. I therefore expect that in the future a new scientific language will emerge. This language can connect fields that are far apart from each other at first sight, but make interdisciplinary co-research possible. It requires interdisciplinary thinking that encompasses engineering domains as well as human factors and business acumen, creative thinking, cross-cultural communication and collaboration, and a global mind-set (Kamp, 2016). This does not alter the fact that separate research in specific fields will become unnecessary. But there is a new field to discover for researchers who are capable of facilitating interdisciplinary research to make engineering research future-proof and tackle the social-technical question of the future.

7.2 Introduction to design research

In the 1980s design research developed as a recognisable field of study, in the 1980s it became of age, and from there on it has continued to expand further (Cross, 1993). Nowadays terms as design research, design thinking and service design are commonly used. The main strength of design research is that it is an interdisciplinary approach that combines methods and tools from various disciplines. It is an iterative process in a holistic way to gain a comprehensive, empathic understanding of customer needs. Resulting in the design of systems and processes that aim to improve factors like; ease of use, satisfaction, loyalty and efficiency and providing a holistic service to the user (Stickdorn & Schneider, 2013). The strength of design research is the potential to contribute to improving public transport from the travellers perspective. Because the traveller who will eventually be served, is given the position of the expert of their experience and they play a large role in the knowledge development, idea generation and concept development (Sanders & Stappers, 2008). Resulting in a service that better finds the traveller needs.

User-centred co-design is one of the key aspects of service design. The services should be experienced through the eyes of the customer. In a good co-design process users and stakeholders are given appropriate tools for expressing themselves, which help them to participate actively in the design process and ensure a good fit between the design and the use of future products or service (Wilkinson & De Angeli, 2014). Figure 21, show the role of the researcher, designer and user in the co-design process, including the description of these roles for this research.

Figure 21. The role of the researcher, designer and user in the co-design process

There are different design processes (as the double diamond as mentioned above) and technique that have either been published by practitioners or described in the literature in the last couple of decades. For this research, various design techniques are used to help to reach deeper levels of knowledge. Knowledge in this context is defined as; "thoughts and ideas that have already been experienced and have been stored in memory" cited from Sanders & Stappers (2014). Four levels of knowledge can be distinguished:

- **Explicit:** knowledge that can be stated in words
- **Observable:** knowledge that refers to thoughts and ideas that can be obtained by watching how things happen or how people behave
- **Tacit:** knowledge that refers to things we know, but we are not able to verbally communicate with others.
- **Latent:** knowledge that refers to thoughts and ideas that we have not experienced yet, but on which we can form an opinion based on past experiences.

Figure 22, shown these levels. A distinction is made between knowledge that is at the surface and that what is at the deeper levels. In this research is looked at how can the experiences of, and the provision of information to, bus travellers during disruptions be used to improve service quality during disruptions from the operator. Different techniques are applied in this research to reach the different levels of knowledge and help to have in depth and extensive understanding of the reality. This include interviews, observations and context mapping. The methods are elaborated here.

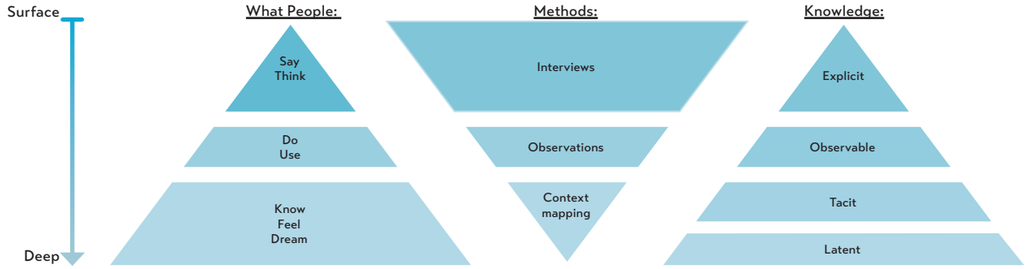
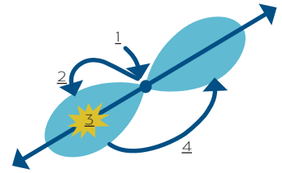


Figure 22. Overview of different knowledge levels with corresponding behaviours and analysis methods (Sanders & Stappers, 2014).

Interviews

Interviewing is one of the most common methods for collecting data in qualitative research. Interviews provide insights and helping in understand a specific context, problem, extreme and extraordinary situations. There are different interview set-ups, structured, semi-structured and unstructured. Qualitative researches focusing on experience mostly use semi-structured and unstructured interviews sets-up or sometimes referred as (in)-depth interviews. These type of interview are making mostly use of open-ended question and due to the not fixed structure provided the opportunity on the part of the interviewer to probe and expand the interviewee's responses (Rubin & Rubin, 2012). In-depth interviews guided by a semi-structured interview guide are used in this research in two ways. One for the travellers as part of the context mapping process as explained later on. With the Traffic Controller, Traveller Informant and Bus Drivers interviews are done to gain more insight about their working environment, role is during a disruption, contribution to the traveller information provision and future vision.

A 'layering approach' is most of the times incorporate as it is one of the most useful techniques that help participant first to create a complete story, then evaluate it and find the underlying reasons for their evaluation (Sanders & Stappers, 2014). With this layering approach, the underlying values can be discovered. Furthermore 'the path of expression' is useful to guide the understanding of the experience of travellers, see Figure 23 for an explanation. As the experience is both connected to past and future experiences (Sanders & Stappers, 2014).



1. **Start with observing, documenting and talking about their current activities around the topic of the study.**
2. **Then recall memories from earlier experiences.**
3. **Reflect on those memories.**
4. **Then go to the possibilities for the future.**

Figure 23. 'The path of expression'; a useful tool to understand traveller experiences (Sanders & Stappers, 2014).

Observations

Observation gives the researcher the opportunity to look at what is taking place rather than get the information indirectly. It helps to get insight in what people do and use and so reaching out the deeper level of knowledge. It enables a better understanding of the context by seeing things that might otherwise be unconsciously missed and it helps to move beyond perception-based data and to access personal knowledge (Welch & Patton, 1992). Observation makes it possible to collecting data simultaneously with the occurrence of the event, without interfering with the occurrence of the event (Kawulich, 2005). Within this research various observations session are done to get insight in the working environment and processes (behaviour) of various actors during an event of a disruption. There is a standard typology of four observatory roles that are typically referred by researches (Gold, 1957), see Figure 24.

The complete observer, *who maintains some distance, does not interact and where the participant(s) do not know that they are being observed.*

The observer as a participant, *who undertakes intermittent observation alongside interviewing, where the participant(s) do now the research goals of the observer.*

The complete participant, *who interacts within the social situation, but again where the participant(s) do not know that they are being observed . A spy.*

The participant as an observer, *who undertakes prolonged observation, is involved in all the activities of the organisation and is fully engaged with the participants.*

Figure 24. The standard typology of four different observatory roles.

Context mapping

Generative research techniques are used to gain a deeper understanding of user needs and desires and reach out the deepest level of knowledge (Sanders & Stappers, 2014). One of the methods that are used in co-design and is a generative designs technique is Context mapping. Context mapping is initially developed at the Delft University of Technology, however, has nowadays been adapted in design practice worldwide as it helps to understand efficiently needs, wishes and the motivation of users. The fundamental perspective of context mapping is that every user is an expert in his/her own experiences (Sleeswijk Visser, 2009). It is an 'intensive research activity' that enables users to 'express deeper levels of knowledge about their experiences' (Sleeswijk Visser, Stappers, van der Lugt, & Sanders, 2005). The number of participants is relatively small, 6 – 20 people, in order to establish close personal contact. Research has shown that 15 suitable respondents can already make up 75% of the collective gained insights (Zaltman, 2003).However, as the unit of analysis is experience and not the individuals, it is more important the chose the participant accordance specific criteria so they contributions to the structure and character of the experience under investigation. The data gathering procedures and the variety of evidence that these can produce are more importance than the number of participants (Polkinghorne, 2005)

The reason for using the context mapping methodology in this research is that it helps to understand needs, wishes and the motivation of the bus traveller. It is qualitative research, analysis and conceptualisation method to explore, reflect on, and express users experiences. Different phases of the context mapping process contribute to reaching these more deeper levels of knowledge (Sleeswijk Visser et al., 2005). Figure 25, gives an overview of the process of a context mapping study.

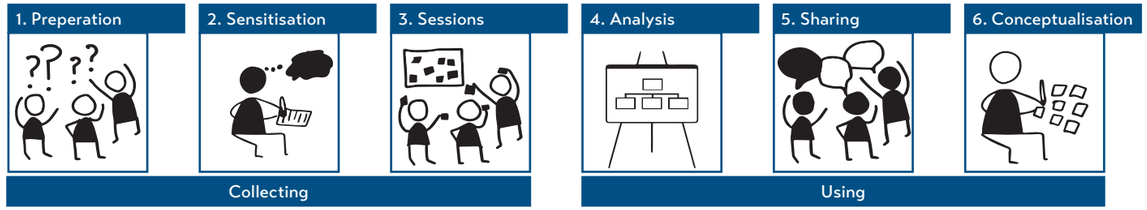


Figure 25. Different phases in the context mapping process

This process originates from the Doctoral dissertation publication of Sleeswijk Visser (Sleeswijk Visser, 2009), which describes the following different stages in the process of context mapping:

1. **The preparation stage:** this stage determines/sets a well-developed goal and it describes how the results will be useful for the conceptualisation stage. I as well describes organisational aspects of the study, such as people and time planning.
2. **The sensitisation stage:** During this stage, the users receive a packages {booklet} to record some of their daily routines. This helps them become more aware of their habits and what parts of these routines mean to them. When they arrive at the session stage, they will have more explicit knowledge at hand.
3. **The session(s) stage:** The session can take place with a group of users or individually. The session is used to 'make' things, such as collages, story lines, 3D models, in which participants express their experiences and present their creations to the group and/ or the researchers.
4. **The analysis stage:** In this stage, the researchers analyse the data, forms categories and models. These will, in turn, be used as the basis for the next stage.
5. **The sharing stage:** The documents generated in the analysis stage are shared and presented to the design team. After which a discussion will take place on any interesting observations.
6. **The conceptualisation stage:** In the last stage the results are used as input for creating new concepts, which are based on a deep understanding of the users.

In this research, the above describes the steps that are worked out but then in a slightly different manner. This as this research does not have a design character but a more exploratory character for the transportation engineering field. The following chapter explains the steps in the field user-research involving bus travellers and the other actors (Traffic Controller, Traveller Informant and Bus Driver) contributing to the disruption experience and traveller information provision of the travellers.

7.3 Steps field user research the bus-traveller

This research describes the concerns, appraisals and emotions that the target group experiences during their journey and during any disruptions. This understanding is captured during a procedure based on context mapping as explained in the previous sub-chapter. Data is collected through sensitising and interviewing travellers, revealing what travellers do, how they behave and what they 'know, feel and dream of' (cited in (Sleeswijk Visser et al., 2005)). By analysing this dataset, behavioural patterns and underlying values among bus travellers were discovered. In addition, a brief social media data mining has been done. Because, as cited in the literature study, social media plays an increasingly important role in present-day life, and there is noticed that passengers desire more frequent communication from social media to the operator (Accenture, 2013). Adequately use of social media data offers operators valuable insights into the passengers' experience perspectives (Nikolaidou & Papaioannou, 2018). In the next Chapter 9, the findings are presented.

1. Preparation stage

This research aims to get insight into bus travellers' journeys; what is their experience in a regular situation and during disruptions, and how do they seek traveller information. Furthermore, the goal is to introduce a design thinking research methodology in the field of public transport engineering and show the value of combining different areas of expertise with an active link between science and practice.
A sensitising booklet based on the research statement and underlying questions has been developed and printed to hand out. In the following stage this booklet is presented and its setup is explained. During the flyering sessions at the bus station RET promotion clothing was provided to ensure proper recognisability. Flyering was done by myself during the morning (8:00/10:00h) and afternoon rush hours (16:00/19:00) on several weekdays at different bus stations (Rotterdam Centraal, Kralingse Zoom, Rotterdam Zuidplein). Travellers were introduced to the research and asked to participate. A gift was offered in return for filling out and submitting the booklet. To recruit as many participants as reasonably possible, various social media posts (Facebook, LinkedIn) and personal relations were leveraged.

2. Sensitising stage

Sensitising is the process where 'participants are triggered, encouraged and motivated to think, reflect, wonder and explore aspects of their personal context in their own time and environment' (Sleeswijk Visser et al., 2005). Therefore a booklet was developed. The booklet can be found in Apppendix 5. This is a personal diary and consisting of various exercises that address the topic of public bus transport in Rotterdam. Focus topics are on the bus travellers experiences, during the journey and traveller information during disruptions. The participants were advised to do one exercise each day, which enabled them to finish the booklet within one week (when travelling daily).

The target group were frequent public transport travellers and frequent to occasionally bus travellers in the age group of 25 to 55 years. In order to reduce the interference to a minimum the criteria for the target group including the following, Dutch speaking, digital capable, frequent public transport user and higher educated employed people. Frequent public transport travellers was one of the criteria to ensure the travellers have enough past experiences as examples to refer to, again with the help of sensitising. The higher educated criteria was important because of the ability to express themselves. The criteria of participants currently being employed and using public transport for their (daily) commute was used. This because of the expectation that these people would have a higher perceived value of time compared to leisure travellers and therefore would be more aware of the impact of disruptions and the effect on their overall experience. Furthermore this group aligned with previous research done by RET on tram and metro travellers (RET NV., 2016b).

Below the some of the main characteristics of the participants of the user research are stated. It is a homogeneous group off five higher educated people who do not have a car and therefore rely on public transport for both commuting and leisure travel. Their travel frequency on the bus varies from daily to once a month. The teacher, developer and student use the bus for the same journey. However, the journalist and the service designer vary more often as they take different trips for work.

Teacher, 29y.
Weekly PT-traveller for work
Monthly bus-traveller for leisure

Developer, 48y.
Daily bus-traveller for work
Monthly PT-traveller for leisure

Service designer, 28y
Daily PT-traveller for work
Monthly bus-traveller for work
Monthly PT-traveller for leisure

Journalist, 27y.
Daily PT-traveller for work
Monthly bus-traveller for work
Weekly PT-traveller for leisure

Student,26y.
Weekly bus-traveller for education
Monthly PT-traveller for leisure

3. Session stage
A semi-structured interview is used to see what is going on the tact and latent levels of what people say. One participant participates in a 1,5-hour follow-up semi-structured in-depth interview session. The executed exercises in the sensitising booklet were the starting point, and the semi-structured interview guide can be found in Appendix 6. The main topics of the interview were: General travel behaviour, Travel behaviour, experiences and need during disruptions and ideas and solution for the future. The interview structure followed the path of expression and the layering approach to discover the values behind.

3.1 Social Media data mining
In addition the twitter channels employed by RET to inform and connect with travellers is analysed. A selection has been made from Twitter messages from the past 9 months that are related to (negative) statements from travellers about the bus service of information service of the RET. Use has been made of the search function on Twitter and the search terms #RET Rotterdam, Bus, Information. The comments were scanned and categorised on the basis of the travellers issue . A selection of the tweets are shared in the rapport.

3.2 In-depth case study
As part of an in-depth analysis on an unplanned disruption, a case has been worked out for a disruption that actually took place. The disruption has been followed from different perspectives (Passenger, Bus Driver, CVL) and different traveller information channels (RET Real-Time app, RET website, RET Twitter, 9292OV, Google Maps) have been followed in parallel

4. Analysing stage
The analysing stage is the stage where the raw data is converted into valuable information. The qualitative dataset consists of the filled out booklets, the interview transcript and social media data. The interview and booklet are studied to mark interesting quotes, by 'analysing on the wall' the quotes are linked to the main themes travellers experience and traveller information in the regular and disrupted situation. The experiences of the five participants are mapped in a so called customer journey format for a regular. From the participant that participate in the interview the disrupted journey experience is also mapped in a customer journey.

7.4 Steps field user research the other actors
To give a boarder perspective and to understand the context of disruption handling and the information provision process with the RET. Other actors, the Traffic Controller, Traveller Informant and the Bus Driver are also included in a field users research. The staff are an important part of the perceived service quality of the traveller as addressed in sub-chapter 3.2.1. This can be direct as the Bus Driver that is in direct contact with the travellers. Or the Traffic Controller and travel informant who from the CVL contribute to the journey (experience) of travellers.

In the previous section context an image is already drawn about their working environment their responsibilities and how they are involved. However, this is based on the theoretical process. This field user research is conducted to capture the real working environment, responsibilities and working processes. Therefore the actors are visited and raw data is captured during observations and semi-structured and unstructured interviews. Resulting in observation notes, conversation notes and interview transcript. By analysing this dataset underlying themes and insights can be found. The steps taken are explained below. The findings resulting from the research can be found in Chapter 9.

1. Observing
Observations are used as well as enable to collect data simultaneously with the occurrence of a disruption in the bus-service. Within this research various observations session are done to get insight in the working environment and processes (behaviour) of the Traffic Controller, Traveller Informant and bus-driver.

In this research, the role as the complete observer and observer as a participant has been taken. The participants (Bus Drivers, bus Traffic Controller and traveller information informant) were aware of the observation and knew the research goals. They were observed because

they are most closely related to disruption handling and information provision. As a complete observer I got the opportunity to take a step back and see and hear what happens while not disturbing the regular working process. In the role as observer as participant, I actively asked questions in order to clarify what at the participants were actually doing and why.

In order to get an impression of the CVL Traffic Controller and Traveller Informant roles, I observed two bus Traffic Controller and one traveller information informant at the beginning of my research. This helped to get a general understanding of their working environment, activities and behaviours. In a later stage of this research, I observed them again in a more focused manner. Specific attention was paid to their actions during an unplanned disruption and interactions. The Bus Drivers was observed as a complete observer may times during my personal bus journeys. By taking place on the front row seats, I was able to observe the drivers behaviour and conversations. The Bus Drivers did not know my role as researcher and that they were being observed. One formal focused observation was taken at a later stage of the research when I joined for a few trips on the bus. I observed the systems on the bus, their use and the interaction between the passenger and driver. Afterwards we talked about his work, the systems and his experiences with disruptions, travellers and the contact with the Traffic Controller.

2. Interviewing
Firstly unstructured interviews have taken place with many different RET employees who are involved in their way with bus, disruptions or passenger information. An unstructured interview is an informal conversational interview which is based on an unplanned set of questions that are generated instantaneously during the interview. The unstructured interviews helped to get a better understanding of the context which the research is studying. Later on, semi-structured interviews were held to see what is going on the tacit and latent levels of what people say. A Bus Drivers, bus Traffic Controller and traveller information informant, participated in semi-structured in-depth interview sessions. The semi-structured interview guide can be found in Appendix 7. The key themes in the interview were their; working activities, experience with disruption, relation towards the traveller, future vision. The interview structure followed the path of expression and the layering approach as explained in sub-chapter 7.2.

3. Analysing stage
The analysing stage is the stage where the raw data is processed to valuable information. The qualitative data-set consists of observation notes, interview transcripts and conversation notes. The raw data set was studied to mark interesting notes and quotes, by "analysing on the wall" the quotes are linked to the main themes of the three actors: Traffic Controller, Traveller Informant and Bus Drives. This helps the identify patterns and interesting insights.

8. Findings of the field user research: the bus-traveller

This chapter presents the findings from the field user research for the bus traveller. Although 'the bus traveller' does not exist because different travellers show different behaviours and have different needs (Susilo & Cats, 2014). So, what defines this group? This is what will be addressed in the first sub-chapter 8.1. General findings following from the booklets are presented first before sub-chapter 8.3 focus on the bus traveller experience for a regular trip, including the customer journey and traveller information needs. Then the focus is on a disrupted journey where it is first discussed how disruptions affect the traveller, then the customer journey is presented and the information needs are addressed. In order to expose the pain points of the traveller and in the traveller information system, different real cases are shared within section 8.5. The last sub-chapter gives a summary of the key insights and findings from the field user research of the bus-travellers.

Different emotions are mentioned in this chapter, so not to cause any confusion, the definitions are stated below. Negative emotions are cited from Delft Institute of Positive Design (2019) and the positive emotions are cited from Desmet (2018).

- ***Anger:*** *The feeling when someone did something bad that harmed or offended you. You want to go against this person to stop them or prevent them from doing it again.*
- ***Annoyance:*** *The feeling when something is happening that bothers you. You have the urge to say or do something to change it or make it stop.*
- ***Frustration:*** *The feeling when you want to achieve something, but find your action blocked. Nevertheless, you keep trying.*
- ***Dissatisfaction:*** *The feeling of being unfulfilled when something happens that is different from what you expected. You feel that it should be changed to meet your expectation.*
- ***Anxiety:*** *The feeling when you think about bad things that could happen to you. You are on guard, because you do not know what the threat is.*
- ***Distrust:*** *The feeling when you think that someone is not truthful and does not have good intentions. You feel the need to be very careful what you do or say to this person.*
- ***Worry:*** *The feeling when something happened that could mean something bad will happen to you or someone else. You cannot stop thinking about this.*
- ***Confusion:*** *The feeling when you get information that does not make sense to you, leaving you uncertain what to do with it.*
- ***Happy****: The representation of a positive emotional state.*
- ***Relief:*** *The feeling of enjoying a recent removal of stress or discomfort and the ability to take our mind off the source.*
- ***Relaxed:*** *The feeling of enjoying a state of mental or physical calmness, slowing down and savouring the present moment.*
- ***Satisfied:*** *The feeling of enjoying the recent fulfilment of a need, expectation, or desire.*

8.1 The bus-traveller, who are they?

Putting the (bus) traveller first is the key message in public transportation nowadays. In order to do so, you need to know who your travellers are. However, precise and clear data on this is currently lacking as in research and databases (CBS, ODIN) the bus is often merged with tram and metro information. RET also was not able to provide precise data on their bus travellers. Although RET is working to improve this in 2021 by realising a database of over 100,000 travellers, of which half should have a 360 ° customer profile. This 360 ° customer profile helps to get to know the customer and better response to their needs (RET NV., 2019). Also, The Dutch Ministry of Infrastructure and Environment identified this lack of information and therefore commissioned the Knowledge Institute for Mobility Policy (KiM) to examine the profile of bus users. Their findings are published in 'Busgebruikers door dik en dun' (Kennisinstituut voor Mobiliteitsbeleid, 2018), making it one of the few available (open) sources of information. The outcomes will be elaborated on below.

The Netherlands has 4 to 4.5 million bus users (people who say they have used the bus in the last six months). So in total seven out of ten people do (almost) never use the bus. Daily, there are around 2.4 million bus passengers, with 1 million unique travellers (CROW-KpVV, 2017b). Only a small group of less than 3% of the Dutch population travels four days or more per week by bus. The RET bus network handles around 115,000 passengers per day in Rotterdam. Which is approximately 12% of the total number of bus passengers per day is in the Netherlands and around 15% of the total amount of traveller using the RET per day. The average travel distance in highly urban areas is less than 7 km (Gemeente Rotterdam & MRDH, 2017).

With less than 3% of the population of The Netherlanders travelling four or more days per week, it are the occasional travellers that dominate the group of bus users. Most of the occasional bus users can be classified as 'choice travellers'. In specific situations they choose the bus, for example to avoid parking costs, traffic jams or cycling in bad weather. The bus can be considered as their fall-back option.

The frequent bus user is predominantly female and has an average age of 45 years. Interestingly enough, the image of the frequent bus traveller may differ significantly from the perception that would arise if you were to observe random passengers on the bus. This as the group would be dominated by daily travellers: mainly school pupils, students and commuters who travel mostly during peak hours. This group, as well as people with reduced mobility and people with a relatively low income, are less likely to have alternatives available and are more dependent on the bus. However, this study shows that they are not the largest group of frequent travellers.

Approximately 75% of bus users possess driving licenses. Bus users state that bicycles are their most important mode of transport in terms of frequency of use: nearly half of all bus users said they travelled by bicycle at least four times per week. The bus is used in a multi-modal way. In urban areas it is often combined with the metro or tram. Approximately one in ten bus users stated that they have a temporary or permanent disability that limits their mobility, and affects their ability to travel independently. Bus users in the capillaries are also more dependent on bus transport than average. Because there are often no other public transport modes available in these outlying areas.

8.2 General findings bus travellers research

Five bus travellers where the subject of the research their answers in their booklets give some general insights about the bus traveller preferences, behaviour and experience.

None of the participants has a car. The bus is the only way to get to their destination by public transport. One of the participants specifically stated that he has made a conscious choice for traveling by public transport because it is a sustainable mode choice.

They like that the bus because it is above the ground as compare to the metro it gives you the possibilities to enjoy the view. Also, because you also do not have to pay attention to the traffic. The bus is affordable way of travelling. Furthermore, the buses of the RET offer a good connection to their trams and metro's.

A drawback of the bus is that is has no priority line, which makes you are sometimes still stuck in the traffic jams or in other traffic situations that cause delays. Furthermore, a bus leaving too early is a major source of irritation and makes the bus less reliable. The climate control of the bus is poor and standing in the bus is uncomfortable. Also, the buses are not connecting well to intercity trains.

Most used is 9292OV or Google Maps to plan PT trips. These apps gives them the information in a structures manner for all mobilities. Drawback in Rotterdam is, that the Google Maps does not show the actual location of the bus, other cities have this.
Only one of the participants use the RET App. He likes that it gives a overview of stops and bus-line nearby plus the actual departure times. You know exactly how long you need to wait, really pleasant.

The majority does not fully trust the departure information provide on the DRIS. As they have had bad experiences with inaccurate with inaccurate information (deviating departure times or buses that did not appear). Also, the information on the DRIS is not always the same as the information in their app (9292OV. Google Maps).
The signs getting confusing when many bus-line are shown and it is not clear if their is a delay as it only show minutes until departure. One participant really like to use the DRIS signs and would like to see that every bus-stop has a one.

No participant gave the same answer about what they see as disruption. Answers were: As a travel option falls away and I did not have or get a good alternative. I have a delay of more than 5 minutes. Any change of my travel schedule as planned due to delay or cancellation. When I no longer able to get my (original) connection.

Travellers are most of the time unaware of the cause of the disruption. The information they get about the expected delay(time) are inaccurate. They get no information about possible alternative, Also, they experience a poor communication about planned disruptions.

8.3 Regular trip experience of travellers

Before unravelling the bus-traveller experience during a disruption first, an understanding should be there about the experience of the regular trip as this helps to understand where what and when the division of the experience occurs. This sub-chapter provides in the outcomes of the research was conducted with five different participants. The results from the booklets and interview are used to make customer journey for a regular bus trip and to describe the travellers' information needs.

8.3.1 The Customer journey - regular trip

Building on the customer journey approach as introduced in chapter 4.2.1, the emotions of travellers for each episode of the Customer Journey are mapped including quotes of the participants. This provides insight into the highs and lows as well as potential improvement areas based on the needs of the traveller. Besides it is focused on the traveller information needs of travellers during different stages of their trip.

The customer journey in Figure 26, presents the emotion curves from the five participants. The emotion curves show that even without disruptions, the travellers experience some negative emotions. This occurs especially in the early stages of their journey when they are travelling to the bus stops. They feel rushed and a bit stressed as they are concerned if they will be on time. This is also triggered by past experiences of buses leaving earlier than planned (van Oort, 2016). In addition, the buses often run low-frequency, so missing a bus has a significant negative impact on their journey. As a result, they often plan to arrive at the bus stop early and have to wait a little bit longer for the bus to arrive.

The journeys then show a small relief when the bus arrives. After that, the actual ride experience depends on the person and specific circumstances. Not being able to sit and an uncomfortable climate are considered as the main disturbing factors. However, on the other hand, listening to music, reading, dozing off and looking out the window are experienced as pleasant experiences. Just before arriving at the stop, a moment of uncertainty arise; "Is this already my stop?", "Will the bus actually stop", "Will I be able to catch my transfer"? Getting off the bus, especially if the bus is on time gives a sense of relief; "yes I made it, on time!". It also is a moment being back in control of the situation, which reinforces this sense of relief. Especially when they are travelling for work this is a crucial moment as they indicated that it is important for them to be on time. "I always feel a bit uncomfortable when I have to apologise for being late due to public transport delays.". As a coping strategy, they take sufficient buffer time to be able to miss one bus and still be on time if they catch the next. This copping strategy was also found to be a key insight by Papangelis et al. (2016).

The feeling of being in control over their trip is an urgent need. Travellers are searching for things that give them that feeling that they are in control. Examples of this are that they have searched out all different options to reach to their destination, taking an OV-Bike for the last miles instead of going by bus, checking their traveller information apps also during the journey.

It is interesting to see the similarities in these five customer journeys by five different bus travellers. Besides there is also similarity with the customer journey presented by van Hagen for a train trip, see Figure 10, that identifies some peaks by sitting on the bus/train or when arriving at the destination. When the travellers can sit on the bus/train means that the time spent is considered as valuable time (= personal time). However, this peak can negatively be influenced by other factors such as the cleanness and climate in the vehicle, behaviour of other passengers etcetera. The off peaks are when heading towards the stop/station, waiting, leaving the bus/train).

Unfortunately, it is difficult to compare these customer journeys with those of RET. RET has chosen different episodes on their customer journey from the consideration for the journey up to arrival at the destination. Because this customer journey that is much more zoomed out and shows more than just the journey. And the explanation is limited it does not really reveal what happens at the different stages of the journey itself.

8.3.2 Traveller information

Traveller information is a main subject in this research therefore a look is taken at which traveller information the five participants consult. All participants indicated they check their travel information more than once before departure, and then a few times at the stop and on the bus. However, they consult different channels and have different information needs which is also found in previous studies, e.g. (Grotenhuis et al., 2007).

Travellers seem to check their travel route options and departure times before leaving for the bus. It is interesting to note this reverse planning phenomenon, as they start with the desired arrival time and plan their journey backwards from there. One participant specifically mentioned using the weather app because taking the bus for her is also weather depended. In preparation for their journey, they mainly want an app that gives them a total picture of a proper multi-modal travel plan. Theretofore 9292OV and Google Maps are most preferred. Although the RET app also offers this possibility it is unknown, or not used by 4 out of 5 participants. It is noted that it is sometimes difficult to know which stop you should have for travelling a certain direction with the same line number. At the large bus-stops, it is sometimes unclear on which platform you should wait for which bus.

The participants mainly looked at their current location and updates for their journey at the stop.; Such as departure times, disruption, better alternative options, and expected travel times. They also often perform a double-check of the actual departure time as information on the DRIS boards is not always fully trusted. Some have had bad experiences with inaccurate information (deviating departure times or buses that did not appear). Also, the information on the DRIS boards is not always similar to the information in the app (9292OV, Google Maps). The signs can be experienced as being confusing when multiple bus-lines are displayed at the same time. This sometimes conflicting information causes agitation and brings uncertainty about which channel (DRIS or app) should be trusted. The RET app offers the possibility to see where the bus is in real-time on a map. However, the app is mostly unknown among travellers, or they have certain reasons not to use it. It is important to consider that this unreliability in general traveller information, can create scepticism about the provision of information in relation to disruptions.

" I know that RET has a certain app on which you can see where the bus is. But in my opinion it is a very confusing app that's why I don't actually use it."

"On the RET travel app you can see all the buses at a bus stop in de neighbourhood. Time is indicated so you know how long you have to wait, very convenient!"

During the participants' trip, the expected arrival time was carefully monitored and their transfer if they have one. If the route is unknown, the exit stop was also rechecked. Bus stop names are sometimes considered to be confusing. The current location is also sometimes monitored via Google Maps in parallel to ensure that the bus stop is not missed. The information screens on the bus are not considered to be convenient or pleasant because the screen changes all the time, sometimes even with advertisements in between. As a result, you do not immediately receive the information that you are looking for. In addition, the screens in the bus often do not work properly.

Important core values of the travel information for the traveller is: that the information is accurate, it offers a total overview, provides a certain choice, has a degree of customisation and is easily accessible. The information needs are determined by the level of control or trust that the traveller experiences in that situation. This is influenced by where they are going, the reason for the trip, whether the trip is familiar or not. Besides, it is also related to personal character, where one person prefers to feel more in control than others.

The Customer journey for a regular trip

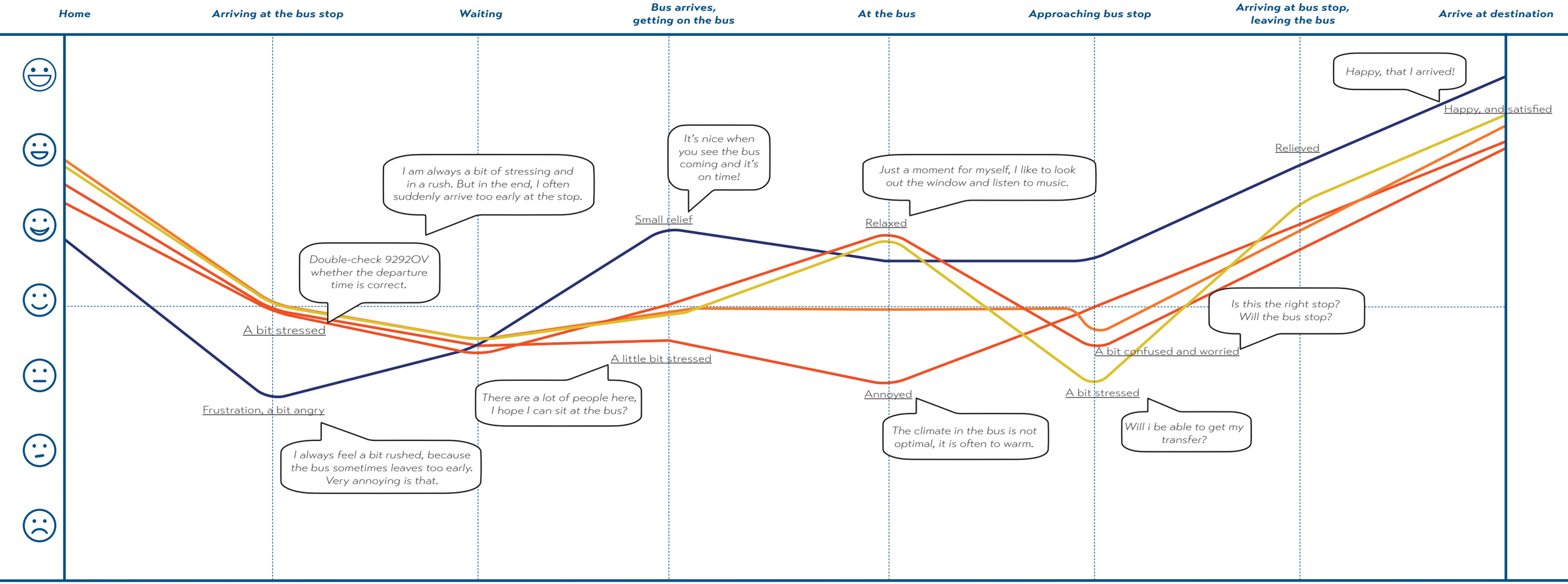


Figure 26. Customer Journey Map of the five bus travellers for a regular trip based on the user research.

8.4 Disrupted trip experience of travellers

Disruption is a negative situation by definition and traveller can develop highly negative feelings. Each individual experiences disruption differently, depending among other things on personality and previous experiences. The results from the booklet, interview and social media data mining are used for unravelling their experiences. Firstly, a number of ways in which bus delays and disruption affect travellers negatively are highlighted, before the customer journey is explained. Finally, the information needs during disruption will be addressed.

"What to my mind still happens a lot is that the bus is always a couple of minutes late, and only because it has to use the same road in the city of course, so yes it can't be helped."

Travellers recognise the fact that disruptions are unavoidable. As buses share public road space with other vehicles which means that some delays and disruption are sometimes unavoidable and are an inherent part of this mode of travel. However, the frequent traveller notes that some factors can be better anticipated, such as planned roadwork, and normal rush hour traffic congestions. Diversions are often poorly communicated and there are bus lines that are delayed by default during rush hour. Disruptions has consequences for both the waiting time and the in-vehicle time. The effect on the waiting time depends on the arrival pattern of traveller and the irregularity or punctuality of the buses. The possible transfer time is also influenced by disruption in the service, such as a late arrival, as a result of which a planned transfer will be missed. Due to the variation in driving times and thus in the departure times and follow-up times at the stop, the average waiting time at the stop increases and so the total travel time (van Oort, 2015). As such, they build a degree of contingency into their journey time to allow for potential delays and disruption. However, this does not take away the hinder they are experiencing. There are a number of ways in which bus delays and disruption affect travellers negatively who are elaborated below.

On the next pages the selected twitter tweets related to traveller complainant about the bus service are shown, which are given valuable additional insights into the travellers experience .

Financially

A delay represents poor service and therefore, poor value for money. RET offers compensation from delays which last longer than 30 minutes. Or if more than two delays occur within one week (both lasting longer than 20 minutes). The compensation can be requested via the contact form on their website.

"Money refunded in case of delay at RET, I wouldn't even know how to do that. Most probably it is not worth the time and effort for those few euro..."

Lateness

A delayed bus results in travellers arriving later than planned at their destination. For one person, a delay or disruption is a mild interruption of their day when they might go for a cup of coffee or simply just arrive late. However, depending on where they are going and the reason for travelling, it may be experienced as far more severe. The spectrum of experienced inconvenience ranges from none to very stressful. It is not only the delay of buses that causes travellers lateness. Buses leaving too early also result for the traveller missing their bus and also causing lateness. This to the great annoyance of the traveller and also influences the reliability of the service (van Oort, 2015). Another phenomenon causing annoyance are buses that drive past bus stops that they are supposed to stop at. This might occur when an earlier bus is cancelled or when there are delays elsewhere in the network, which results in a too high number of travellers versus the available capacity in a bus.

Missing connections

A delay can cause a domino-effect throughout a journey as sequential connection might be missed. This might occur more often than with other modes of transport as the bus is more often used in a multi-modal journey than other modalities. This is especially annoying with two sequential low-frequency connections, for example between the bus and train. Travellers can miss their connection due to a relatively short delay on the first part of their trip, which might, in the end, result in a delayed of 30 minutes or more.

Anxiety and discomfort at the bus stop

Waiting is experienced as unpleasant, especially when it is unclear when the next bus will be arriving, which causes anxiety. Frustration occurs if the passenger could have taken an alternative option but has no information to help decide whether this would be a better option instead of waiting for their original planned bus.

"And what's important for me is look; I travel so often with public transport with whatever type of transport. I have the feeling that I will get the train. But I always want to know at that moment, do I get there this way? So, is this bus line going to take me where I have to be and is the next one coming then or should I do something very different because otherwise I will be just waiting and waiting. I cannot leave so to speak. That leads to stress"

Discomfort during the bus ride

Due to an earlier cancelled bus or disruption elsewhere in the network or by other modalities crowding on later buses could occur. Besides that, this in itself can cause delays, as a larger number of people attempts to board a single bus simultaneously, causing major discomfort.

Avoidance of travel

Disruptions and delays can also lead travellers to decide not to make the journey at all or to postpone their travel. However, the sooner the traveller is aware that their desired journey will not be possible, the faster the traveller is empowered to make a decision which puts them back in control. This might even lead to behaviour in which the traveller consciously decides to avoid the bus modality as an option. Altogether, this includes switching to shared mobilities like the OV-bike, Mobike, Felyx , or their own bike or car when this option is available. Experiences with disruptions and delays and not being able to reach the destination as planned can lead to avoidance bus usage in the future.

"I took the train recently and consequently I had the possibility to take the bus or walk a short stretch or grab an OV bike at the train station. Naturally I take that bike because then I simply know that on a bike I will get there unless my legs won't do it anymore. And if you take the bus you'll always have the uncertainty that you arrive just a couple of minutes later. The OV bike gives me certainty one way and return"

In many cases, delays have a negative impact on passengers, their journey and on the rest of their day. As alternatives are rarely readily available when bus services are disrupted. Bus-travellers travelling for work tend to be less accepting due to the impact the delay has on their work, and because they, in general, more frequently experience delays. Also not having an alternative could result in that they are less likely than others to be in the frame of mind to accept the situation. The choice traveller could be so dissatisfied by experiences and impact of a disruption, that this can result in avoiding the bus all together (in some situations). Travellers feel that more can be done to avoid delays and disruption on buses and to better manage and recognise the impact on them as a traveller.

Alexandra Myk @mykje · Oct 4
Wat een niet sociale #ret #buschauffeur van **bus** 173 halte Berkelseweg (08.21 uur) die gewoon door rijdt en drie **mensen** in de regen laat **staan**! Niet gewend deze service #klantnietcentraal

Worldfamous @MichelKoreman · 2h
Replying to @RETRotterdam
Ja op de fiets.. na 40 min wachten toch maar door de regen gefietst. Ik snap dat er verstoringen kunnen zijn maar de paal geeft geen actuele reisinformatie en dat is erg onhandig en zorgt voor irritatie

Shelley Wilson @ShelleyWilsonn · Oct 14
En weer mocht iedereen wachtend bij de Oostdijk naar de Roelantweg lopen... Geen #Bus140 te zien.

> **Shelley Wilson** @ShelleyWilsonn · Oct 10
> Hi @RETRotterdam! Net kwam bus 140 (voor de derde keer in een maand) weer niet opdagen. 9292 meldt geen vertraging en ook op twitter is er niks over vermeld. Zijn er nog andere kanalen waarmee jullie over het uitvallen van bussen communiceren? Alvast bedankt!

RET @RETRotterdam · Oct 10
Hallo Shelley, wat vervelend weer voor je. Ik heb het even voor je nagekeken maar ik heb geen uitval gezien bij bus 140. De RET communiceert via de digitale haltepaal bij de bus. Bij een langdurige storing via de website van de RET. - Hanneke

Shelley Wilson @ShelleyWilsonn
Replying to @RETRotterdam and @9292
Dat is dan toch apart. Anderen bij de halte ervaren hetzelfde probleem de laatste maanden. Ik heb er ruim twintig minuten gestaan en er is toch echt geen bus voorbij gereden. En een digitale paal is er niet bij de haltes Oostdijk/IJsselmondsehoofd.

Milko @DegenOnTour
@RETRotterdam goede communicatie. Heel busstation Rodenrijs staat vol na een uitgevallen bus zonder communicatie. Wel een stilstaande bus met RET personeel aanwezig. Een bericht van de chauffeur was wel zo netjes geweest.
Translate Tweet
6:55 PM · Apr 2, 2019 · Twitter for iPhone

RET @RETRotterdam · Apr 2
Replying to @DegenOnTour
Hi Miko, ik begrijp dat dat niet prettig is. Ik heb dit dan ook doorgestuurd naar de desbetreffende afdeling. Heb je de RET Real Time App al? Via de app kun je je nieuwe reis plannen. -Levy

Milko @DegenOnTour · Apr 2
Er staat hier een heel mooi bord met alle tijden erop. Neem aan dat als jullie daar van afwijken dat jullie dat net zo goed van de app doen.
Beetje slecht moment om je app te promoten.

RET @RETRotterdam · Apr 3
Goedemorgen, mijn collega had niet de bedoeling om onze app te promoten. Wel om jou een alternatief aan te bieden zodat je zo snel mogelijk je reis kon voortzetten. -Jordy

Risky Vandoorne @RiskyVandoorne
@RETRotterdam Beste RET vanmiddag 2 uur geleden wilde ik vanaf school naar mijn afspraak gaan in Barendrecht. Bus 68 was heel vol en er werd meerdere keren gedrukt en de chauffeur werd boos en reed bij Slinge Metro door! Zo had ik mijn 183 gemist en kwam ik te laat! 68 van 15:10
Translate Tweet
4:51 PM · Jan 15, 2019 · Twitter for iPhone

RET @RETRotterdam · Jan 15
Replying to @RiskyVandoorne
Dat is heel vervelend Risky, ik breng je reactie onder de aandacht bij de Divisie Bus en @ret_controle zodat zij op de hoogte zijn van je reiservaring en maatregelen kunnen nemen.-Yolanda

Free Spirit @DubbelBoa
@RETRotterdam @RET_controle voor de 2e dag op rij stopt bus 68 vanuit #Heijplaat richting #Zuidplein niet bij halte #Plein1953.Terwijl het stoplampje brand.Reden leerlingen @STCGroupNL drukken steeds op stopknop.Chauffeurs negeren passagiers! Dit roept agressie op bij passagiers!
Translate Tweet
3:23 PM · Sep 19, 2019 · Twitter for Android

RET @RETRotterdam · Sep 19
Replying to @DubbelBoa and @STCGroupNL
Hoi Free, wat en vervelende situatie. Ik zal het onder de aandacht brengen. Roep ook even richting chauffeur als je eruit moet.
Fijne avond alvast. -Ruby

RET Veiligheid @RET_controle · Sep 19
Replying to @DubbelBoa @RETRotterdam and @STCGroupNL
Goed dat je het meldt! Wij gaan proberen er extra aandacht op te geven. #overlast #bus68 #heijplaat ^SCS

Free Spirit @DubbelBoa · Sep 19
Ja maar alle reacties gaan voorbij aan het feit dat normale betalende passagiers niet uit mogen stappen. Als me dit weer overkomt sta ik niet meer voor meezelf in.

RET @RETRotterdam · Sep 19
Natuurlijk hoort de buschauffeur te stoppen als het stoplampje brand, maar ga geen gekke dingen doen. Daar wordt niemand wijzer van. -Roger

Tweet

Sandy @SandyRdam
Echt hoor @RETRotterdam , kom ik om 16:50 aan bij de bushalte, is de bus van 16:52 al weg! #faal #nietdeeerstekeer
Translate Tweet
4:55 PM · Oct 28, 2019 · Twitter for iPhone

RET @RETRotterdam · Oct 28
Replying to @SandyRdam
Dat is inderdaad niet leuk, maar alle tijden op de halte zijn bnjbenadering dus kan de bus ook iets ieder zijn. -Rinus

Sandy @SandyRdam · Oct 28
Goede tekst...

RET @RETRotterdam · 17h
Tja.. goed punt en hiermee werd natuurlijk bedoeld bij benadering.. -Kristel

ilias @pairpajrkfisbah
Replying to @pairpajrkfisbah and @RETRotterdam
@RETRotterdam en bus 56 2 min te laat. Dat betekent nog een metro gemist.
Translate Tweet
7:00 AM · Jun 12, 2019 · Twitter Web App

RET @RETRotterdam · Jun 12
Replying to @pairpajrkfisbah
Goedemorgen Ilias, wat vervelend dat je ochtend niet loopt volgens planning. Bus 56 dient zich te houden aan de volgende dienstregeling: bit.ly/2V3hMHg. Volgens jou is dat dus consequent niet het geval? -Jordy

Dienstregeling
De dienstregeling van de RET met alle vertrektijden voor alle haltes voor de bus, tram, metro en Fast Ferry.
ret.nl

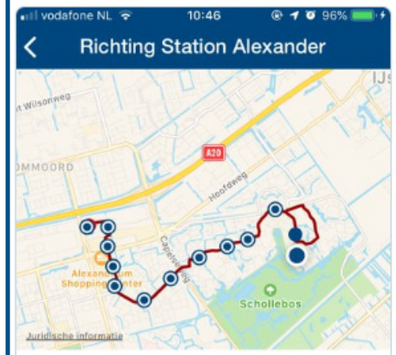
ilias @pairpajrkfisbah · Jun 12
Beide niet. 156 en 56. Gister was hetzelfde verhaal alleen was 156 te laat en 56 te vroeg.
Tenminste wat jullie ret app aangeven. Ik ga er van uit dat ret app klopt.

RET @RETRotterdam · Jun 12
Daar mag je in principe natuurlijk ook vanuit gaan! Ik ga dan ook een melding maken van je berichten zodat we ermee aan de slag kunnen! Hopelijk ben je overigens inmiddels ook aangekomen op plaats van bestemming! -Jordy

Raymond vd Hoven @RaymondvdHoven · Apr 6
Wat een waardeloze dienstregeling #RET op de **bussen** naar Maasslui. 14 minuten wachten op een bus die om het kwart nou echt geen betere aansluiting op de treinen mogelijk?

marjan keuter @marjanke · Jul 18
Replying to @JanHenk038
hoezo? het is geen pretlijntje, maar dagelijkse noodzaak om naar werk of school te komen. Al 2 jaar gepropt in afgeschreven **bussen** in de file over de A20 zonder dat de **RET** daar een boodschap aan heeft.

sylvia @wolfje_sylvia
@RETRotterdam rijd bus 30 nu toch wel weer langs halte operalaan?
Volgens de ret real app namelijk wel?
Zou wel fijn zijn aangezien het mij een kwartier extra kost om anders naar station schollevaar te lopen
Translate Tweet



Operalaan 10:52
Station Schollevaar 10:53
Posthoorn 10:54
Sara Burgerhart Erf 10:55
Heksendans 10:56
Port Saïdstraat 10:58

Vertrektijden · Planner · Omleidingen · Klantenservice

10:50 AM · Aug 23, 2019 · Twitter for iPhone

RET @RETRotterdam · Aug 23
Replying to @wolfje_sylvia
Hi Sylvia, Ik heb dit even voor je uitgezocht, maar deze bus rijdt nog steeds een omleiding. Deze werkzaamheden bij de Hermitage duren tot en met 4 oktober. -Cher

sylvia @wolfje_sylvia · Aug 23
Oké jammer! Maar bedankt voor uw reactie

RET @RETRotterdam · Aug 23
Graag gedaan! -Cher

Feyenoord Stats @Feyenoord_Stats
Replying to @RETRotterdam
Beste RET, waarom rijdt bus 156 al de gehele week niet 'S ochtends? Dit resulteert in overvolle 56 bussen waar mensen zelfs niet meer in kunnen stappen bij meerdere haltes. Lijkt me niet echt de bedoeling..
Translate Tweet
7:59 AM · Sep 26, 2019 · Twitter for iPhone

RET @RETRotterdam · Sep 26
Replying to @Feyenoord_Stats
Hoi, dat is inderdaad niet de bedoeling. Er zijn inderdaad de afgelopen week ritten komen te vervallen, waardoor er zeer onregelmatig wordt gereden. Ook vandaag is dit zo. Onze excuses. Ik heb je bericht onder de aandacht gebracht. -Roger

Feyenoord Stats @Feyenoord_Stats · Sep 26
Oke. Zou hier dan wel over gecommuniceerd kunnen worden? Mensen stellen hun reizen hier op in.

RET @RETRotterdam · Sep 26
Zeker, ik heb je bericht onder de aandacht gebracht.

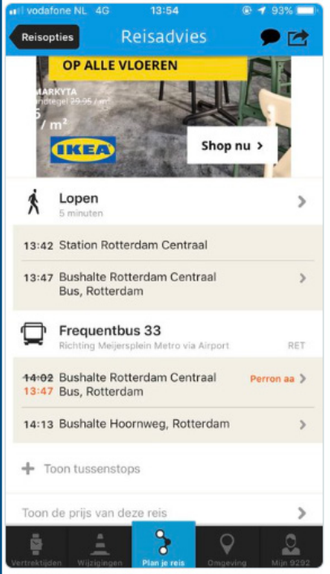
Feyenoord Stats @Feyenoord_Stats · Sep 26
Dit is nu de situatie bij Vijfsluizen + een hal die volstaat..

RET @RETRotterdam · Sep 26
Sorry voor deze situatie buslijn 156 is uitgevallen vanwege defect materieel -Rich

Feyenoord Stats @Feyenoord_Stats · Sep 26
Haha de hele week zeker? Wie nemen jullie nou in de maling, ik hoor van de chauffeurs wel andere verhalen. Iets met een personeelstekort?

RET @RETRotterdam · Sep 26
Dat is mij niet bekent. -Rich

Georgie @ikheetnietjors
@RETRotterdam wat is dit nou weer voor geks, ik moet nu 25 min wachten op de volgende bus #bus33 helemaal kut weer
Translate Tweet



1:55 PM · Aug 23, 2019 · Twitter for iPhone

RET @RETRotterdam · Aug 23
Replying to @ikheetnietjors and @RETRotterdam
Geen idee, Georgie. Bus 33 vertrekt in ieder geval om 14.17 uur en om 14.37 uur vanaf CS. Misschien de RET Real Time App gebruiken. -Ruby

Rob van Heijst @robvanheijst · Oct 16
Wat mij vanmorgen toch overkomen is met de @RETRotterdam. Sta ik op bus 245 te wachten, rijdt hij nog ook! Dat is de eerste keer deze week. En hij was zelfs op tijd. Het moet niet gekker worden. #Ridderkerk #OV

Anouk @AnoukdeR_ · Nov 21
@RETRotterdam lekker 20min later pas een **bus** op 156 van 09.05 vondelstraat en nergens een melding maken. Voor de zoveelste keer. Lekker weer uitleggen bij mijn baas, waarom ik nu weer 2 aansluitingen mis. Minimaal maandelijks gesprek inmiddels.

8.4.1 The Customer journey - disrupted trip

No previous research has been found that specifically looks at the emotional experience of bus travellers during disruptions. The customer journey in Figure 27, shows the results from two participants, that was asked to map out their bus journey, including a disruption. During the in-depth interview, there is elaborated more on this experience of one of the participants.

Unplanned disruptions are common in public transport and although most of the time they come as a surprise to the traveller, which leads to a sudden increase in stress and anxiety because the traveller ends up in an uncertain situation. The traveller is very alert just before the scheduled departure time. The uncertainty is triggered from the moment the bus should actually have been there but is not. The margins in this vary from person to person, for one person this is already within one minute, while for others it is from 5 minutes. The uncertainty triggered emotions of anxiety, frustration and something even anger. That gets worse as the duration of the uncertainty or the wait increase. Traveller information can ensure that the uncertainty decreases a bit again. However, due to the negative emotions the travellers are less good in take note, comprehend, retain and process traveller information.

Due to previous experiences with incorrect information during the disruption, travellers become more suspicious. A kind of sceptical arises whether the bus is still going to come while the DRIS may indicate that it arrives in a couple minutes. There is a slight relief when the bus arrives. After that, an estimation is quickly made of the expected arrival time and therefore what the impact is of the delay for the traveller. Frustration remains. When leaving the bus the feeling of dissatisfaction arises. It is noticeable that the stress and frustration of the journey are taken into the day, the size of which depends on the impact of the delay and how the person deals with setbacks. Especially the travellers who travel for business as he feels that it is not professional to be late due to public transport disruption. They also have the feeling it is less accepted than being late by car.

Each individual experiences disruption differently, depending among other things on personality and previous experience. This is why they will also not react in the same way when they experience a disruption.

- Some travellers appear to become oblivious to the whole situation, and sort of freeze in the moment.
- Some might start looking at other people standing at the bus stop, and they blindly follow what these other travellers do or say.
- Some might immediately feel the anger for the Operator and begins to express their anger against fellow travellers and/or staff.
- Etcetera.

This may be just one emotion curve of the participant following from the in-depth interview, but that one line represents many bus-traveller that experience similar experiences every day. The emotions can also be found in the tweets, as can be seen on the previous pages, that people post. However, there is only a small group of travellers who ultimately really make themselves heard. As a result, the seriousness of the experience is unknown to the operator. Besides that, the operator is also not always taking the experience of the traveller serious as can be seen in the responses of the tweets, which are sometimes really customer unfriendly.

There also appears to be something in the accuracy and availability of 'real-time' traveller information. Where every traveller does have an example of a situation that he/she has experienced in which the information was incorrect or contradictory or was not there at all. Therefore the next sub-chapter elaborates more on the experience of travellers with traveller information. In sub-chapter 8.5 a case will be highlighted that shows where the pain points are in 'real-time' traveller information for the traveller.

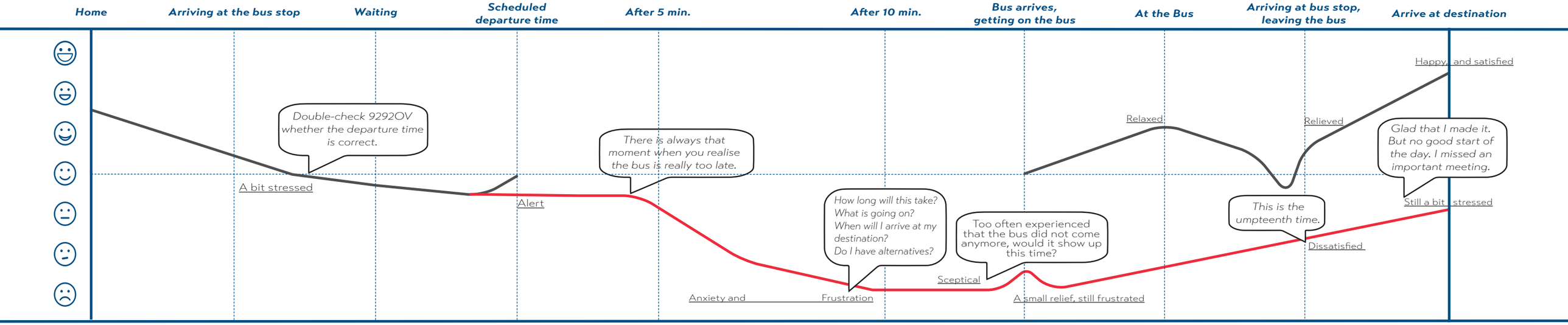


Figure 27. Customer Journey Map of one bus travellers for a disrupted trip based on the user research.

8.4.2 Traveller information needs - disrupted trip

Traveller information provision is an essential part of the disruption experienced as the information can potentially determine the overall impact of the disruptions, for example when alternative options are available. Different kinds of information are desirable in different situations. In this section a distinction will be made between planned and unplanned disruptions, as they trigger for both situations is significantly different from each other. Although this research focuses primarily on unplanned disruptions. However, during this study traveller information provision around planned disruptions came up on multiple occasions and is therefore included in this report.

Planned disruption

Although the focus of this research is on unplanned disruptions, both in the booklet and during the in-depth interview expressions of dissatisfaction with planned disruptions were made. The messages around planned diversion are experienced as incomprehensible, which is demonstrated through an example of actual events below. See Figure 28, for an example of such traveller message coming from the RET Real-Time app.

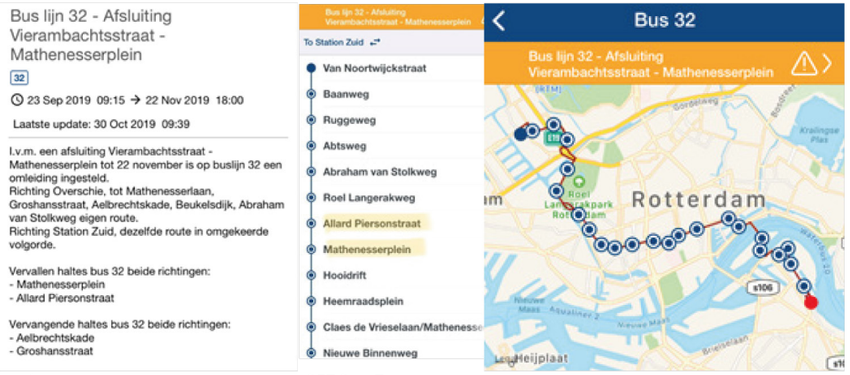


Figure 28. Examples of planned disruptions messages in the RET Real-Time app

As can be seen in this example, one has to be very familiar with the route to know which stops on the route are out of service. The temporary bus stops are mentioned, but they are not indicated in the timetable or map. In addition, this information is only visible on the RET app and website. When you plan this trip in other apps like 9292 or Google Maps, this is not the case, while these apps are used most frequently among the participants. So in those cases the diversion cancelled and temporary stops are not known. This can, therefore, lead to the fact that some traveller mentioned that they were not aware of the (planned) diversion until they have arrived at the stop. In the RET message information currently lacks the distance from the original stop and a map of the detour and temporary bus stops. It is also not clear if the detour affects the overall bus trip's time schedule.

So in general, several general aspects that might be considered to improve overall communication around planned disruptions:

- Brief details about any changes to the route, which roads, stops or lines are out of use.
- Alternative stops or line numbers.
- Visualisation of the division, an updated line map is highly preferred.
- Anticipated duration of the disruption.
- The approximate impact on the journey time.
- The reason for the disruption

Unplanned disruption

Back to the main focus of this research information provision during unplanned disruption. Results from the booklet, the interview, the twitter analyses and the case study show that there is also room for improvement here. As statement are made by travellers that the underlying cause is often unknown, the information about the delay(time) is incorrect, no information on alternatives provided and 'the system' is not even aware of the disruption travellers are experiencing. So travellers may feel that there is no information available at all and that there was no way of finding additional information. This does not directly mean that the cause is not known at the RET, but it makes clear that the information does not always find its way to the traveller.

"The bus is standing on de DRIS, minutes run down but by the end the bus is not coming after all? That is downright frustrating!"

The cause of a disruption influences the travellers' choices but also their opinions. For example, is the bus delayed due to the traffic jams. They understand that this is out of the control of RET and are more forgiving towards RET. If they had taken the car, they would probably have had the same delay. Another annoyance is the information about the delay(time) being incorrect. The wrong prognosis might be provided which are then also not updated correctly after the event. Even in the situation where causes, prognoses or alternatives are not known yet, travellers appreciate some kind of interaction and communication because interaction reassures travellers that they are not simply abandoned in case of disruptions.

"I came home 1,5 hours later than usual . While it was indicated that the delay was 20 minutes. That felt extremely unpleasant"
"In the end I heard via a fellow traveller that it was about a car that turned over on the Brienenoord bridge. That was force majeure. But it did not really feel right. One is very dependent on public transport in such cases."

If the reason behind the disruption is shared with the traveller, they are more open to understand and empathise with the operator. Additionally, the scale of the problem is important. For example; does the cause only have an impact on this specific bus, or have all buses on the line been affected? Or in case of bad weather conditions, are other modalities affected as well?

"I think that often the type of information is what you in fact want to know hey if the bus is not going. Is the bus not going because there is a little bit of a traffic jam in the city. Or has the previous bus crashed somebody and are the buses not coming as a consequence or is your road closed off by this bus or isn't it coming your way anyway. Those sort of things I would like to know"

Because digital information is not always correct, people also start to distrust it more. People find personal travel information and a little personal attention important. People tend to trust another person a little more than something on a phone in an app. With digital information, it is especially important to know when it is posted and updated.

"It was indicated that it should be leaving in ten minutes or so, but in fact it should be in two minutes. And funny enough two similar buses of which I should come in ten minutes and I in eleven minutes. That creates a little bit of confusion of course but there were a few people still waiting. So I think that that always creates some trust. If you are the only person waiting in the middle of nowhere for a bus which is too late then you get a feeling of uncertainty. But if there is a group of people clearly waiting there for the one that has not come or has something happened"

The DRIS signs are considered as impractical during disruptions. This is because it only indicates the time until departure in minutes. With a delay, the time increases or freezes, and therefore does not clearly indicate how much the bus is delayed versus the planned departure time. Diversions are also not immediately seeing, only if they are sometimes communicated on the bottom of the board.

"On the DRIS enormous texts pass. And often you just miss the first part and then you are waiting again until it competed entirely."

When a traveller is aware of what is happing, they are empowered to make practical decisions and can deliberately choose to wait and travel as per plan or to go for an alternative trip. Not having this information, affects them not only by being delayed but also emotionally. The dependency on public transport can lead to frustrations, anxiety and sometimes even fear or anger, which results in dissatisfaction with the overall service.

Following from all above, the statement can be made that important aspects for the traveller to know during unplanned disruptions are:

- The cause; Transparency is a very important value.
- An estimated impact on journey time; Honest information is demanded.
- An idea of the scale and duration of the problem.
- The alternative options.

Moreover, the timeliness of communication is important. Hearing about disruption is never a good thing, but the sooner the traveller is aware of the situation, the better they can decide what their next step should be. In addition, consistency of the message on all channels is also of great importance. It must also be accessible by different channels since not all travellers use or have access to information via all channels. That traveller information is not always consistent, timely and accurate will become clear from the case example discussed in the following sub-chapter.

8.5 Disrupted trip experience of travellers - case study

As part of an in-depth analysis on an unplanned disruption, a case has been worked out for a disruption that actually took place. It concerns a disruption on line 173 from bus stop Station Centrum West Zoetermeer travelling to bus stop Rodenrijs via Bleiswijk on Thursday 31 Oct 2019. The worked-out case helps to gain a better insight into the timeline of a disruption and the impact on traveller information. The disruption has been followed from different perspectives (Passenger, Bus Driver, CVL) and different traveller information channels (RET Real-Time app, RET website, RET Twitter, 9292OV, Google Maps) have been followed in parallel. The case can be found on the next three pages and the analyse from the travellers perspective can be found afterwards. In this research only one case has been fully worked out in detail, however, many similar situations have been observed. The case helps to expose the specific pain points for the traveller and at a later stage supports recommendations for improving the traveller information provision to the traveller.

Figure 29, shows the routes of line 173 (blue) and line 170 (light blue), the red dot is stop Werner Von Siemenstraat and the orange dot is stop Lansingerland-Zoetermeer railway station.

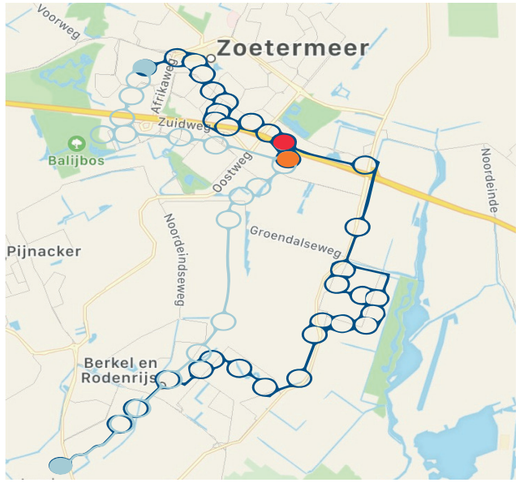


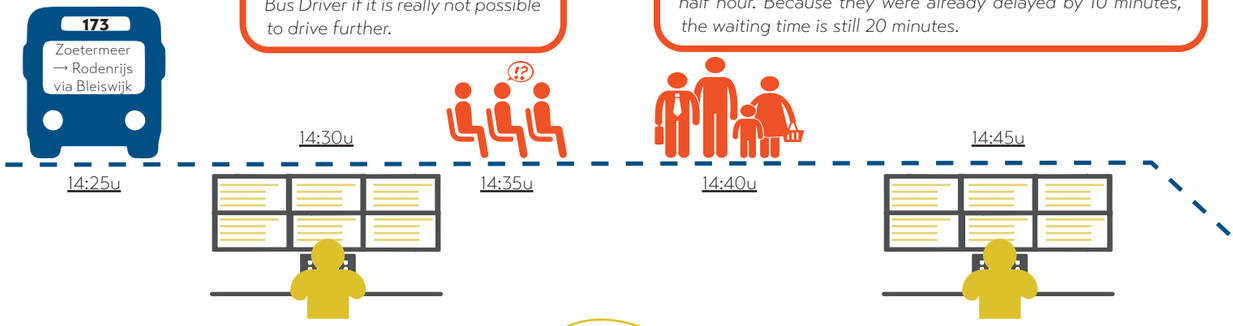
Figure 29. Overview of the routes of line 173 (blue) and line 170 (light blue).

The Bus Driver of Bus 173, direction Rodenrijs Metro departed at 14:13 from Station Centrum West and noticed a flat tire close after the stop Werner Von Siemenstraat, and messaged the Traffic Controller via the radio.

The Bus Driver asked traffic control if he could drive one stop further (850m). Permission is granted to drive towards Lansingerland-Zoetermeer railway station. The Bus Driver explain the situation, shows the picture of the tire to some passenger that are still asking if the bus really could not drive further. The Bus Driver makes apologises and explains the alternatives to traveller further by train, by bus 174 or wait for the next bus 173.

The passengers in the bus become impatience and ask the Bus Driver if it is really not possible to drive further.

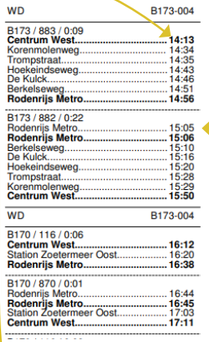
Some passengers, are able to traveller further by train or bus 174, others have to wait for the next bus 173, who comes every half hour. Because they were already delayed by 10 minutes, the waiting time is still 20 minutes.



The Traffic Controller cancelled ride B173/883 in EBS from the stop Werner Von Siemenstraat until the end stop Rodenrijs Metro. As a result, the ride will no longer be visible on the DRIS signs at the stops on the route. However, the cancelled stops are not visible in the traveller information apps/website.

The Traffic Controller contact fleet service by phone which contact an external company that will come to the location to replaces the flat tire.

The Traffic Controller agrees to the Bus Driver which continue until Lansingerland-Zoetermeer railway station. And told that the Bus Driver to wait there until a technician comes,waiting time unknown but estimated 1 hour.

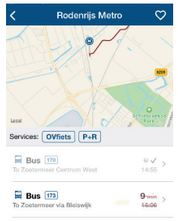


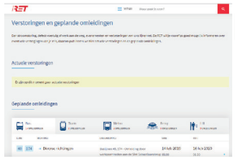
WD	B173-004
B173 / 883 / 0:09	
Centrum West	**14:13**
Korenmolenweg	14:34
Trompstraat	14:35
Hoekeindseweg	14:43
De Kulck	14:46
Berkelseweg	14:51
Rodenrijs Metro	**14:56**
B173 / 882 / 0:22	
Rodenrijs Metro	15:05
Rodenrijs Metro	**15:06**
Berkelseweg	15:10
De Kulck	15:16
Hoekeindseweg	15:20
Trompstraat	15:28
Korenmolenweg	15:29
Centrum West	**15:50**

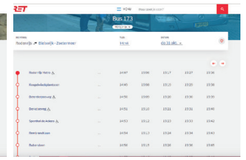
WD	B173-004
B170 / 116 / 0:06	
Centrum West	**16:12**
Station Zoetermeer Oost	16:20
Rodenrijs Metro	**16:38**
B170 / 870 / 0:01	
Rodenrijs Metro	16:44
Rodenrijs Metro	**16:45**
Station Zoetermeer Oost	17:03
Centrum West	**17:11**

The Traffic Controller cancelled the entire follow-up ride B173/882 of the driver in EBS. Because the bus will not be fixed on time and there is no replacement bus. The cancellation in EBS makes that this ride disappear on all DRIS signs along the route.

The Traffic Controller contacts the Traveller Informant by phone to inform her about the cancelled trip and the reason.

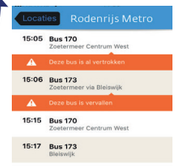


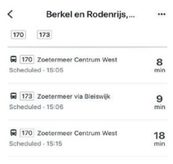




RET Website, *shows no messages under the disruption-tab. The timetable overview shows no red indicator for line 173. The red indicator indicates that the line have deviation from normal which could be plan or unplanned. The cancellation is also not visible in the timetable it self.*

RET Real-Time App, *shows that the ride is cancelled, however no reason is provided. The disruption is not mentioned on the front interface of the app. Only by clicking on the bus-line the cancellation is visible.*





9292OV App, *shows cancellation. However, no reason is provided.*

Google Maps, *shows that the bus is operating normally.*

RET twitter, *no update is posted.*

14:55u

14:50u

The Traveller Informant compose a message in RIVER by the 'OPGA-principle' and selected the channels to broadcast the message. Geo-GUI is used to place the message on to the DRIS signs. Although some passenger experience a delay of +30minutes the 'OPGA-messages' is only shared with the DRIS and Real-Time App.

Travellers that were heading for bus B173/883 experience a delay of +30 minutes. Without knowing what is going on, as none of the traveller information apps provide information about the partly cancelled trip.

14:55u

This is the next bus 173 that goes in the direction of Metro Rodenrijs which arrives at 14:55u at stop Lansingerland-Zoetermeer railway station and picks up the stranded travellers.

15:00u

15:17u, is the first bus that is going in the direction of Korenmolenweg-Bleiswijk. Followed by the next bus at 15:27u. in that same direction.

This is the first bus that runs in the direction of Centrum West Station via Bleiswijk.

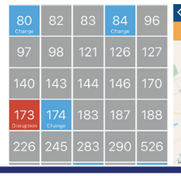
Travellers that were heading for bus B173/882 and did not need to travel further than Bleiswijk, experience a 11 minute delay.

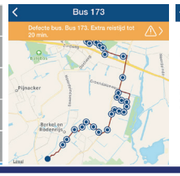
Travellers that were heading for bus B173/882 and need to travel further than Bleiswijk, experience a 30 minutes delay.

The buses tire is fixed and the Bus Driver is heading toward Zoetermeer for the next ride Bus 170/116, which departed on time.

This is the sequel ride, B173/882, of the bus that has been cancelled due to a flat tire. As stated on the previous page, it was clear to the travellers that this ride was cancelled, Although the reason was unknown for them.

15:06u





RET Real-Time App, *Now the disruption on line 173 is visible on the front interface of the App. By clicking on the line the map plus notification about the disruption is readable. This also states the cause of the trip cancellation.*

15:17u 15:27u 15:36u 16:20u >16:20u

The traveller information available is presented on the previous page. From around 15:55 the cancellation and cause were also visible on the DRIS signs at the stops and in the RET Real-Time App.

RET Real-Time, *The disruption on line 173 is still visible at the front interface of the App and when clicking on the line itself.*

9. Findings of the field user research: the other actors

This chapter will focus on the three main other actors that are involved in handling operational disruption with buses and support ion the information exchange to travellers. These three other actors are the Traffic Controller for the buses, the Traveller Informant and finally the Bus Driver. Following the research approach as described in Chapter 7, this chapter will describe some of the key finding from the research that was conducted. For the sake of clarity, the findings have been grouped in specific theme's, but do keep in mind that these themes and underpinning findings are very much related to each other. One overall findings that emerged throughout RET is the unwritten but outspoken modality hierarchy of first the metro, then the tram, and then the bus. The next chapter will use the findings described here into the key insights that were deducted from this research.

9.1 Traffic Controller Bus

The main themes identified for the Traffic Controller are; Complexity, operational limitations, peak workload and working principles. These key themes will be further explained based on learning deducted from several interviews and observations that were performed.

Operational limitations

There are multiple factors that are limiting the flexibility of the Traffic Controller, specifically during operational disruptions. The main three operational limiting factors will be described below.

Within the RET there is a strong culture of a silo thinking, which limits them in benefiting from cross team collaboration, such as quick decision making, knowledge sharing, workload peak shaving etc. This behaviour was observed in multiple different department within the RET, so also applies to the other actors described below. This is partially driven by the fact that the different RET departments charge each other internally for their services. This effect is even more he case for the Bus BV. as they are listed as a fully separate legal entity as well. The main disadvantage related to this observation is the limitation of workload and knowledge sharing between the different modalities; the metro, tram & bus departments.

A second observation is related to the concession agreements between RET and the MRDH. One of the influences this has is that is causes a negative reinforcement culture in within the Traffic Controller community. In the concession agreement fines for under performance of the transport company, for example on punctuality and cancellations of bus lines are included. Although there are also agreements on bonuses based on the customer barometer results. Above all, the fines predominates in the perception of the Traffic Controller. The several interviews and observations show that the Traffic Controllers themselves experience this agreement as a limiting factor, as they feel it limits them in the creativity they can apply to resolve certain disruptions. Some of the remarks below underpin the experience they have around this.

"The traveller is not important! It is all about money: Fines Fines Fines"

"As presently, a bus has fallen out; one would like to put the last carriage in front and have the front carriage driven slower in order to spread the impact more proportionate on the network. This is not possible however, because then you get 3x fines on 3 buses instead of 1x fine on just the fallen out bus"

"If something happens at the tram you would be prepared to put in a bus there which is in the neighbourhood. In order to pick up stranded travellers. Or in case of delay at the metro that a connected bus waits just a little longer to offer travellers the connection. However, that will cost the Bus BV. a lot of fines and exploitation money. That money must be cashed at all concerned departments and that appears to be a difficult route. That is why it's (bus, tram and metro) each for himself!"

Thirdly, the Traffic Controllers flexibility is reduced due to the limited spare capacity both in terms of backup drivers as well as backup buses. This in itself can also work the other way around, where the limited amount of spare capacity might actually cause disruptions, for example in case of Bus Driver illness or technical bus failures. This is underpinned by the number of IRMS incidents listed as technical failures as were presented in chapter 2.2.2.

Complexity

The following sections will describe the second main theme, and will elaborate on three aspects that determine the level of complexity the bus network.

The second aspect that is of importance to note for the Traffic Controller is the overall **size and complexity of the network** that they are scheduling. The RET bus network is managed by 2 Traffic Controllers who cover 51 different lines with over 230 individual buses. Their task has a bigger level of complexity compared to tram and metro schedulers. As the tram network is also scheduled by 2 Traffic Controllers which oversee 11 different lines with 100 individual trams, whereas the metro network is scheduled by 5 Traffic Controllers who manage 5 different lines with 60 individual metros.

The bus network also has an additional layer of complexity due to the fact that it makes uses of a planning strategy called **Interlining.** Interlining means that a single bus (+ driver) cover an order of different trips (bus-lines) at the same day. Interlining occurs between buses (lines) linked to the same Garage (Sluisjesdijk,Kleiweg, Krimpen en Ridderkerk). An example of this is a 6 hour Bus Driver shift which covers the following lines respectively; 38-54-38-40-38-53-51-38-40-40. The risk of this scheduling principal is that a disruption on a line, can have a knock-on effect on a different, seemingly unrelated line. One can imagine that this might cause additional complexity for the Traffic Controller especially in case of multiple, simultaneous disruptions. The interviews with different Traffic Controllers revealed that the Interlining principal I considered as one of their main challenges.

A third and final layer of additional complexity in bus scheduling compared to tram and metro scheduling is related to the **environment in which buses operate.** Namely in the middle of other traffic therefore being more exposed to external factor that might trigger certain incidents or disruptions. This requires the bus Traffic Controller to be creative, as they have a more dynamic set of options to resolve disruptions. Which can also be a risk as the bus is in some occasions less flexible than your average car, for example taking a detour through narrow street, or streets with low overhanging trees.

Peak workload

The third main theme is related to peaks in workload for the Traffic Controllers, which will be explained in more detail below.

In addition to the complexity, the interview and observations show that the Traffic Controllers are confronted with large fluctuations in their workload, which sometimes means that they have time to socialize with each other. But that this can change in a split second if calls from drivers come in via the radio. In particular, a large peak on workload occurs when several incidents or disruptions occur at the same time. At the moment of an incident there are many actions that must be taken by the Traffic Controller in a very brief time period. As the Figure 17, also shows, this means entails; keeping in touch with drivers, operating the EBS system, collecting information, taking mitigation measures, informing the Travel Informant and creating an IRMS report.

In the event of multiple incidents, observations show that prioritisation of tasks is key for the Traffic Controller in order not to drop any balls. This often means that the controller's attention is first and foremost focused on properly supporting the Bus Driver and taking the correct mitigation measures and implementing these in EBS. Tasks such as calling the Traveller Informant and creating IRMS notifications can therefore sometimes be forgotten. This often means that incidents that have passed are not always reported to the Traveller Informant because other incidents might have occurred that got priority over properly closing out the previous incident.

The observations also show that the communication method becomes shorter during peak moments. Also some irritation might arise between the driver and the Traffic Controller, due to the late response on calls via the two-way radio and the limited information provided by the Traffic Controller to the driver. The Bus Driver often shows little patience in properly explaining the situation and possible mitigations to the Traveller Controller. There also seems to be a knowledge gap with the Traveller Controller on how these situations can develop in the real world, and what consequences their decisions might have.

"They know everything about the metro, but they don't know anything about us, we have to tell them everything from scratch .... Even if I have made an IRMS notification with everything in detail which they can look into as well they still call for an explanation... I don't have the time for that if it is very busy!"

Working principles

The fourth and final main theme relates to the working principles used by the Traveller Controller which can be split into three underlying observations.

The work of the Traffic Controllers is characterized by a reactive attitude, as they only seem to act when a problem occurs. The observations showed that this attitude is very strongly related to individual characteristics. For example, the EBS system automatic sends gives a message when a vehicle is more than 3 minutes too early, too late and again if the vehicle is more than 5 minutes too late. Some Traffic Controllers choose to actively monitor the messages in order to keep to the timetable as much as they can. Other Traffic Controllers choose to take a more reactive approach and await messages from the driver regarding delays.

In addition, there are no fixed scenarios for common bus disruptions, which do exist for common disruptions of trams and metros. Such scenarios can offer a standard approach for the Traffic Controller where certain processes are automatically triggered when a scenario is activated. For example, sending EBS messages to the drivers with predetermined travel information. For the bus, however, everything takes place in the head of the Traffic Controllers. This also means that the transfer of knowledge mostly takes places verbally only, thus leading to a very fragile knowledge retention process. Hardly any standard protocols for bus disruptions, and possible solutions for the Traffic Controller are documented.

Thirdly, there is no real feedback loop in place in the work process. The Traffic Controllers are ultimately there to ensure that the bus timetables are met. However, the feedback regarding the impact of their choices hardly ever finds its way back to them. The only feedback they receive is in the form of monetary claims from the MRDH in case punctuality targets are not met. It turns out the that Traffic Controllers with previous experience as a Bus Driver have a way better understanding of the magnitude of the impact on travellers. Traffic Controller that do not have this experience are therefore much more dependent on the information they receive from the Bus Driver.

9.2 The Bus Drivers

For Bus Drivers, the main themes are; interface with the traveller, communication with RET internally and equipment reliability. These themes are explained by combining the findings from the two interviews and the observations in the field.

Driver – Traveller interface

For the Bus Driver, interaction with the traveller is considered to be a big part of their job. Namely, unlike the tram or metro driver, they are in direct contact with the travellers. Which means that in addition to driving the bus, they also have peripheral tasks such as ticket sales and assisting travellers. The Bus Driver therefore has to deal with complex and varied social situations. An example of this was observed during one of the bus rides, where a middle-aged woman walked from the back to the front and started talking to the driver while driving. She thought she was on the wrong bus, but did not speak Dutch very well, nor did she know exactly which stop she was going to. A difficult situation arose where the driver did his best to try to help the woman while safely operating the bus. An interesting observation here was to see how much effort the driver was putting into helping this traveller in need, and the high expectations the driver set for himself.

"Our RET station employees have the possibility in some situations to offer a 2-hours free travel card and at NS they have coffee coupons. Often we can just offer nothing else but apologies.... Although sometimes when I am very much delayed I allow all travellers to check out. I don't know if that is allowed... but I feel that is the only thing I can do in such cases of the traveller to soften the inconvenience."

It also emerged from the interviews that the Bus Driver often does not have the information requested by the traveller, which mostly concerns intra modality information. The most often heard question is regarding travellers requesting information on making their transfer in time. There is a function for this on their EBS computer CoPilot, but no information is displayed there. In addition, there are no line maps in the buses, as there are in the metro and tram.

"Sometimes it would be nice to have a lines card per garage (region) to make it easy to indicate quickly or circle something and make it clear to the traveller. Now I use my phone and Google Maps, but that is not ideal. Because often that does not make it clear to the traveller. A card can be useful in this."

As the literature study shows, traveller find broadcasting a pleasant way to be notified of disruptions. The interviewed Bus Driver understood this finding and tried to explain why he nevertheless often does not use the broadcasting system in the bus:

"I need more information from the Traffic Controller so that I know what to broadcast. Because if I call I must be able to tell what is happening exactly and what it means for the traveller and if there is an alternative... sometimes I decide not to call for instance if the only alternative is that people have to walk a long track or have to wait for a long time... a tram driver is in a booth, but as a Bus Driver you get a lot of upset people and that can be unpleasant.. I don't always feel safe ."

The feeling of insecurity was more often expressed in the interview. This subject is not included in the scope of this research, but it is an important point for the RET to be aware of. Certainly, as it in some occasions may hinders the provision of information to the traveller. Another point that was mentioned in the interview was the annoyance of the response from MVS (Marketing, sales and service). MVS responses are sometimes internally forwarded among drivers, as wrong facts or assumptions might be communicated to travellers. An example of this is shown below:

"They say "report it to the driver and then the bus will be exchanged immediately at a defect airco.... That simply is not true because we don't have materials... we have to explain that consequently to the traveller who comes reporting to us..... this leads to an annoying situation for us again."

Integral communication

For Bus Drivers, communication with the Traffic Controller is an important life line to the organisation. After all, a Bus Driver operates relatively stand-alone. Whereas there are always several RET employees on a tram or metro, the Bus Driver is on his/her own and there is very little supervision on the bus. However, communication with the Traffic Controller is not always experienced as optimal. The following conversations show that a Bus Driver is often not aware of what is happening on the line they are currently operating. The Bus Drivers indicated that they assume that this information is known by the Traffic Controller, but that it is not pro actively communicated to them.

"Sometimes I arrive at a bus stop and there are many more people than normally, I often conclude if or what is happening on my line or elsewhere in the network. Sometimes Traffic Control says that this line of that time has fallen out and expected is that it will operate again at a certain time, that is convenient!"

"What I find troublesome is that I cannot see which bus is going in front or behind me on the same line. Traffic Control can see this on the line chart. But I can't. So sometimes I just look outside on the DRIMS to see where the other buses are if I am delayed. Because if I am very close to my last carriage the chance is big that a part of the travellers from that bus has entered my bus already, this results in my bus being full and the past carriage driving almost empty behind me."

Bus lines that offer a connection to the metro and vice versa can benefit by being informed pro-actively in case of events or disruptions. Especially in early morning hours and late evening hours or during weekends when bus lines often run less frequently. Because if a traveller miss their connection during these time periods, it causes a more substantial impact on their waiting time. After all, it is not possible for the Bus Driver to contact the metro, so this must be done by the Traffic Controller.

It is also found that the Bus Drivers have varying experiences based on which particular Traffic Controller is working at that time. One Traffic Controller can be a lot more user-friendly, more detailed in their communication and more understanding of the Bus Driver's situation.
Another annoyance for Bus Drivers can be that they do not feel understood well enough by the Traffic Controller. The Bus Drivers understand a lot of what is going on in the overall network as they usually operate different lines. They have quite a good understanding of where the bottlenecks are and where opportunities for improvement are. However, they feel that they are not being taken seriously in their recommendations. Sometimes this results in them trying to actively encourage travellers to complain about certain topic towards RET.

"The only thing that really works to get things changed is if the traveller starts complaining to RET directly. Because we as bus drivers can provide feedback 100 times over, but no one ever seems to listen."

Equipment availability and reliability
The state of the RET bus fleet is currently a major problem for the driver but often also for the traveller. Drivers are often dispatched with buses that have known malfunctions, but due to the scarcity of equipment they do not really have an alternative. Even in case a bus fails, this often means that the Bus Driver needs to wait for at least an hour for repairs to be completed. This time the Bus Driver is sitting in their bus, often with limited information from the Traffic Controller and without any accessibility to any facilities (water, toilet, etcetera.). In addition, some systems on the bus are outdated. An example of this is the communication system for the traffic lights that give the bus priority over other traffic. Due to the outdated systems in the buses and new systems in place at some of the traffic lights, the bus is not recognised by the traffic light system and therefore does not get priority. On some routes this systematically results in delays due to the longer waiting times at traffic lights, as at especially larger intersections waiting times can take up to 5 minutes.

9.3 The Traveller Informant

For the final actor, three main themes have been chosen: peak working load, working process and systems design. These themes are explained with findings from an interview and various observation moments.

Peak workload
The Traveller Informant experiences several peak moments. This is because one individual Traveller Informant is responsible for the passenger information for all three modalities (bus, tram and metro) at the same time. These moments are typically during rush hour and during bad weather, as this causes a peak in disruptions for all three mobilities. At such moments the workload can become too much causing the quality of the service to drop drastically. This means that they will have to prioritise tasks accordingly. The observations and interview confirmed that the priority often is given to the metro instead of the tram and bus. This was found to be mainly driven by the bus being perceived as difficult and complex due to the large amount of lines, inter-lines and the differences in line frequencies.

Working processes
Because of the Traveller Informant's position in the communication chain, their work is very reactive. They wait until they get a message from the Traffic Controller and only then take action. The observations clearly showed a difference in communication with the Traffic Controller for the metro versus the communication with the Traffic Controller for the tram and bus. The communication between the Traffic Controller metro and the Travel Informant is all face to face, as the Travel Informant sits directly behind the Traffic Controller metro (See Figure 16, for floor plan CVL). Where the Traveller Informant can also overhear the conversations between the different Traffic Controllers and metro drivers.

For the tram there occasionally is some face-to-face communication, whereas the bus communication takes place mainly via phone. This as the bus scheduling teams sits too far away from the Traveller Informant. The Traveller Informant has access to the EBS system for the bus and tram, but it is however not possible to listen in on communication between the different Traffic Controllers and the drivers. Face to face communication is perceived to be more spontaneous and faster than communication over the telephone. This is especially reflected

in the interim monitoring of the status of a disruption and the rate of closure of a disruption. The face to face communication ensures more communication between the Traffic Controller and Traveller Informant and ensures that the Informant is better informed on change to the situation around a disruption. As a result, the Informant is informed at an earlier stage when a disturbance is over, and therefore can close out the incident more promptly. This means the disturbance message is closed in the RIVER system more quickly resulting in the message no longer being visible to passenger via the various information channels. The MVS department has set out certain guidelines on when to use which Traveller communication channels in case of disruptions, which can be found below.

- With a delay <15 minutes the message is sent to Geo-GUI, Real-Time App
- With a delay > 30 minutes the message is sent to Geo-GUI, Real-Time App, RET website, Twitter
- Trip cancellation or diversions, the message is sent to Geo-GUI, Real-Time App, RET website, Twitter
- With a delay of > 30 or major disruptions in the network, the message is also sent on the Bus, Tram, Metro and at the stations screens.

Additionally the Traveller Informants work in their reporting tools according to the 'OPGA-principle', where they for example use a very large list of predetermined causes (see Appendix 3). This large predetermined list is not always experienced as useful and sometimes even creates confusion. For example, you can choose 'the bus runs a detour' or you can choose 'the bus runs differently'.

"In case of a 20 minutes schedule for the bus I will choose to put it on Twitter. Because a lot of people use Twitter any way. For the traveller the impact of a fallen out ride in this case means a delay of 40 minutes."

Furthermore, MVS has decided to stop the collaboration with the 9292 platform, which means that all travel information is no longer forwarded directly to the 9292 and that they only have access to the open source data (as mentioned in context). The Traveller Informant does indicate that this could result in deviations between the information shared via 9292 and the RET real-time app.

System design
The Traveller Informant indicated in the interview that she sees the passenger information system as being quite comprehensive. She has more than 20 years of experience in this job and therefore has seen it develop over time. However, a tricky point is that all systems must cooperate seamlessly. For example the Geo-GUI program which operates the DRIS signs often has to do with failure. Causing many DRIS signs to not work properly. Geo-GUI is currently being run on outdated software, which means that linking it into new systems is not possible and many manual intervention is require to make this system deliver the results it needs to.

"I think this is ridiculous. We have a new PC but we cannot use it as the Geo-GUI software is not supported any longer. Therefore it is impossible to connect it to our traveller information system RIVER

Insights

In this section the key insights from this research will be deducted from all previous described literature, the context chapter and the user research. Firstly, the insights are divided into specific parts of the process, namely; the traveller specific insights, the traveller/RET interface related insights, RET specific insight and finally a set over overarching insights. In the final step all of these insights are combined and mapped in a model that will describe their relationships, which will reveal the main contributing factors to a service failure during disruptions. The strength of this chapter lies in combining the observation of all the different stakeholders, which enable this research to clearly identify the main improvement opportunities for RET, especially during disruptions.

10. Insights

As mentioned earlier, qualitative data requires a different analytical approach than a quantitative research dataset, which has empirical or measurable evidence and principles of reasoning. The dataset of this research consists of; literature research, sensitising booklet, interview transcripts, observations notes and RET internal documents. The general findings based on this dataset have been described in the previous section, which can also be described as the 'data' and 'information' layers. Now the point has come were this data and information will be used to create a level of 'knowledge' in the form of key insights. These insights will answer the research sub-questions and thereafter they will be used to answer the main research question. The main research question will be answered by defining a set of improvement opportunities for RET, which will be presented in the form of a roadmap. The setup of these different stages of this research is represented in Figure 30, In this DIKW scheme, each 'layer' adds a certain set of attributes to the previous one. In this section the focus is on the information layer, where synthesis helps to finds the value from the data layer and translates this into a process. The 'Analysing on the wall' technique is used as it is a suitable process for small sample sizes. During this process three overarching themes were determined namely, the traveller, the interface between the traveller and RET, and RET. Then the following iteration of 'Analysing on the wall' took place to establish a next layer; the overarching theme. Each of the following sub-chapters will mention which specific research sub-questions will be answered in that section, after which the main research question will be answered in chapter 11.

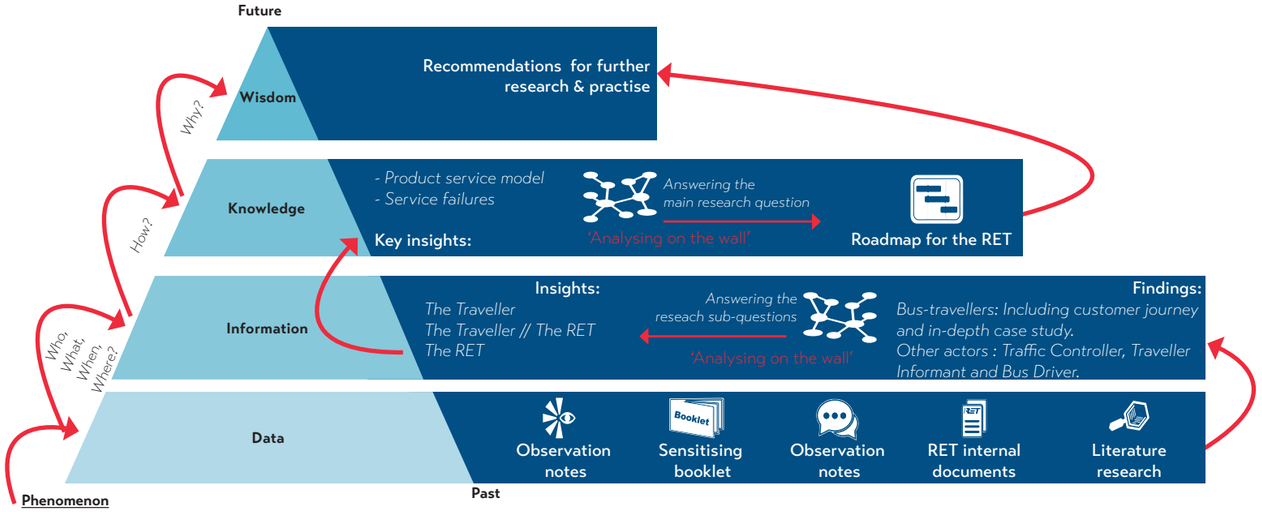


Figure 30 Overview of the research sections linked to the Data, Information, Knowledge, Wisdom scheme.

10.1 The traveller

Disruptions (delays, diversions and cancellations) are part of public transport, and can never be prevented entirely. Disruption result in quantifiable impacts both financially and in delays, which can be expressed in terms of money and time lost per traveller, and can also be scaled over an entire network. However, there are also more intangible consequences, which are harder to quantify and are linked to the traveller personally. This research focused on the more intangible consequences of disruption for the traveller, related to the traveller experience. By making use of qualitative research techniques of context mapping, in-depth interview combined with the gained knowledge from the literature studies these intangible consequences became more clearly appeared.

The research questions that are answered in this sub-chapter are:

- *What determines the traveller experience?*
- *What is the experience of travellers in public transportation? And how does this change during disruption?*
- *What are the traveller information needs during, a regular and disrupted situation?*

Traveller experience

The traveller experience is strictly personal and holistic, including the cognitive, affective, emotional, social, and physical responses to a public transport service (Gentile, Spiller, & Noci, 2007). The traveller experience is influenced by different components as; perceived service quality, past experiences and traveller characteristics, the latter of which is out of the scope of this research. The perceived quality is the difference between the actual service quality delivered by the operator and the expected service quality. Which is determined by the traveller's needs which consist of two aspects; basic traveller needs (Peek & van Hagen, 2002) and personal needs related to the traveller characteristics. The experience ultimately determines the level of satisfaction. Figure 13, that was first presented in the background section gives a schematic representation of this traveller satisfaction model.

Traveller experience in regular and disrupted situation

In general the experience of public bus travellers is positive, this could be seen in the overall results of the 'OV-klantenbarometer' with a score above 75% since 2011. Also the five booklets of the participants gave an insight into their experience in a regular situation and as the customer journey in Figure 26, show most parts of the journey are experienced positively. However, even without disruptions, the travellers experience some negative emotions. This occurs especially in the early stages of their journey when they are travelling to the bus stops. They feel rushed and a bit stressed as they are concerned if they will be on time. The experience of the bus ride itself is really depending on the person and the specific circumstances, this can be influences by the crowdedness, cleanness, climate, driving style and so one. The feeling of being in control over their trip is an urgent need. This translates to searched out all different travel options, keep an eye on the traveller information apps during the journey or taking an OV-bike instead of the bus for the last miles. It is interesting to see that the experience of the five participants between themselves are quite similar, but also show similarities with the customer journey presented by van Hagen for a train trip (chapter 4.2.1.).

When looking at the disrupted trip, as both the literature study and user-research show, a disruption increases the gap between the expected service and the actual service resulting in a negative experience. Because experience is linked to traveller characteristics and past experiences, each individual will experience a disruption differently. Disruptions most of the time come as a surprise to the traveller, which leads to a sudden increase in stress and anxiety because the traveller ends up in an uncertain situation. A disruption can also trigger other emotions like frustration and sometimes even anger as travellers are no longer in control over the situation. These negative emotions often remain present for a while, due to the impact that the disruption has had on travellers' activities after the journey, as was stated by the participants. The extent of which depends on the impact of the disruption, related to the travel motive and traveller's personality. The negative experiences (past experiences) influence the expectations and perceived reliability of the bus service. A negative experience(s) can result in developing a coping mechanism; a traveller mostly builds a degree of contingency into their journey. Which is 'extra time' to allow for potential delays and disruption. This coping mechanism was found in previous research (Papangelis, Velaga, et al., 2016) but also the participants mentioned in specific situations (like work related travels or during exams) they take one bus earlier to have some contingency time. In addition, these negative experiences can also contribute to avoiding travelling by bus. They opt for other modes the bus competes with shared mobilities like the OV-bike, Mobike, Felyx, or their bike or car when this option is available. Literature show that in public transportation, negative experiences have more impact than positive experiences (Backhaus & Bauer, 2001). Which indicates that it is for operators importance to investigate how they can reduce the negative experiences of travellers and invest adequate resources.

As literature and the bus traveller interview show, traveller information plays an important role in the experience of travellers during disruption. Because if a traveller is aware of what is happing, they are empowered to make practical decisions and can deliberately choose to wait and travel as per plan or to go for an alternative trip. Not having this information, affects them not only by being delayed but also emotionally. As mentioned above an uncertainty triggers negative emotions like anxiety, frustrations, and sometimes even anger. Which

eventually result in dissatisfaction with the overall service. The provision of real-time traveller information during disruptions, however, has the potential to significantly improve the passenger comfort level, decrease anxiety levels and diminish the negative experience and the level of dissatisfaction.

Traveller information needs during disruption

From the literature is known that the need for traveller information is the highest in the disrupted situation. Public transport operators provide everyone with general information. That works well if there is no disruption. However, during a disruption, many people have different expectations from the public transport system resulting in different information needs (Ministerie van Verkeer en Waterstaat, 2003). The information expected for the operator are determined by traveller characteristic, past experience(s) and the level of control or trust that the traveller experiences in that situation. During disruptions due to the uncertainty, the traveller evokes negative emotions, this state of mind reduces the ability to take note, comprehend, retain and process information. Besides, previous bad experiences with inaccurate, not on time or the complete lack of traveller information influences the perceived reliability of the information. The causes distrust them the information issued or advice given. Resulting in the paradox that traveller information is at its worst as it should be at its best (Cheung, 2010; Chorus et al., 2006).

This research shows that essential information for the traveller by unplanned disruption are; the cause, an estimated impact on journey time, an idea of the scale and duration of the cause, and any alternative options. Besides, timely, transparency and honesty are important here. Meet the traveller information needs during disruption can lead to a lot of 'goodwill' among travellers, sometimes even more than when there was no disruption at all, which related to the service recovery paradox (McCollough & Bharadwaj, 1992). The reason behind the service recovery paradox is that a successful recovery, which timely, relevant, accurate and transparent traveller information contributes to, increases the perceived reliability and confidence from the traveller with the bus-service.

10.2 The traveller and RET

The transfer of traveller information takes place on the interface between the traveler and RET, via various channels including the Bus Drivers. The result of a 5.3/10 for RET in the 'OV-klantenbarometer' on the subject of travel information during disruption was the starting point for this research (CROW-KpVV, 2018). However, this score only indicates nothing more than that travellers are dissatisfied with traveller information during disruptions and satisfied with traveler information during the normal situation. By making use of qualitative research techniques such as interviews and observations, it was possible to gain a more detailed insight into what is going on during disruptions in the field of travel information. The qualitative research methods help to uncover the more 'soft' data as underlying feelings and problems and reach to the deeper layers of knowledge (explained in chapter 7.2). This helped to identify what is really going on, because when at the into the traveller information provision process and systems on paper, based on RET internal documents, it seems a smooth and well working process. The RET also confirms this by their public statement that their internal processes relating traveller information are in order and technical processes are optimised.

However this research looked at both side the situation 'on paper' and the 'real-life' situation. The resulted in some valuable insights on this topic. The research question that are answered in this sub-chapter are:

- *What does the traveller information provision look like?*
- *What is the perceive traveller information during disruptions for public bus tra*vellers ?

The traveller information provision process

The traveller information landscape consists of automatically and manually generated traveller information content. There automatically generated information related to the vehicle location (KV6, KV8, KV19) and the timetable (KV1, KV7) that provides actual information on departure and arrival times. In addition, there is information that is automatic sent when the Traffic Controller makes adjustments in EBS to the bus service planning (KV17). But there are also the manually created traveller information messages in the event of planned and unplanned disruptions (KV15 and own text content by the operator). The information that is of the highest value for the traveller during disruptions contains 'OPGA' information which is currently only generated manually. Because this is a manually created entry, it takes

longer to reach the traveller than automatically generated information. Both the automatic and manual information generation processes can be found in figure 17.

From the RET side the Traffic Controller and Traveller Informant are responsible that the 'OPGA- information' reaches the traveller. However, observations at the CVL have shown that due to the lack of communication between the Traffic Controller and Traveller Informant about disruptions, it occasionally happens that this information is missed completely. Causing this high value information not to reach the traveller at all. The reasons behind that are elaborate on in the next sub-chapter on the key-insight at RET. Furthermore, there is a difference in the information that RET shares via its channels, (RET-website, Real-Time App and Twitter) and the information that is shared via external parties (DRIS and various travel apps). For the RET's channels they work with specific protocols about when which channels should be used, as described in the Context section, see Table 3. These information protocols are not openly communicated with travellers. What this means for the traveller is discussed below.

Perceived traveler information during disruption

The research shown that one of the key-themes in inconsistency. The inconsistency results from various aspects at different levels at the RET side, which are summarized below.

- The difference between the content and timing and availability of automatically and manually generated traveller information.
- The difference between external traveller information channels and internal RET own traveller information channels.
- The RET protocols for using different channels.

These differences cause for the traveller an inconsistency or lack of traveller information during disruption. The in-depth case study discussed in chapter 8.5 give insights in what this means for the traveller. This inconsistency was also mentioned by 4 out of the 5 participants in the booklet when they were asked about the perceived consistency and reliability of DRIS versus traveller information apps. Negative experiences with traveller information result in a decreased perceived reliability of, and trust in the public transport service. Decreased perceived reliability and distrust could in some circumstances even leads to avoidance of travelling by bus altogether.

The RET protocols for using different channels, could increase digital exclusion, although this is outside the scope of this research. Digital exclusion means that uneven distribution in the access to, use of, or impact of information and communication technologies (A. Durand et al., 2019). The travellers who do not have access or uses mobile apps are currently excluded from accurate traveller information about disruptions via the RETs channels.

DRIS sign is a good alternative channel besides digital media to reach out to travellers. In the regular situation they satisfy the traveller needs as a RET study shows (RET NV., 2011). However, still one-third of all RET bus-stops are not equipped with DRIS-sign (RET N.V., 2018a;2018c). In the disrupted situation the DRIS signs does not fulfil in the traveller information needs of; cause, estimated impact on journey time, an idea of the scale and duration of the cause, and any alternative options. As this information must be manually entered by the Traveller Informant, it reaches the traveller later, plus not every DRIS is suitable for free text. In addition, the user research show that the information is not pleasant to read due to the 'circulating text'.

Another important interface is the one between the Bus Driver and the traveller. Besides that the Bus Driver has to deal with complex and varied social situations, he is also an important preferred information channel for the traveller (RET NV., 2011). For the bus-traveller the Bus Driver is most of the time the only interpersonal contact they have with RET. During disruption the driver has the potential to play an important role in the information provision and support travellers in an interpersonal way. However, currently the Bus Driver indicates he is insufficiently kept up to date by the Traffic Controller and systems. Information is lacking about disruption on the line he is operating but also further in the network. Another information lack is intra-modality information of connection modes with the bus. The role of the Bus Driver should not be underestimated as he can play an important role in the service recovery during disruption for his passengers. Enabling the Bus Driver with the information that he needs to support his passengers can have a positive effect on the perceived service quality. From an operator perspective, personal attention from employees with a traveller has an important role in the bonding with the company (van Hagen & Bron, 2014).

The last part on the interface between traveller and the RET is the framing of the traveller information. The various choice of text options for the 'OPGA-message' and lack of clear guidelines, result in inconsistency in the traveller information messages in corresponding disruption situations. Furthermore, transparency and honesty are important aspects in the message framing not only in the traveller information but in all interaction between traveller and RET. So, also via their social media channel. Social media, provides opportunities to gain direct feedback on the service delivered and gaps in the system. However, as the desk research on twitter messages show the traveller is not always taking serious and the RET response is not always honest and transparent. This is not only noticed by travellers themselves but as found out during the interviews of this research, the Bus Driver and Traveller Informant are also not always satisfied with the social media replies from RET. In their view the answers are not aligned with the responsible departments to which the answer relates. This eventually results in inconsistent information reaching the traveller, which can trigger negative experiences.

10.3 RET

This part related to the RET, by 'analysing on the wall' of the observations notes, interview transcripts concerning the Traffic Controller and Traveller Informant, and internal documents. In the process of analysing one of the overarching themes that was found was; high workload and communication interfaces and systems. The workload in the context of this research is based on Meckiff et al. (1998)who state that the workload (for an air Traffic Controller) is a function of three elements:

- The geometrical nature of the (air) traffic.
- The operational procedures and practices used to handle the traffic.
- The competences and behaviour of individual controllers (experience, orderliness etc.).

Below is explained why this is quite applicable to the situation of the bus Traffic Controller as well. The research question that with this are answered are:

- *What does the traveller information provision look like? And which actors are involved?*
- *What does the disruption handling process look like? And which actors are involved?*

Workload of the Traffic Controller in the disruption handling process

The workload description of Meckiff et al. (1998) states that the workload is a function of three elements, when looking at the three elements related to the Traffic Controller the following insights are found from the data analysis, see also Figure 31.

- **The geometrical nature** of the bus service operations is complex due to the size of the network, its many interfaces, the interlining principle, and the dynamic environment buses operate in (free traffic).
- **The operational procedures and practices** used to handle the bus service have certain limitations, such as silo thinking, the negative reinforcement culture and limited spare capacity of resources. Furthermore, there is an absence of disruption protocols which puts a certain strain on the amount of experience and knowledge the individual Traffic Controller has. Although the EBS system might be of help in term of increased efficiency, it will not support in taking away some of the cognitive workload of the Traffic Controller.
- **The experience and specific knowledge** of an individual Traffic Controller has, another factor that contributes to the efficiency and effectiveness of a traffic control is his/her ability to multi task, work in an orderly fashion and stay resilient under (time) pressure. Another point that adds to the performance of the Traffic Controller is their ability to translate solutions into clear actions that work in the real world, mostly determined based on past experience working as a Bus Driver.

Workload of Traveller Informant in the traveller information provision process

For the Traveller Informant the story is slightly different than for the Traffic Controller. Peak workload is also one of the main challenges for the Traveller Informant, but this is driven by a few different factors. The main factors determining the workload of the Traveller Informant are:

- The responsibility from and input from three different mobilities (Metro, Tram and Bus).
- The competences and behaviour of individual informants.
- The (traveller) communication interface, including communication systems (RIVER, Geo-GUI).

Due to these factors the Traveller Informant experiences several addition workload peaks as compared to the Traffic Controller, as there is only one individual informant that is responsible for all three modalities at the same time. This forces the informant to prioritize their work, where observations and interviews have shown that the metro usually gets the highest priority, followed by the tram, and only thereafter the bus requests are handled during workload peaks. Giving other modalities priority over the bus seems to be caused by mainly one overarching challenge for the informant, namely the complexity of the bus system. This complexity is, as described before, caused by several aspects such as the (unwritten) modality hierarchy within the RET, the size and dynamics of the bus network and the different communication interface. Additionally, the lack of knowledge and experience of Traveller Informants with the bus network, is also one of the main drivers to prioritize other modalities over the bus. Ironically enough this leads to a vicious circle, where the bus is given lowest priority due to the lack of understanding, which keeps this understanding in place.

Communication interfaces and systems

The third point listed above relates to added workload caused by some inefficiencies in the communication interfaces and systems. As already mentioned above, the communication interface between the Traveller Informant and Traffic Controller for the buses differs from the one for the metro and tram. Due to the physical layout of the work floor, the informant is able to speak to the metro and tram controllers face-to-face, whereas communication with the bus controller needs to happen via phone. This does not only create a hurdle to share information but also doesn't allow for overhearing certain problems or updates for the bus network. Causing a far less efficient communication process, in terms of closing out incidents and establishing a short feedback loop between the bus Traffic Controller and the Traveller Informant. A secondary communication related driver that adds to the peak workload are the limitations of some of the communications systems used. The DRIS system, for example, is outdated and therefore requires manual entries to do what it is designed to do. Costing precious time of the informant, adding to the peak in workload. Another example of this is high amount of OPGA input options in the RIVER system, which are experienced as quite cumbersome by the informants.

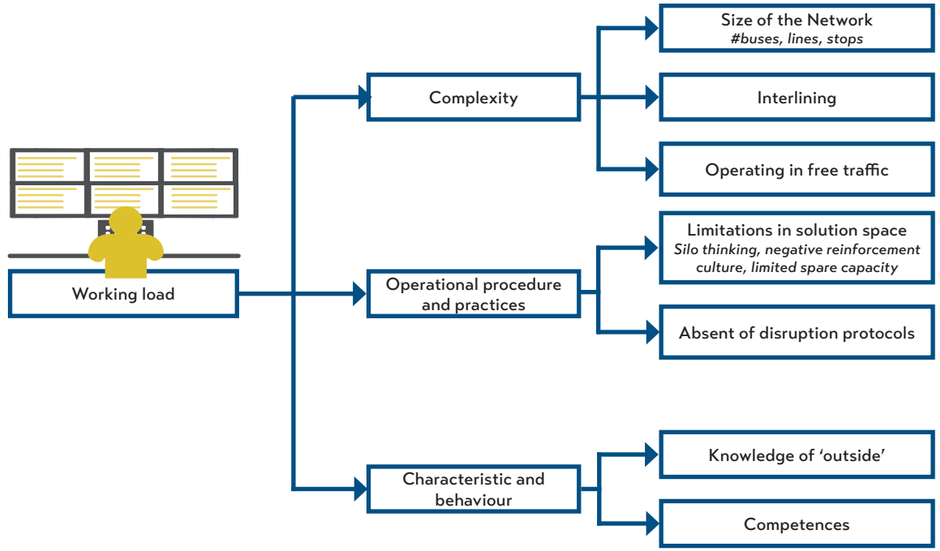


Figure 31. Workload elements related to Traffic Controller

10.4 Overarching insights

In order to clearly summarise the key insights gained from the research, a visualisation of these insights and interrelationship has been created relating to the traveller information during disruption, this can be found on the next pages.

As mentioned earlier, public transport is a socio-technical systems and a service product. Looking from a high-level at the situation of traveller information provision during disruption, this can be linked to the product service model presented by Tomiyama (2001). The model consists of five elements: the provider, receiver, service, product and system. The provider shares a service via a product with the receiver, supported by a system. When this is applied to the context of this research the different elements include the following:

- **Provider:** The RET
- **Receiver:** The bus-traveller
- **Service:** Traveller information
- **Product:** RET Real Time App, RET website, RET twitter, DRIS signs and occasionally the Bus Driver
- **System:** Traffic Controller and Traveller Informant plus supporting software (EBS, RIVER and Geo-GUI)

The products & service received by the traveller result in an experience, which is a cognitive, affective, emotional, social, and physical response to a product & service (Gentile et al., 2007). This experience defines the valuation of the products & service. When the valuation is not in line with the expectations of the traveller, a perceived service gap occurs. Also known as a service failure. Figure 32, shows the product service model of this research.

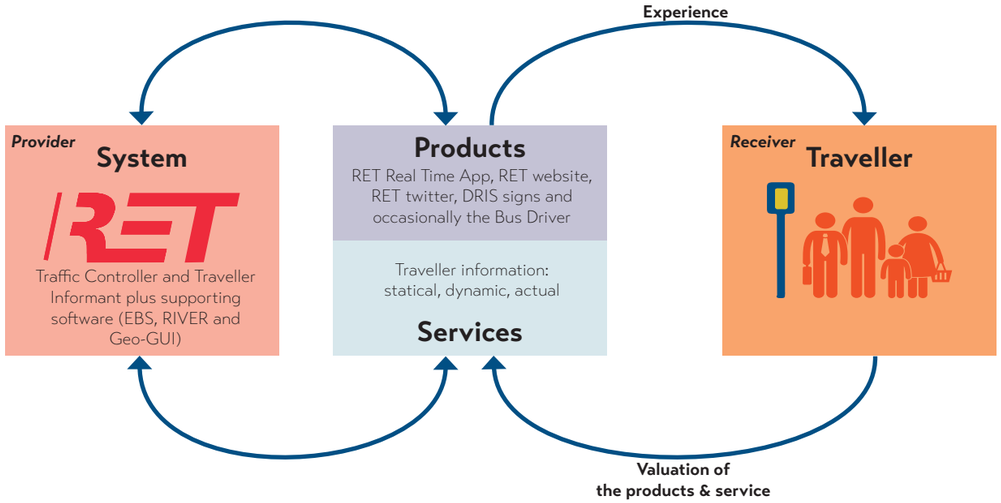


Figure 32. Overview of the RET product service model.

This research has, through interviews, observations and a case study, uncovered that there are attributes in the system, products and service that contribute to the experience of the traveller which eventually lead to a certain valuation of products & service (and not the system). This research specifically focused on the role of traveller information during disruption on the experience of the traveller. Based on literature, the sensitising booklet and the interviews, it appears that the current traveller information provision during a disruptions triggers negative emotions for the traveller. The negative experience related to these negative emotions occur due to the service gap, as the actual service level is not matching the expected service level of the traveller. These negative experiences eventually result in a more diverse landscape of information needs among the travellers. This as all travellers have their individual characteristics, personalities and travel motives which show more during a disruption. Some travellers might for example be more in need of personalised information, whereas others just want simple information fast. As stated by all five participants negative experience during disruption in the context of traveller information lead to a valuation where travellers are dissatisfied with the service and classify it as unreliable, and they distrust it. This dissatisfaction with the service is also shown in the score of the 'OV-klantenbarometer' as the traveller information score during regular operations results by the 75% overall traveller feedback score in the 'OV-klantenbarometer' since 2011 (CROW-KpVV, n.d.). However during disrupted operations, the valuation of this service significantly drops to a 53% (CROW-KpVV, 2018).

The system is studied by observations at the CVL and in the bus, interviews with the Traffic Controller, Traveller Informant and Bus Driver and by studying internal documents Which have uncovered that there are flaws in the system setup combined with the way the system is currently being operated eventually leads through the products and services to the travellers currently experience during disruptions.

On the next page, a summary scheme is provided with the key-insights on the traveller information provision during disruption, including the impact on the system, service and traveller. The products are not specifically included in the overview, because they were not part of the main scope of this research. On the system side the Traveller Informant, Traffic Controller and the supporting software (EBS, RIVER and Geo-GUI) are included. On the system side the key inconsistency and inefficient can be classified as operational or technical. Operational aspects are; workload, working protocols and the overall communication interface. Technical aspects are; the set-up of support software RIVER and Geo-GUI. A third element is the underlying culture that influences the way to system is operated, which can in itself also cause certain inconsistencies and/or inefficiencies. The research also found some cultural aspects (as the silo thinking and hierarchical culture of RET) that are underlying on the processes in the system, these culture aspects are not included in this figure. However, they do have some influence on the set-up and functioning of the system. The yellow arrows show how the elements on the system side relate to the main service failures experienced by the traveller during disruption. The blue boxes and lines represent the service: consisting of static, dynamic and actual traveller information. As the bus traveller user research and literature study showed, 'OPGA-information' has the highest value for travellers during disruptions. However as the scheme shows, the current system setup results in the most service failure related to "OPGA-information". The traveller interview and literature study shows the traveller experience in orange, which are triggered by the service failure (Papangelis, Nelson, et al., 2016; Papangelis, Velaga, et al., 2016). As seen previously in the product service model, an experience with a service & product results in a valuation. The current situation of Traveller Informant results in a dissatisfaction caused by unreliability of information and distrust in the service.

A summary of a key-insights related to operational, technical and culture are stated on page 92, 93. The next chapter will be focusing on how RET specifically can improver this experience through adjustment in their system, hereby the main research question will be answered.

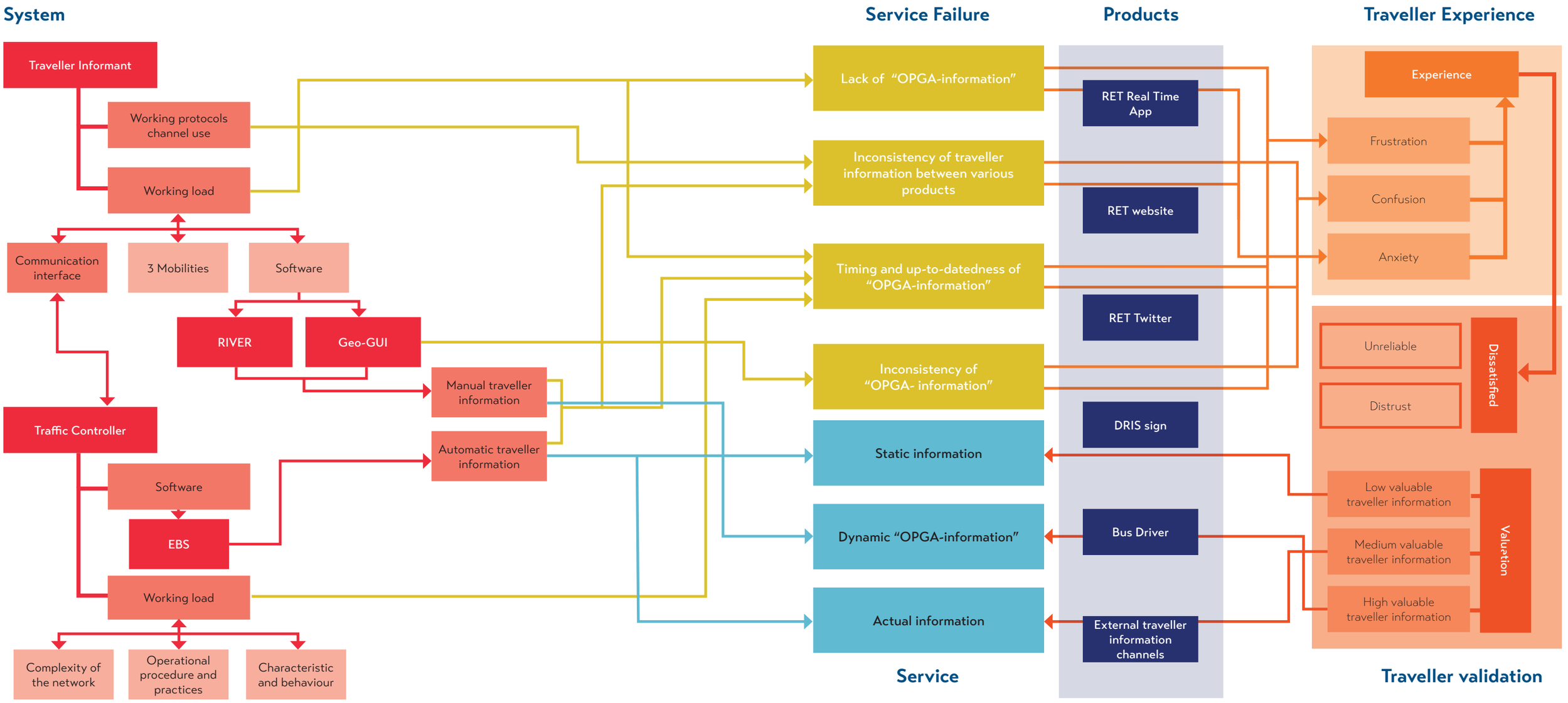


Figure 33. Summary scheme with key insights on the traveller information provision during disruption.

Operational

Traffic Controller:

- The lack of disruption protocols for the Traffic Controller.
- The peak working load of the Traffic Controller (geometrical nature, operational procedures and practices, experience & specific knowledge)

Traveller Informant:

- The current protocol on which channels to use by the Traveller Informant.
- The peak working load of the Traveller Informant (3 mobilities, competence & knowledge, software : RIVER, Geo-GUI).

Bus Driver:

- The encounter of complex and varied social situation with travellers.
- The lack of accessibility to traveller information to serve the traveller.
- The scarcity and reliability of the equipment (the bus and systems).

Interaction Traffic Controller // Traffic Informant

- The communication interface by phone between Traffic Controller // traffic informant.
- The lack of up-to-datedness and closing of traveller information messages about disruptions.

Interaction Traffic Controller // Bus Driver

- Non-proactive sharing of disruption information on the line or further in the network.
- The lack of uniformity in the handling and communication of the Traffic Controller with the Bus Driver.

Technical

Traveller Informant:

- RIVER: To large selection list for “OPGA” message composition combined with the lack of clear guidelines,
- Geo-GUI: Run on outdated software, which means that linking it into new systems is not possible, require extra manual handling by the Traveller Informant.

Traveller information:

- Manual versus Automatic generated traveller information: difference in timing, up-to-datedness and availability
- One-third of all RET bus-stops are not equipped with DRIS-signs.
- The current RET bus-stops are still equipped with the “old-fashioned” mono led DRIS-signs.

Cultural

- Hierarchical culture: due to the traditional hierarchical company structure and the (unwritten) modality hierarchy of first the Metro, then tram then bus.
- Silo-thinking: results in operational limitations for the Traffic Controller
- Negative reinforcement culture: caused by the financial fines from the concession agreement with the MRDH, results in operational limitations for the Traffic Controller.
- Lack of empathy with the traveller: results in taking them not seriously and not acknowledge their (inconvenienced) experiences (a.o. Twitter messaging) .

Closing

In this closing section of the research the conclusions and recommendations will be provided based on the insights gained in the previous section. Firstly, the overall conclusion will be resented which will elaborate on the high-level relationships between the different contributing factors causing a service failure during disruptions. Thereafter, based on these conclusions, a set of improvement opportunities will be provided with RET can use to close the gap in terms of their information provision score during disruptions. These RET specific recommendations will be presented in the form of a roadmap, which will highlight the reason and contribution of each recommendations to improving the information provision during disruptions.

11. Conclusion

After having discussed all main insights in detail in the previous chapter, and the related sub-questions. It is now time to go back to the overall goal of this research and summarise the main conclusions. Based on these conclusions a set of recommendations will be provided which will directly contribute to answering the main question of this research, namely:

"How can RET use traveller experience insights and traveller information provision to improve the bus traveller experience during disruptions?"

Firstly, the process of this research describes shortly before answering the main research question. After that, the recommendations are presented in form of a road map including the main pillars of improvement; standardisation, travellers intimacy, improved efficiency and embracing digitisation.

11.1 Process

This research investigated what can be learned from traveller experience insights and the current traveller information provision, to improve the bus traveller experience during a disruption by the operator. The research is conduct in co-operation with the public transport operator RET, that is responsible for the exploitation of buses, trams, metro's and a ferry in the metropole region Rotterdam – The Netherlands.

The research consists of three main aspects to collect data; background research, context research and user research. The background research was a literature study on the topics: Traveller information needs during a regular and disrupted situation, the disruption handling from a traveller perspective, and what determined the travellers perceived service quality, experience and satisfaction. The context research was desk research in RET internal documentation, working instructions and business plan. Focused on the RET's vision on traveller experience, the different roles involved in the disruption handling process, and how the roles contribute to the traveller information provision. The user research was qualitative field-research focussing on the bus travellers and RET staff that are directly related to the disruption handling and traveller information provision namely, the Traffic Controller, Traveller Informant and Bus Driver. Qualitative design research methodologies as context mapping, in-depth interviewing and an in-depth case study are used to gain insight into the experience of bus travellers in the regular and disrupted situation how they perceive traveller information and what determines their experience. To gain insights in the actual working environment, procedures and system design for disruption handling and traveller information provision, observation and in-depth interviews are executed at the Traffic Control Centre (CVL) of the RET were the Traffic Controllers and Traveller Informant are executing their work. For the bus driver observations are done in the bus during operations.

The evaluation process was done after each of the three aspects of the research, resulted in findings. For the background research this resulted in the defined literature gap and the construction of traveller satisfaction model. In the context research a traveller information provision model is constructed, including actors, software systems and different types of information and there links. The user research for the bus traveller revealed the customer journey map for a regular and disrupted bus trip of the participants and a in-depth case study that expose the perceived traveller information from a traveller perspective and shows how this related to the system. The user research with the Traffic Controller, Traveller Informant and Bus Driver gained insights in their actual working environment, and role is during a disruption and contribution to the traveller information provision. All the findings are interpreted and combined by 'analysing on the wall'. The key insights are related to themes that are housed under the main themes the Traveller, the Traveller and RET, and RET. As a summary of the key-insights related to the main service failures experience by travellers is presented in Figure in chapter 10.

This research had an exploratory character by being one of the first in exploring the human aspects of holistic experience by design methodologies in the field of public transport engineering research that is typically characterised by quantitative research set-ups. The strong part of this research is that it not only focused on the traveller side, including the products and services but there is also look at the RET side which includes the system, that supports the products and services. This combined with executing qualitative design research has enabled this research to gain precious insight with regard to traveller experience during disruptions and the traveller information provision process of the operator.

11.2 Main conclusion

The research is used to investigated what can be learned from traveller experience insights and the current traveller information provision, to improve the bus traveller experience during a disruption by the operator. This research has shown that by applying qualitative design methodologies as context mapping, in-depth interviews, observations and case study valuable findings could be gained on the traveller, the RET and the traveller information provision. By combining the findings and revealing their interrelationships, interesting insights are gained. These insights highlighted the opportunities for the RET to improve their traveller information provision during disruptions. Before stating these opportunities and recommendation for the RET in a roadmap, first, a high-level overview is sketched on what happens during traveller experience during disruption. This overview includes the main actors the RET and the Traveller, and the variation of the perceived service gap (yellow line) influenced by disruption and traveller information perceived from a traveller perspective. The three phases are explained below, whereas the grey dots indicate the gap distance in the previous phase(s).

Situation 1: The regular situation

The perceived service gap between RET and the Traveller during regular operations is not that wide, underpinned by the 75% overall traveller feedback score in the 'OV-klantenbarometer'(CROW-KpVV, 2018). Even without disruptions, the travellers experience some negative emotions, but they are in general quite positive about their journey. This resulted from the field user-research, presented in a customer journey map, shows the emotion curve of five traveller during various phases of a regular bus trip (Figure 26).

Situation 2: The disrupted situation.

During a disruption the perceived service gap between RET and the traveller instantly increases. Because the expected service of the traveller is diverging further from the actual service delivered by RET. The gap size is determined by handling of the disruption at the RET side (red arrow). At the traveller side, the needs of travellers change caused by the uncertainty the situations brings. Which also trigger emotions of stress and anxiety or emotions like frustration, and something even anger as travellers are no longer in control of the situation. This resulted from literure study and the field user-research, presented in a customer journey map, shows the emotion curve of one traveller during various phases of a disrupted bus trip (Figure 27).The impact and size of the service gap is dependent on factors like personality and travel motives. Which might strengthen the negative impact even further (orange arrow).

Situation 3: The disrupted situation and the role of traveller information provision

This study has revealed by literature and the user research that there is a third aspect which can increase or decrease the perceived service gap during disruption, and that is the provision of traveller information. Because when a traveller is notified on what is happing, they are empowered to make practical decisions and reduce the level of uncertainty. For a traveller perspective the gap can be increased by the need for more individual traveller information, caused by different travel motives, personalities and characteristics of the traveller (orange arrow). At the RET side currently discrepancies and inefficiencies in the traveller information system, combined with peak workload for the traffic controller and traveller informant, increases the gap between the desired traveller information provision and the actual service delivered. These inefficiencies include manual system input, system complexity, outdated software and inefficient internal communication. (red arrow).

However, the provision of travel information can at the same time be the key to reduce the perceived service level gap if appropriately deployed. The travellers indicated in the research that traveller information should, in general, include the following information; the cause, an estimated impact on the journey time, an idea of the scale and duration of the cause, and any alternative options. This information should at the same time be shared timely, transparently and honestly. This traveller information needs show overlap to previous researches (e.g. (Kasti, 2017; Ministerie van Verkeer en Waterstaat, 2003; Zhang et al., 2008). Overarchingly this information should be consistent and accessible for travellers across the various information channels. How this can be achieved is presented in the next sub-chapter revealing the recommendation for if RET.

This principle of the increasing service gap during disruption related to traveller information can be linked to the key-service failures regarding traveller information. How bigger the gap how lower the valuation of the service & product is at that moment. What this research has shown is that experience research is a powerful tool to gain insight into how traveller perceived services & products by enabling the reach to the deeper layers of knowledge and understand traveller's needs, behaviour, emotions and use cases in the naturalistic environment. Because the receiver is often not in direct contact with the system, but the system is again closely linked to the product and the service. This means that the experience of the traveller and the valuation can be used as feedback on your system. By exposing the service failures from the traveller and looking objectively at the system by observing it in the naturalistic operations, valuable insights can be found and with that opportunities. The value of these opportunities created from the insights that origin at the experience of the traveller is that improvement often leads to value-creating for the traveller. This really puts the traveller at the centre of the system, and if the experience of travellers in different target groups on different topics continues be investigated, it is possible to invest purposefully with resource and financial means and thereby improve the experience of travellers. Which ultimately results in a satisfied traveller.

11.2.1 Roadmap for RET

After having identified and explained the service gap principle and the related service failures from a travellers' perspective and stated the key-insights on the system side divided into operational, technical and cultural, now it is time to answer the main question of this research;

"How can RET use traveller experience insights and traveller information provision to improve the bus traveller experience during disruptions?"

The question is answered through a set of recommendations and the representation of a roadmap. A roadmap is a graphical, high-level plan defining an overarching strategic objective and capturing the major steps planned for achieving that objective. As knows it is RETs' objective to score a 70% on the topic traveller information during disruption on the 'OV-klantenbarometer' in 2021 (RET NV., 2019). The scores of 2019 will be announced in April 2020, but moving away from the 2018 score of 53% requires focussed improvements nevertheless.

This is quantitative aim of RET could also be translated to a more qualitative aim related to the findings of this research. Whereas the traveller information provision is currently validated by the travellers as unreliable and distrusted. Which is not in line with the valuation RET would like to have for their traveller information service. It is the RET aim to deliver a service quality which is valued as reliable and trustful. However, RET should be aware that it will take time before traveller is reaching that state. Because, as the satisfaction model presented in chapter 5 shows, past experience influences new experiences. So a series of better experiences will have to come before this valuation significantly changes and traveller trust the system.

The research insights clusters in operational, technical and cultural are translated into opportunities for RET whereas they are divided in the main pillars of: standardisation, travellers intimacy, improved efficiency and embracing digitisation. First the opportunities and therefore the recommendation for RET is explained, on-page 102-103, the visual representation can be found.

Standardisation: this pillar helps to improve clarity and guarantees quality with the goal to provide more consistency towards the traveller. This pillar is focused on the service level. The recommendations are:

- **Clear strategy on the use of external communication channels.** RET could benefit from a more clearly formulated strategy around the use of its external traveller information channels. Either they should make sure all channels (app, website & Twitter) contain the same information, or that they make travellers more aware of the content differences for each of the channels. This will create more transparency and consistency in the information provision and will eventually hopefully lead to a lower level of uncertainty around disruptions.
- **Reduction of the drop-down disruption options in the RIVER system**. The RIVER system currently contains a too extensive set of disruption causes and effects, which may be interpreted differently by different individual Traveller Informants. This set of pre-determined causes and effects should be distilled into a less extensive list with more clearly defined guidelines on when to use which options. This would lead to more standardisation in the tracking of incidents and will result in higher consistency in external communication.

Traveller intimacy: this pillar helps to improve the awareness of, and the alignment with the travellers' needs. This will contribute to become more traveller centric and improve travellers' empathy. This pillar does not directly contribute to service failures however and is more focused on the underlying cultural level. However, RET will ultimately reach the traveller through the products and services and those are therefore no less important. The recommendations are:

- **Establish a customer panel.** Currently, a proper feedback loop from the traveller towards the RETs' products and services is lacking. Therefore RET would benefit from establishing a customer panel which will enable them to receive qualitative feedback and more continuing feedback on their performance. Whereas they are now (fully) depending on the results of the 'OV-klantenbarometer' ones a year, or by purchasing research from external parties. Additionally, this will help them test new ideas and build a closer relationship with a core group of their travellers. See as an example the NS labs app, in which they test various new functionalities that can make the travellers' journey better and more enjoyable. But also short internet survey with open and closed questions can already help to get a better idea of the needs and experiences of the travellers. It is a smart way and relatively easy way to include and align innovation better with your travellers, by making them part of the process and getting feedback & value insights from them
- **Improved communication standard for Twitter messaging.** The social media desk research showed that RET responses not always show empathy towards the traveller, as answers are not honest, transparent nor alight within the different internal departments. Social media becomes more important as a channel, RET could benefit from a higher quality standard in term of messaging, and could additionally benefit form a more humble approach. The messaging should be more aligned with the responsible departments within RET, to prevent false promises or statements. This honesty should also result in the messaging being more and transparent which will increase the perceived service level of this particular information channel. Additionally, any messaging received via Twitter should be considered as constructive feedback instead of answering a question. This will enable RET to create an active and easily accessible feedback loop with some of their travellers.
- **Use the Bus Driver more actively as a channel.** Currently, the Bus Driver is frequently not provided with the right amount of information to effectively support travellers during disruptions. This is really a missed opportunity, as travellers indicated to prefer the 'personal touch' of information shared by the Bus Driver during disruptions. If the Traffic Controller would be able to share more detailed information in a more standardised way, it would enable to Bus Driver to have a better, more decisive role in the information provision during disruptions. This would eventually lead to a higher perceived service level and demonstrate message consistency with other communication channels. Furthermore, the Bus Driver is in touch with the traveller on a daily basis, and through that valuable insight could be gained here to increase insight into traveller needs, behaviours and struggles. By listening more carefully to the Bus Diver and value the feedback he/she is providing steps are making to breaking down the hierarchical company culture.

Improved efficiency: this pillar is focused on reducing the peak workload and speed up the traveller information provision, through improved alignment between different actors in the system and reduce the room for errors. This pillar is linked to the operational, technical and cultural layer as alignment on all levels is important to strive for improved overall efficiency.

- **Improved communication interface between Traffic Controller and Traveller Informant.** The current floor plan of the CVL only allows for telephone contact between the Traffic Controller and the Traveller Informant. An ideal situation would be to create the same situation for the bus (and tram) as currently being used for the metro, namely that the Traveller Informant is positioned directly is behind the Traffic Controller. Such a set-up facilitates face to face communication and provides the Traveller Informant with the possibility to watch at and listen to the work of the Traffic Controllers. This results in a significantly faster response time during disruptions, assisted by the verbal communication that makes it possible for the Traffic Controller to transfer the situation to the Traveller Informant simultaneous with other activities. The face to face communication also enables a higher frequency in communication and better phrasing of the message. Because by keeping a close eye on the disruption, scaling up or down the intensity can be done directly when required.
  Furthermore, the more frequently face-to-face communication and by watching and listening in on the Traffic Controller will increase the knowledge level of the Traveller Informant about the bus network, disruption types and impact, which is desirable due to the complexity of the nature of the bus service. For the bus-traveller this will result is less situations where there is a complete lack of information and will enable the sharing of more high value (OPGA) information more accurately and timely. This will contribute to a more reliably perceived traveller information provision.
- **Establishment of disruptions protocols for the bus.** Currently, there are no disruption protocols for common disruptions for the bus as there are for the metro and tram. These disruption protocols help to speed up the disruption handling of the Traffic Controller and support the information provision by the Traveller Informant. Although capturing all the different disruptions scenarios for the bus might seem impossible, it would be beneficial for the Traffic Controller and traffic informant if some of the high-frequency disruptions are captured in a disruption protocol. This does not only encourage (formal) knowledge retention, but it also helps to reduce some of the peak workload. These protocols may, for example, include frequently used detours, standard traveller information, expected disruption duration, etc. This will contribute to the timing and accuracy of the traveller information for the travellers.
- **Updating the geo-GUI system**. The Geo-GUI system is currently quite outdated, which does not allow it to establish an automatic link with the RIVER system, resulting in the fact that currently all messages having to be entered manually. Automating this part of the systems will not only reduce the workload of the Traveller Informant (during peak hours) but will also enable faster messaging to the traveller.
- **Additional resources and restructuring of the traveller information role.** One of the main identified internal constraints is the peak workload for the Traffic Controller and Traveller Informant. This workload problem might be reduced through simply adding additional FTEs for especially the Traveller Informant role. This will enable to make one Traveller Informant responsible for the metro and one for the tram and bus, which does not only reduce the peak workload but also contributes to reducing the current unwritten hierarchical culture of metro, tram and then the bus. Furthermore, this will positively contribute to the knowledge development of the Traveller Informant — all of this will result for the traveller in faster, more accurate, up-to-date traveller information.
  Beside by reducing the workload on the Traveller Informant by adding addition FTEs, it might helping to restructure the role of the Traveller Informant into a more proactive role (instead of the current reactive nature). The extra FTEs can then also be employed to increase the quality of the planned disruption traveller information, as shortly highlighted in this thesis, there also seems room for improvement there.
- **Breaking down the walls.** Currently, RET has a hierarchical organisation structure with a strong silo-thinking culture. Which is for the bus section reinforced by the splitting off the BUS BV in 2012. A culture of 'chain thinking', opposite to silo thinking, distinguishes itself by having a more holistic perspective. It strives for collaboration between the links in the chain to improve the integrated processes along the entire chain. This will contribute to better coordination in the system but also contributes to the products and services delivery and also contribute to 'traveller intimacy'.

Embrace digitalisation: this pillar is focused on the optimisation and digitalisation of internal processes and external products. This pillar is linked to the products and related background technology. The recommendations are:

- **RETs' app improvement.** The RET app is currently marketed as the main source of up to date travel information, however in practice this does not always seems to be the case. "Do it right or don't do it at all." – Quoted of Ray Charles (1998). Which is highly applicable to this situation as the current app is really lacking in terms of providing optimum support and service to travellers before, during and after their journey. Resulting in feelings of distrust and unreliability by the traveller, which does not only affect the valuation of the app but also has an impacted on their overall valuation of RET. Some areas that benefit the overall service delivery of the app might be; automatics app refresh, a clear indication on the time of the last update, more frequent clean-ups of outdated disruption messages and correctly displaying time/date of the start of the disruption as well as the date/time of the last update of the message. Ret could also consider adding more 'nice to haves', like for example the NS app. Furthermore, the service level of the app could be improved by combing the RET barcode app (for digital tickets) and RET real time app into one app.
- **Upgrading of existing DRIS signs and adding signs to stops that currently do not have them.** DRIS signs at stops are an important traveller information channel. However, still not all stops are equipped with a DRIS; currently, 1 out of the 3 RET bus-stop is not equipped, whereas every metro or tram stop is (RET NV., 2018). The current mono-led DRIS do not make optimal use of the true potential of this channel in terms of delivering high-value information in a structured manner. Therefore, it is recommended to implement new graphical led screens when replacing or placing signs at new stops. For the traveller this will contribute to better accessibility of information and improved readability.
- **Revive cooperation with 9292OV.** RET currently do not have a partnership with 9292OV, with means 'OPGA-information' about planned and unplanned disruption are not include in the 9292OV app. Which can be seen as a missed opportunity despite RET wanting every traveller to use their App, which in practise this is not the case. By being more transparent in sharing information with the traveller, it reduces the inconsistency between the various channels and eventually results in a better traveller experience . Furthermore, it is confusing that the RET does use 9292OV as the main source of information for their own app, but they do not share high valuable information about disruptions with 9292OV.

The four pillars and related recommendations are summarized in Figure 34, on the next pages. In the figure the order of the four pillars is not leading.

2018:

A score of 53% on the topic traveller information during disruption on the 'OV-klantenbarometer

Traveller valuation of unreliable and distrustful, due to service failures

2021:

A score of 70% on the topic traveller information during disruption on the 'OV-klantenbarometer

Traveller valuation of more reliable and trust full, by reducing service failures.

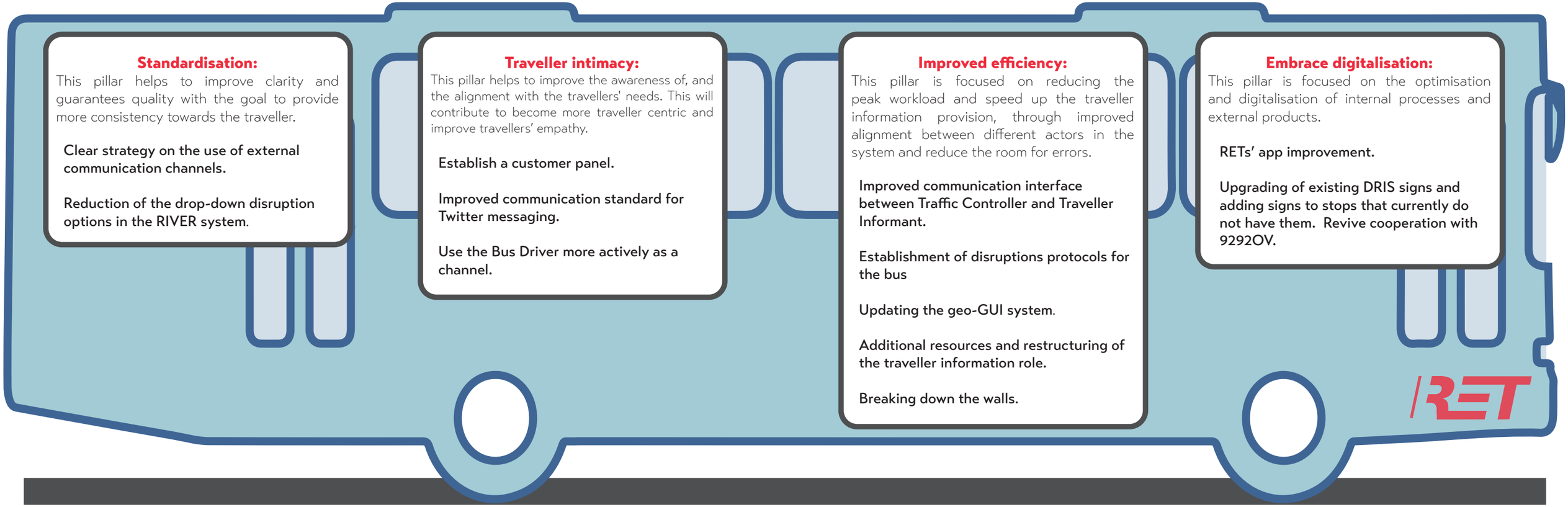


Figure 33. Summary scheme with key insights on the traveller information provision during disruption.

12. Discussion and Recommendations

After presenting the main conclusions of the study next is to bring this research back to a broader perspective by elaborated on the scientific and practical contributions of this research. Reflect on the research methodology applied followed by the reflection on the limitations of this research, which consequently lead to a set of suggestions for future research.

12.1 Main contribution

With the use of qualitative research methodologies and study both the traveller as the RET perspective on the topic traveller information during disruption, the resulting findings, insights and conclusions delivered valuable contribution for the RET as elaborated on in the previous chapter. However, this research also contributed to scientific and practical field and is discussed in the following sub-chapters.

12.1.1 Contribution to science

From the scientific perspective, this research is a pioneering piece in exploring the human aspects by design methodologies in the field of public transport engineering research that is typically characterised by quantitative research set-ups. Public transport is a complex socio-technical system and would be better served when user-centric (qualitative) and techno-centric (quantitative) research methods are combined. This research contributes to getting the public transport engineering field acquainted with qualitative design methodologies as context mapping, qualitative observation and in-depth interviewing which are helpful methods to gain insights in a specific context, problem by in-depth and extensive understanding of the reality and helps to understand needs, wishes and the motivation of travellers.

Design research and methodologies have a different set-up than traditional research. This research gives an example of how the design methods and set-up could be applied in another context than purely design research. In socio-technical systems the combination of applying both qualitative and quantitative research methods would make a strong research because they complement each other's weaknesses and are able to cover the complexity of the system better. This research hopefully encourages more interdisciplinary research to make public transport engineering research future-proof and tackle the social-technical question of the future.

The results of the research are contribution to the research gaps of creating more insight into the holistic experience in the regular and disrupted situation of public bus travellers. The traveller satisfaction model that is composed by combining previous studies provides a good summary and simplistic rendering of the traveller experience and satisfaction process which was not noticed in other research before. Furthermore the results show insights in the perceived service quality of travellers regarding traveller information, and contribute to more research on the 'soft' quality aspects as the public transport research field is currently dominated by research on 'hard' technical aspects of the service (actual service quality). Moreover this research focussed only on bus passengers, and therefore gains specific knowledge about this group, which is valuable because most research and databases are combining data of the bus (travellers) with trams and metro data. However, the nature of bus transport is inherently different from tram and metro. The research contributes to a small part of the population of bus travellers and what we know about them. Because the majority of the public transport research is focused on the metro, then tram it is valuable to not neglect the bus, and ensure that besides this work more studies will be executed, to counter that the results/insights become out-dated.

12.1.2 Contribution to practise

Although this qualitative research is specifically executed for the case at the RET, insights of the research could also be interesting for other public transport operators. As mentioned in the DIKW scheme in Figure 30, going from the knowledge layer to the wisdom layer can be achieved by looking from a higher level and see which insights could be generally applicable. In the Netherlands, as the 'OV-klantenbarometer' shows the average score on the topic traveller information during disruption is a 5.8/10 (CROW-KpVV, 2018). This research can hopefully inspire them to improve the current situation.

One of the lessons to learn for the public transport operators are the phenomena described in the conclusion of the difference between the perceived service gap in the regular situation and the disrupted situation. In the disrupted situation traveller information is one of the main contributed to reducing the perceived service gap during a disruption. However, it is of importance that the traveller information provided meets the travellers' needs of knowing: the cause, an estimated impact on journey time, an idea of the scale and duration of the cause, and any alternative options. Besides, timely, transparency and honesty are important here.

Another import lesson that can be taken from this research is the importance of consistency of the traveller information via various channels. Because inconsistency in information trigger emotions of confusion and anxiety at the travellers side, and could contribute to the distrust of further traveller information and makes the public transport service as a whole more unreliable. Furthermore they should be aware of the fact the most valuable traveller information during disruption the 'OPGA-information' is currently manually generated information. Which makes it important to reduce flaws and inefficiency in the system behind this information provision, to ensure that this information reaches the traveller as soon as possible via various channels. Important here is to do a cross-check, as the system may work well on paper. But as this research has shown it does not have to be in practice. By first looking at the traveller (target group) side to see what experiences there are, and this can, of course, be done on other subjects than traveller information during disruptions, as well. These experiences and the associated valuation of product & service give the operator direct feedback from the target group on the product & service but thereby also on the underlying system. When these elements are then objectively studied, where observation in natural setting and conversation with the directed related employees are preferred when possible because then value insights can be obtained. Because it helps to gain in-depth and extensive understanding of the reality, by researching to the different layers of knowledge and insights could be gained which are not accessible at first hand. These insights can lead to opportunities and improvements that directly contribute to the value creation for the target group. Helping the operators to do affected resources and financial investments and really put the traveller in the first place.

Whereas currently high value is attached to the scores of 'OV-klantenbarometer'. To which bonuses and fines are linked for the operators. This study hopefully makes it clear that in addition to this quantitative questionnaire that are helpful for to gain generalised information and make a comparison between operators, it is also important in addition to conducting qualitative studies among travellers. In order to gain more specific insight into what really drives the traveller. The recommendation towards the RET of establish a customer panel could also beneficially for other operators to gain more insights and knowledge about the drivers of their travellers.

12.2 Reflection and limitations on methodology

The methodology adopted in this research study provided two things. At first, they support to answer the research question by helping to understand traveller needs and to explore, reflect on, and express the experience of travellers. Furthermore, they revealed flaws and inefficiencies in the system behind the information provision that are not visible when looking at the system on paper. This made it possible to derive specific recommendations for RET to improve the bus traveller experience during disruption by their traveller information provision.

The other aspect is the exploratory character by applying these methods in the field of public transport engineering. Specifically was chosen for design methodology due to the focus on the traveller experience from a holistic perspective. Furthermore, this research also includes the RET system giving it a co-design character with matches with the philosophy of design methodology. However, by only applying qualitative research methodologies, a qualitative data set was obtained. Resulting in insights based on evidence and not based on fact as can be gained from a quantitative data set. They also make it much harder to stated generalised conclusion because of the data obtained is strongly related to a specific case, situations and persons.

When looking at the double diamond design set-up, it is noticeable that this research has just passed the first diamond by presenting the roadmap. However, this also indicates that this is not the end of this study; further design study could be taken up. Which is very contradictory in the set-up of traditional versus design, is the flexibility of the research. In contrast, in traditional research the research questions and approach are much more fixed and established in the very beginning for the research is design research a much more organic process. This is also encountered during this research because of the qualitative set-up enable people to freely talk, and by observing the real situation, things are found that may never think of in first hand. They are resulting from these findings and influence the process on the way. Whereas the traditional public transport engineer is mostly focusing on ex-post studies or situations whereas the further is controlled in simulated environments to test certain assumptions. With the aim to explain how things are. Design research is much more future-oriented by review the here and now opportunities and future opportunities are defined. By design products and services, this pursued future can be obtained. Which aims more on how things should be.

However, social-technical systems consist of more than just products and service but are also surrounded by a complex system which have a social, political and economic relevance as well. Design research at their side is currently less developed to tackle these complex system on their own. As complex system consist of large number of products, processes, and technologies which have dynamic data interfaces, physical connections. Additionally, they are dependent on the operations which interact with an environment and provide a function that meets or exceeds users' needs. Whereas engineering research is more focused on the processes, technological aspects and deals with data interfaces. Design research on the other hand can contribute to the product, physical connection and users 'needs. This is why a combination of both qualitative and quantitative techniques is desired. Traditional research is much more familiarised with tackling complex systems, however, it lacks the ability to include the service and product aspects from a user perspective.

Furthermore, the context mapping methodology in this research was valuable to understand needs and to explore, reflect on, and express the experience of the bus-traveller. However, this methodology needs a lot of knowledge in the design field. This is not only applicable to context mapping as the limitations of interviews. Because the quality of the results depends on the interview skills of the interviewer and the formulation of the questions. Interview and transcription are high time consuming and not suitable to collect results from a large group of participants. Limitations of observations are that it is very time consuming, requires prior preparation and the quality of the observation depends upon the skill of the researcher to observe, document, and interpret what has been observed. The research should be aware of the researcher bias, by being aware of potential biases that stem from the research background of experience, which includes considering how gender, culture, and ideologies provide a filter for understanding of the situation under study (Kawulich, 2005). For the context mapping, not the full process as described in sub-chapter is applied, as no co-creasing session has taken place. However, in the in-depth interviews with the bus-traveller, traveller informant, traffic controller and bus driver. By the use of the layering approach and the path of expression it was possible to gain a bit more insight into how they see their ideal situation. These mentioned possible biases are also reduced by various triangulation procedures in this research. Which mean that data is collected from multiple perspective and in different ways (Hill et al., 1997). By including both the traveller perspective and RET perspective and using various methods like sensitising, observations, interviews and case study combined with literature and internal document studies.
This kind of knowledge is currently not being taught in transport engineering education, which meant additional self-education was needed. Also, recruiting a random bus-travellers turned out to be a lot more difficult than expected. This is due to the qualitative nature of the research, which also demands more from a participant than a (short) close question survey. Due to the sample size of 5 participants in the sensitising stage and 1 participant for the in-depth interview session it. To have a bit more of boarder perspective, there are other sources used to supplement such as the literature study, social media data mining on twitter compliance regarding RET bus service and traveller information, and an in-depth case study to map out a disruption from different perspective. Which also contribute to have a more triangularly research.

The participants were a homogenise group of highly educated people that had no car and depends on public transportation for their transportation. The group consists of 3 participants that travel for work and one for studies and one for leisure with the bus. Only one participant makes the same work trip others are making different trip. Because they do not own a car, the group can be seen as experienced public bus travellers. Which is valuable because they have encountered a lot of experiences, also because of the education level, they were able to express themselves well. However, the group of inexperienced travellers is not covered by this research. As literature study reveals different needs and support in terms of traveller information could be expected here. However, as stated above only one participant makes the same trip every day, the other has a lot of varieties in their travel behaviour which makes them overall experienced, but they are sometimes even inexperienced at certain trips as non-frequent travellers.
The participants were selected, so they do not deal with digital exclusion; this has been chosen to reduce the variable regarding the product side. However, different needs and experience could be expected under the group of travellers that have more social disadvantages, less access to digital media and digital competences. Current research of Anne Durand on the impacts of the increasing digitalisation in transport services could be seen as a relevant contribution to this topic (A. Durand et al., 2019).

12.3 Recommendations for further research

For further research three main topics can be pointed out, namely on the data gathering, the methodology and research extension. They will be described in further detail below.

This research consists of a raw dataset of mainly qualitative data. As mentioned earlier in the validation of qualitative research, triangulation can help here, which means data collection from multiple perspectives and in different ways (Hill et al., 1997). In this research, this is done by using the traveller perspective, context mapping, in-depth interviews, in-depth (observation) case study supported by literature studies. For the system perspective (RET) this is done by use of internal documentation, in-depth interviews and observations. However, through triangulation this could be extended to also include quantitative research methodologies. For example, quantitative research methodologies can be used to gain more insights into the channel (product) use of travellers and their preferences whereas recent research is lacking. This can also helping in contributing to become more demand-oriented instead of the supply-oriented approach, such that it responds better to the product needs of the traveller. Combined research would be valuable to gain more insights into the relationship of service failures, recovery, travellers needs and their behaviour on a more high-level, generalised level. This can also help to extend the customer journey of this research further, which could be seen as the basis for this research. Further research could expand the journey by adding more touch points for both the regular situation and disrupted situation. Further quantitative and qualitative data research would then also be required to gain insights into these touch points, interrelationships and traveller perceptions . Applying both qualitative and quantitative methods would also support the philosophy that social-technical systems such as public transportation would be better served when both are combined. This due to the strong interrelationship between technical and humans aspects in the system.

The research has explored applying design methodologies such as context mapping in the field of public transport engineering. Contextmapping is a valuable tool to understand the needs, wishes and motivations of a target group. The methods also contribute to a co-design setting where users and stakeholders are given appropriate tools for expressing themselves, which help them to participate actively participate in the design process which ensures a good fit between the design and the use of future products or service (Wilkinson & De Angeli, 2014). These insights and co-design setting are not only desirable in service and product design but also for engineering fields that are strongly related to users and/or influenced by various actors. Further research into how design methodologies could be made more fitting with engineering design would be interesting. Because currently context mapping and other design methodologies apply a separation between engineering and designing. Going forward, it would be desirable to create a more interdisciplinary approach from the beginning on. Further research could contribute to the development of new, and adjustment of current methodologies to make them applicable in similar settings.

Research extension could go in two ways, first by the using different samples and target groups to provide a better understanding of the traveller experience from a broad perspective. As literature research reveals, different needs could be expected to result from this. Think of different samples such as; different modalities, cities & operators, and different target groups such as; variety in social-economical factors, level of digital inclusion and purpose of travel. These extension will enable the transferability of the results to other settings. This transferability will also contribute to the validation of this research.
The second part is to progress further through the double diamond principle, whereas this research stops at the ideation phase with the presentation of the recommendation in the form of a roadmap. This is however not the end, and further steps can be taken to 'design things right'. The focus of this research was not primarily on the product and service design side . This could be included if one would progress through the 'HMW'- question: "How might we improve traveller experience during disruption on the product & service side?". This will result in the generation of many potential solutions and ideas, the ideation. Working through the final step of the double diamond could then focus on the design and implementation of the product and service.

References

Accenture. (2013). Public transportation users predict big increases in the use of smartphones, paperless travel and social media, new Accenture survey reveals.

Adviesdienst Verkeer en Vervoer. (2002). *Keuzemogelijkheden: geaccepteerd en geïnformeerd*. Den Haag.

Agee, J. (2009). Developing qualitative research questions: a reflective process. *International Journal of Qualitative Studies in Education*, *22*(4), 431–447.

Allan, G. (2003). A critique of using grounded theory as a research method. *Electronic Journal of Business Research Methods*, *2*(1), 1–10.

Allen, J., Eboli, L., Mazzulla, G., & de Dios Ortúzar, J. (2018). Effect of critical incidents on public transport satisfaction and loyalty: an Ordinal Probit SEM-MIMIC approach. *Transportation*, 1–37.

Anable, J., & Gatersleben, B. (2004). All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes. *Transportation Research Part A: Policy and Practice*, *39*(2), 163–181.

Anderson, R., Condry, B., Findlay, N., Brage-Ardao, R., & Li, H. (2013). Measuring and Valuing Convenience and Service Quality: A Review of Global Practices and Challenges from Mass Transit Operators and Railway Industries. *International Transport Forum Discussion Papers*, (16).

Backhaus, K., & Bauer, M. (2001). The Impact of Critical Incidents on Customer Satisfaction in Business-to-Business Relationships. *Journal of Business-to-Business Marketing*, *8*(1), 25–54.

Barbeau, S., Borning, A., & Watkins, K. E. (2014). OneBusAway Multi-Region--Rapidly Expanding Mobile Transit Apps to New Cities. *Journal of Public Transportation*, *17*(4), 14–34.

Barron, A., Melo, P., Cohen, J., & Anderson, R. (2013). Passenger-focused management approach to measurement of train delay impacts. *Transportation Research Record*, (2351), 46–53.

Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with Computers*, *23*(1), 4–17.

Beecroft, M., & Pangbourne, K. (2015). Personal security in travel by public transport: The role of traveller information and associated technologies. *IET Intelligent Transport Systems*, *9*(2), 167–

Beirão, G., & Cabral, J. A. S. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy*, *14*(6), 478–489.

Bejou, D., Edvardsson, B., & Rakowski, J. P. (1996). A critical incident approach to examining the effects of service failures on customer relationships: The case of Swedish and U.S. airlines. *Journal of Travel Research*, *35*(1), 35–40.

Biklen, S. K. (1992). *Qualitative research for education: An introduction to theory and methods*.

Bitner, M. J., & Hubbert, A. R. (1994). Encounter Satisfaction versus Overall Satisfaction versus Quality: The Customer's Voice. In R. . Rus & R. L. Oliver (Eds.), *Service Quality: New Directions in Theory and Practice* (pp. 72–94).

Bolton, R. N., & Drew, J. H. (1992). Mitigating the effect of service encounters. *Marketing Letters*, *3*(1), 57–70.

Brakewood, C., Barbeau, S., & Watkins, K. E. (2014). An experiment evaluating the impacts of real-time transit information on bus riders in Tampa, Florida. *Transportation Research Part A: Policy and Practice*, *69*, 409–422.

Brakewood, C., & Watkins, K. E. (2019). A literature review of the passenger benefits of real-time transit information. *Transport Reviews*, *39*(3), 327–356. 7

Bregman, S. (2012). Uses of Social Media in Public Transportation. In *Transit cooperative research program (TCRP) Synthesis Report 99*. Washington, D.C.: Transportation Research Board.

Bregman, S., & Watkins, K. E. (2013). *Best Practices for Transportation Agency Use of Social Media* (Susan Bregman & K. E. Watkins, Eds.).

Bruglieri, M., Bruschi, F., Colorni, A., Luè, A., Nocerino, R., & Rana, V. (2015). A real-time information system for public transport in case of delays and service disruptions. *Transportation Research Procedia*, *10*, 493–502.

Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbride, A., & Goodwin, P. (2004). *Smarter choices - Changing the way we travel.* Retrieved from www.dft.gov.uk

Carreira, R., Patrício, L., Natal Jorge, R., & Magee, C. (2014). Understanding the travel experience and its impact on attitudes, emotions and loyalty towards the transportation provider–A quantitative study with mid-distance bus trips. *Transport Policy*, *31*, 35–46.

Carreira, R., Patrício, L., Natal Jorge, R., Magee, C., & Van Eikema Hommes, Q. (2013). Towards a holistic approach to the travel experience: A qualitative study of bus transportation. *Transport Policy*, *25*, 233–243.

Cats, O., & Jenelius, E. (2014). Dynamic Vulnerability Analysis of Public Transport Networks: Mitigation Effects of Real-Time Information. *Networks and Spatial Economics*, *14*(3–4), 435–463.

Cats, O., Koutsopoulos, H. N., Burghout, W., & Toledo, T. (2011). Effect of real-time transit information on dynamic path choice of passengers. *Transportation Research Record*, (2217), 46–54.

Cats, O., Yap, M. D., & van Oort, N. (2016). Exposing the role of exposure: Public transport network risk analysis. *Transportation Research Part A: Policy and Practice*, *88*, 1–14.

Caulfield, B., & O'Mahony, M. (2007). An examination of the public transport information requirements of users. *IEEE Transactions on Intelligent Transportation Systems*, *8*(1), 21–30.

Caulfield, B., & O'Mahony, M. (2009). A Stated Preference Analysis of Real-Time Public Transit Stop Information. *Journal of Public Transportation*, *12*(3), 1–20.

Chakravorti, S. (2011). Managing organizational culture change and knowledge to enhance customer experiences: analysis and framework. *Journal of Strategic Marketing*, *19*(2), 123–151.

Cheung, F. (2010). Real-time multimodal travel information in the Netherlands. *The European Transport Conference*, 1–13.

Chorus, C. G., Molin, E. J. E., & van Wee, B. (2006). Travel information as an instrument to change car drivers travel choices : a literature review. *European Journal of Transport and Infrastructure Research*, *6*(4), 335–364.

Cleveland, H. (1982). Information as a resource. *Futurist*, *16*(6), 34–39.

Cohen, S., Glaser, B. G., & Strauss, A. L. (1969). The Discovery of Grounded Theory: Strategies for Qualitative Research. *The British Journal of Sociology*, *20*(2), 227.

Collins, C., Hasan, S., & Ukkusuri, S. (2013). A Novel Transit Rider Satisfaction Metric: Rider Sentiments Measured from Online Social Media Data. *Journal of Public Transportation*, *16*(2), 21–45.

Corsar, D., Markovic, M., Gault, P., Mehdi, M., Edwards, P., Nelson, J. D., … Sripada, S. (2015). TravelBot: Journey disruption alerts utilising social media and linked data. *14th International Semantic Web Conference (ISWC2015, Bethlehem)*, *1486*.

Cottrill, C., Gault, P., Yeboah, G., Nelson, J. D., Anable, J., & Budd, T. (2017). Tweeting Transit: An examination of social media strategies for transport information management during a large event. *Transportation Research Part C: Emerging Technologies*, *77*, 421–432.

Cross, N. (1993). A History of Design Methodology. In *Design Methodology and Relationships with Science* (pp. 15–27).

CROW-KpVV. (n.d.). OV-Klantenbarometer.

CROW-KpVV. (2017a). RET zet in op reisinformatie voor de optimale reisbeleving. Retrieved from https://www.crow.nl/ndov/nieuws/ret-zet-in-op-reisinformatie-voor-de-optimale-re

CROW-KpVV. (2017b). *Staat van het regionale openbaar vervoer 2016*. Ede.

CROW-KpVV. (2018). OV Klantenbarometer 2018. Delft Institute of Postive Design. (2019). Negative Emotion Typology. Retrieved from https://emotiontypology.com/

Dell'Olio, L., Ibeas, A., & Cecin, P. (2011). The quality of service desired by public transport users. *Transport Policy*, *18*(1), 217–227.

Denzin, N., & Lincoln, Y. (2005). Introduction: The discipline and Practice of Qualitative Research. In *Sage Handbook of Qualitative Research* (pp. 1–28). Retrieved from https://ci.nii.ac.jp/naid/10019607065/

Denzin, N., & Lincoln, Y. (2008). The landscape of qualitative research. In *Handbook of qualitative research* (Vol. 1).

Desmet, P. (2018). *700 + Product Emotions*.

DOVA. (2019). *Richtlijn voor de weergave van reisinformatie op DRIS-displays*. Utrecht.

Durand, A. L. (2017). *Managing disruptions in public transport from the passenger perspective: A study to assess and improve operational strategies for the benefit of passengers in rail-bound urban transport systems*. Delft University of Technology.

Durand, A. L., van Oort, N., & Hoogendoorn, S. (2018). Assessing and Improving Operational Strategies for the Benefit of Passengers in Rail-Bound Urban Transport Systems. *Transportation Research Record*, *2672*(8), 421–430.

Durand, A., Zijlstra, T., & van Oort, N. (2019). Toegang geweigerd : Digitale ongelijkheid in het slimme mobiliteitstijdperk. *Contribution for Colloquium Vervoersplanologisch Speurwerk 2019*, 1–15. Leuven.

Dziekan, K., & Vermeulen, A. (2006). Psychological Effects of and Design Preferences for Real-Time Information Displays. *Journal of Public Transportation*, *9*(1), 1–19.

Edvardsson, B. (1992). Service Breakdowns: A study of critical incidents in an airline. *International Journal of Service Industry Management*, *3*(4), 17–29.

Edvardsson, B. (1998). Causes of customer dissatisfaction - studies of public transport by the critical-incident method. *Managing Service Quality: An International Journal*, *8*(3), 189–197.

ENEA. (2004). *Demand Responsive Transport Services: Towards flexible mobility agency* (Vol. 53; G. Ambrosino, J. D. Nelson, & M. Romanaz, Eds.). Rome.

Ettema, D., Friman, M., Gärling, T., & Olsson, L. E. (2016). Travel Mode Use, Travel Mode Shift and Subjective Well-Being: Overview of Theories, Empirical Findings and Policy Implications. In *Mobility, Sociability and Well-being of Urban Living* (pp. 129–150).

Ferris, B., Watkins, K. E., & Borning, A. (2010). OneBusAway: Results from providing real-time arrival information for public transit. *Conference on Human Factors in Computing Systems - Proceedings*, *3*, 1807–1816.

Friman, M. (2004a). Implementing Quality Improvements in Public Transport. *Journal of Public Transportation*, *7*(4), 49–65.

Friman, M. (2004b). The structure of affective reactions to critical incidents. *Journal of Economic Psychology*, *25*(3), 331–353.

Friman, M., Edvardsson, B., & Garling, T. (1998). Perceived Service Quality Attributes in Public Transport: Inferences from Complaints and Negative Critical Incidents. *Journal of Public Transportation*, *2*(1), 67–89.

Friman, M., Edvardsson, B., & Gärling, T. (2001a). Frequency of negative critical incidents and satisfaction with public transport services. I. *Journal of Retailing and Consumer Services*, *8*(2), 95–104.

Friman, M., Edvardsson, B., & Gärling, T. (2001b). Frequency of negative critical incidents and satisfaction with public transport services. I. *Journal of Retailing and Consumer Services*, *8*(2), 95–104.

Gatersleben, B., & Uzzell, D. (2007). Affective Appraisals of the Daily Commute. *Environment and Behavior*, *39*(3), 416–431.

Gemeente Rotterdam, & MRDH. (2017). *Openbaar vervoer als drager van de stad: OV-visie Rotterdam 2018 - 2040*. Rotterdam.

Gentile, C., Spiller, N., & Noci, G. (2007). How to Sustain the Customer Experience:. An Overview of Experience Components that Co-create Value With the Customer. *European Management Journal*, *25*(5), 395–410.

Gold, R. L. (1957). Roles in Sociological Field Observations. *Social Forces*, *36*(3), 217–223.

Grafanaki, S. (1996). How research can change the researcher: The need for sensitivity, flexibility and ethical boundaries in conducting qualitative research in counselling/psychotherapy. *British Journal of Guidance and Counselling*, *24*(3), 329–338.

Grotenhuis, J. W., Wiegmans, B. W., & Rietveld, P. (2007). The desired quality of integrated multimodal travel information in public transport: Customer needs for time and effort savings. *Transport Policy*, *14*, 27–38.

Guan, X., & Chen, C. (2014). Using social media data to understand and assess disasters. *Natural Hazards*, *74*(2), 837–850.

Hart, C. W. L., Heskett, J. L., Sasser Jr, W. E., & Sasser, W. E. (1989). The profitable art of service recovery. *Harvard Business Review*, *68*(4), 148–156.

Hendriks, A., & Egeter, B. (2013). *Visie harmonisatie collectieve reisinformatie openbaar vervoer.* Delft, The Netherlands.

Hendriks, M. (2012). De digitale generatie: Een verkennend onderzoek naar de invloed van reisinformatie op het reisgedrag van young professionals. Utrecht University, Utrecht.

Hill, C. E., Thompson, B. J., & Williams, E. N. (1997). A Guide to Conducting Consensual Qualitative Research. *The Counseling Psychologist*, *25*(4), 517–572.

Hutchinson, T. P. (2011). Classification of reasons for poor customer experiences in service industries: The case of public transport. *Transportation Planning and Technology*, *34*(8), 747–758.

Jain, R., Aagja, J., & Bagdare, S. (2017). Customer experience – a review and research agenda. *Journal of Service Theory and Practice*, Vol. 27, pp. 642–662.

Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When More Pain Is Preferred to Less: Adding a Better End. *Psychological Science*, *4*(6), 401–405.

Kamp, A. (2016). *Engineering Education in the Rapidly Changing World: Rethinking the Vision for Higher engineering Education* (2nd revise). Delft.

Kasti, E. (2017). *Improving passenger experience with disruption handling through proactive information design for KLM*. Delft University of Technology.

Kawulich, B. (2005). Participant Observation as a Data Collection Method. *Forum: Qualitative Social Research*, *6*(2).

Kennisinstituut voor Mobiliteitsbeleid. (2018). *Busgebruikers door dik en dun* (T. Zijlstra, P. Bakker, L. Harms, Durand,A. & H. Wüst, Eds.).

Kennisplatform Verkeer en Vervoer. (2010). *Dynamische reisinformatie in het openbaar vervoer.*

Kepaptsoglou, K., & Karlaftis, M. G. (2009). The bus bridging problem in metro operations: conceptual framework, models and algorithms. *Public Transport*, *1*(4), 275–297.

Kepaptsoglou, K., & Karlaftis, M. G. (2010). A model for analyzing metro station platform conditions following a service disruption. *13th International IEEE Conference on Intelligent Transportation Systems*, 1789–1794.

KLM. (2015). *Annual Report 2015*. Retrieved from www.klm.com

Koopmans, T. C. (1960). Stationary Ordinal Utility and Impatience. *Econometrica*, *28*(2), 287.

Kotler, P. (2000). *Marketing Management, Millenium Edition* (10th ed.).

Lai, W., & Chen, C. (2011). Behavioral intentions of public transit passengers - The roles of service quality, perceived value, satisfaction and involvement. *Transport Policy*, *18*(2), 318–325.

Liljander, V., & Strandvik, T. (1997). Emotions in service satisfaction. *International Journal of Service Industry Management*, *8*(2), 148–169.

Lyons, G., Avineri, E., Farag, S., & Harman, R. (2007). Strategic Review of Travel Information Research. In *Final report to the Department for Transport For contract TDT/149 (R201).* Bristol.

Malterud, K. (2001). Qualitative research: standards, challenges, and guidelines. *The Lancet*, *358*(9280), 483–488.

Mascia, M. (2003). Effects of traveller information systems on modal choice. In *EIRASS workshop Behavioural response to ITS, Eindhoven, The Netherlands*. Eindhoven.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370.

McCollough, M. ., & Bharadwaj, S. G. (1992). The recovery paradox: An examination of consumer satisfaction in relation to disconfirmation. *AMA Winter Educators Conference*, *119*, 119.

Meckiff, C., Chone, R., & Nicolaon, J. P. (1998). The tactical load smoother for multi-sector planning. *Proceedings of the 2nd Usa/Europe Air Traffic Management Research and Development Seminar*, (December), 1–12.

Meesters, K., van Beek, L., & van de Walle, B. (2016). #Help. The Reality of Social Media Use in Crisis Response: Lessons from a Realistic Crisis Exercise. *49th Hawaii International Conference on System Sciences (HICSS)*, 116–125.

Merkert, R., & Pearson, J. (2015). A non-parametric efficiency measure incorporating perceived airline service levels and profitability. *Journal of Transport Economics and Policy*, *49*(2), 261–275.

Ministerie van Verkeer en Waterstaat. (2003). *Gebruikersbehoeften Reisinformatie*.

Monsuur, D., & Idzenga, K. (2016). Focus op kwaliteit. *Ov Magazine*, 28–29.

Morrow, S. L. (2005). Quality and trustworthiness in qualitative research in counseling psychology. *Journal of Counseling Psychology*, Vol. 52, pp. 250–260.

Morton, C., Caulfield, B., & Anable, J. (2016). Customer perceptions of quality of service in public transport: Evidence for bus transit in Scotland. *Case Studies on Transport Policy*, *4*(3), 199–207.

Mouwen, A. (2015). Drivers of customer satisfaction with public transport services. *Transportation Research Part A: Policy and Practice*, *78*, 1–20.

MRDH. (2016). *ONTWERP PROGRAMMA VAN EISEN : Busconcessies Voorne-Putten en Rozenburg, Haaglanden Streek, Rotterdam en omstreken Haaglanden Stad*.

MRDH. (2018). *Vaststelling (exploitatie)subsidies RET Bus 2018*. Retrieved from www.mrdh.nl

Ngoc, A. M., Hung, K. V., & Tuan, V. A. (2017). Towards the Development of Quality Standards for Public Transport Service in Developing Countries: Analysis of Public Transport Users' Behavior. *Transportation Research Procedia*, *25*, 4560–4579.

Nikolaidou, A., & Papaioannou, P. (2018). Utilizing Social Media in Transport Planning and Public Transit Quality: Survey of Literature. *Journal of Transportation Engineering, Part A: Systems*, *144*(4), 1–16.

NS. (2016). *Spoorslags beter*.

Oliver, R. L. (1977). Effect of expectation and disconfirmation on postexposure product evaluations: An alternative interpretation. *Journal of Applied Psychology*, *62*(4), 480–486.

Oliver, R. L. (1996). *Satisfaction: A Behavioral Perspective on the Consumer*.

Oxford Dictionary of English. (2010). *Disruption* (3rd Revise).

Papangelis, K., Nelson, J. D., Sripada, S., & Beecroft. (2016). The effects of mobile real-time information on rural passengers. *Transportation Planning and Technology*, *39*(1), 97–114.

Papangelis, K., Velaga, N. R., Ashmore, F., Sripada, S., Nelson, J. D., & Beecroft, M. (2016). Exploring the rural passenger experience, information needs and decision making during public transport disruption. *Research in Transportation Business and Management*, *18*, 57–69.

Patrício, L., Fisk, R. P., & Falcão e Cunha, J. (2008). Designing Multi-Interface Service Experiences. *Journal of Service Research*, *10*(4), 318–334.

Pedersen, T., Kristensson, P., & Friman, M. (2011). Effects of critical incidents on car users' predicted satisfaction with public transport. *Transportation Research Part F: Traffic Psychology and Behaviour*, *14*(2), 138–146.

Peek, G. J., & van Hagen, M. (2002). Creating Synergy In and Around Stations: Three Strategies for Adding Value. *Transportation Research Record*, *1793*(1), 1–6.

Pender, B., Currie, G., Delbosc, A., & Shiwakoti, N. (2013). Social media utilisation during unplanned passenger rail disruption - What's not to "Like"? *Australasian Transport Research Forum*.

Pine, B. J., & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard Business Review*, *76*(4), 97–105.

Pine, B. J., & Gilmore, J. H. (1999). *The experience economy: work is theatre & every business a stage*.

Politis, I., Papaioannou, P., Basbas, S., & Dimitriadis, N. (2010). Evaluation of a bus passenger information system from the users' point of view in the city of Thessaloniki, Greece. *Research in Transportation Economics*, *29*(1), 249–255.

Polkinghorne, D. E. (2005). Language and meaning: Data collection in qualitative research. *Journal of Counseling Psychology*, Vol. 52, pp. 137–145.

Procopio, C. H., & Procopio, S. T. (2007). Do you know what it means to Miss New Orleans? Internet communication, geographic community, and social capital in crisis. *Journal of Applied Communication Research*, *35*(1), 67–87.

RET NV. (n.d.-a). *Storingsboekje Bus*. Rotterdam.

RET NV. (n.d.-b). *Werkinstructie WCV101 : IRMS melding aanmaken*. Rotterdam.

RET NV. (2011). *Onderzoek Reisinformatie*. Rotterdam.

RET NV. (2016a). *Jaarverslag 2015*. Rotterdam.

RET NV. (2016b). *Kwaliteitsplan Gemak*. Rotterdam.

RET NV. (2018a). *DRIS overzicht*. Rotterdam.

RET NV. (2018b). *Jaarverslag 2018*. Rotterdam.

RET NV. (2018c). *RET-haltebestand*. Roterdam.

RET NV. (2019). *RET Bedrijfsplan 2019 t/m 2021*. Rotterdam.

Rijkswaterstaat. (2009). *De effecten van multimodale reisinformatie: Rapportage van een literatuurverkenning en een expert meeting*. Delft.

Rosenbaum, M. S., Otalora, M. L., & Ramírez, G. C. (2017). How to create a realistic customer journey map. *Business Horizons*, *60*(1), 143–150.

Rowley, J. (2007). The wisdom hierarchy: representations of the DIKW hierarchy. *Journal of Information Science*, *33*(2), 163–180.

Rubin, H. J., & Rubin, I. S. (2012). *Qualitative Interviewing: The Art of Hearing Data* (3rd ed.).

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign*, *4*(1), 5–18.

Sanders, E. B. N., & Stappers, P. J. (2014). *Convivial design toolbox: generative research for the front end of design*.

Schmitt, B. (1999). Experiential Marketing. *Journal of Marketing Management*, *15*(1–3), 53–67.

Schweiger, C. L. (2003). Real-Time Bus Arrival Information Systems. In *Transit Cooperative Research Program (TCRP) Synthesis Report* (Vol. 48). RSleeswijk Visser, F. (2009). *Bringing the everyday life of people into design* (Delft University of Technology). Retrieved from www.contextmapping.com

Sleeswijk Visser, F., Stappers, P. J., van der Lugt, R., & Sanders, E. B. N. (2005). Contextmapping: experiences from practice. *CoDesign*, *1*(2), 119–149.

Smith, A. K., Bolton, R. N., & Wagner, J. (1999). A model of customer satisfaction with service encounters involving failure and recovery. *Journal of Marketing Research*, *36*(3), 356–372.

St-Louis, E., Manaugh, K., van Lierop, D., & El-Geneidy, A. (2014). The happy commuter: A comparison of commuter satisfaction across modes. *Transportation Research Part F: Traffic Psychology and Behaviour*, *26*, 160–170.

Stickdorn, M., & Schneider, J. (2013). *This is service design thinking: Basics - Tools - Cases*. Amsterdam: BIS Publishers.

Stuart, K. R., Mednick, M., & Bockman, J. (2000). Structural Equation Model of Customer Satisfaction for the New York City Subway System. *Transportation Research Record: Journal of the Transportation Research Board*, *1735*(1), 133–137.

Susilo, Y. O., & Cats, O. (2014). Exploring key determinants of travel satisfaction for multi-modal trips by different traveler groups. *Transportation Research Part A: Policy and Practice*, *67*, 366–380.

Taylor, S. A., & Baker, T. L. (1994). An assessment of the relationship between service quality and customer satisfaction in the formation of consumers' purchase intentions. *Journal of Retailing*, *70*(2), 163–178.

Tertoolen, G., de Vries, J., & Otto, M. (2015). 8 tips voor nog effectievere reisinformatie. Retrieved from Verkeerskunde: hét multimediale platform voor verkeerskundigen website: http://www.verkeerskunde.nl/internetartikelen/vakartikelen/wat-doen-we-eigenlijk-met-reisinformatie-(vk-2.39656.lynkx

The Marketing Science Institute. (2014). *2014–2016 Research Priorities*.

Tomiyama, T. (2001). Service engineering to intensify service contents in product life cycles. *Proceedings - 2nd International Symposium on Environmentally Conscious Design and Inverse Manufacturing*, 613–618.

van Beynen de Hoog, P. (2004). "Hoe kiest de keuzereiziger? Mogelijke determinanten van vervoerwijzekeuzegedrag onder keuzereizigers." *Colloquium Vervoersplanologisch Speurwerk*, 1327–1345.

van der Bijl, R., Maartens, M., & van Oort, N. (2016). Waarde ov sterk onderschat. *Ov Magazine*, 10–12. van der Merwe, H. (1996). The research process: Problem statement and research design. In *Effective research in the human sciences – Research management for researchers, supervisors and master's and doctoral candidates*.

van Hagen, M., & Bron, P. (2013). *De emotionele reis van onze klant. Waarom 56 minder is dan 45.* Rotterdam.

van Hagen, M., & Bron, P. (2014). Enhancing the Experience of the Train Journey: Changing the Focus from Satisfaction to Emotional Experience of Customers. *Transportation Research Procedia*, *1*, 253–263.

van Hagen, M., & de Bruyn, M. (2012). The Ten Commandments of How to Become a Customer-driven Railway Operator. *European Transport Conference*, 8–10.

van Hagen, M., & de Bruyn, M. (2015). Emotions during a train journey quantified. *European Transport Conference 2015*. Retrieved from https://trid.trb.org/view/1372794

van Hagen, M., Govers, B., & de Haan, M. (2012). *Robuust sturen op keuzegedrag van mobilisten. Waarom consequent sturen op veraangenaming zo effectief is in de stedelijke mobiliteit.* Amsterdam.

van Hagen, M., & van Oort, N. (2019). Improving Railway Passengers Experience: Two Perspectives. *Journal of Traffic and Transportation Engineering*, *7*, 97–110.

van Lierop, D., & El-Geneidy, A. (2016). Enjoying loyalty: The relationship between service quality, customer satisfaction, and behavioral intentions in public transit. *Research in Transportation Economics*, *59*, 50–59.

van Oort, N. (2015). Reizigerseffecten van onbetrouwbaar OV in maatschappelijke kostenbatenanalyses. *TVW Tijdschrift Vervoerswetenschap Jaargang*, *51*(1), 67–81. Retrieved from www.vervoerswetenschap.nl

van Oort, N. (2016). Incorporating enhanced service reliability of public transport in cost-benefit analyses. *Public Transport*, *8*(1), 143–160.

Verhoef, P. C., Lemon, K. N., Parasuraman, A., Roggeveen, A., Tsiros, M., & Schlesinger, L. A. (2009). Customer Experience Creation: Determinants, Dynamics and Management Strategies. *Journal of Retailing*, *85*(1), 31–41.

Watkins, K. E., Ferris, B., Borning, A., Rutherford, G. S., & Layton, D. (2011). Where Is My Bus? Impact of mobile real-time information on the perceived and actual wait time of transit riders. *Transportation Research Part A: Policy and Practice*, *45*(8), 839–848.

Welch, J. K., & Patton, M. Q. (1992). Qualitative Evaluation and Research Methods. *The Modern Language Journal*, *76*(4), 169–186.

Wilkinson, C. R., & De Angeli, A. (2014). Applying user centred and participatory design approaches to commercial product development. *Design Studies*, *35*(6), 614–631.

Wilson, A., Zeithaml, V., Bitner, M. J., & Gremler, D. D. (2016). *Services marketing: Integrating customer focus across the firm* (3rd Europe). Yap, M. D., van Oort, N., van Nes, R., & van Arem, B. (2015). Robustness of Multi-Level Public Transport Networks: a Methodology To Quantify Robustness From a Passenger Perspective. *Tijdschrift Vervoerswetenschap*, *51*(1), 82–99.

Yap, M. D., van Oort, N., van Nes, R., & van Arem, B. (2018). Identification and quantification of link vulnerability in multi-level public transport networks: a passenger perspective. *Transportation*, *45*(4), 1161–1180.

Yates, D., & Paquette, S. (2011). Emergency knowledge management and social media technologies: A case study of the 2010 Haitian earthquake. *International Journal of Information Management*, *31*(1), 6–13.

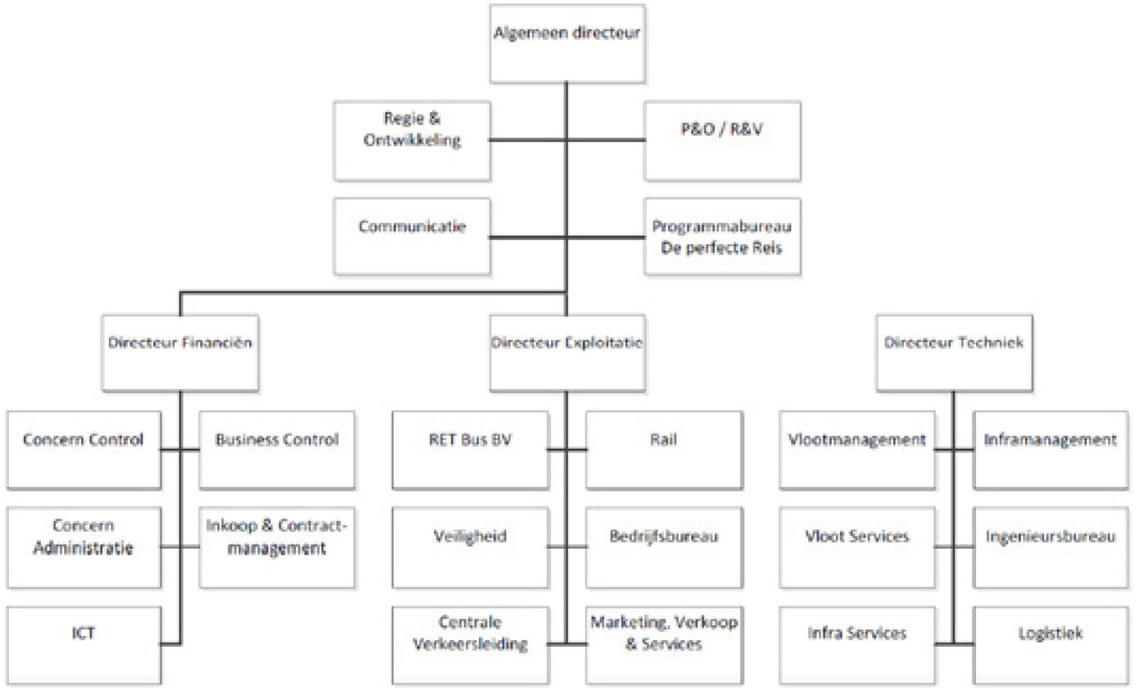
Yilmaz, K. (2013). Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences. *European Journal of Education*, *48*(2), 311–325.

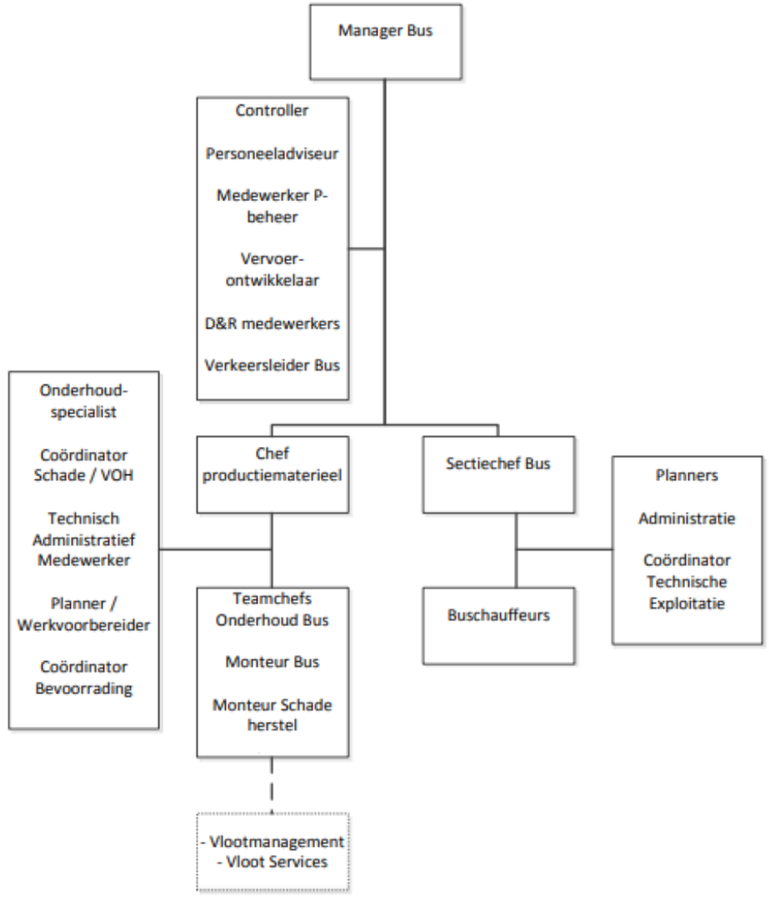
Zaltman, G. (2003). *How Customers Think: Essential Insights into the Mind of the Market*. Boston: Harvard Business School Press.

Zhang, F., Shen, Q., & Clifton, K. J. (2008). Examination of traveler responses to real-time information about bus arrivals using panel data. *Transportation Research Record*, *2082*(1), 107–115.

Appendix

Appendix 1 : Organization chart RET NV. and Bus BV. (in Dutch)

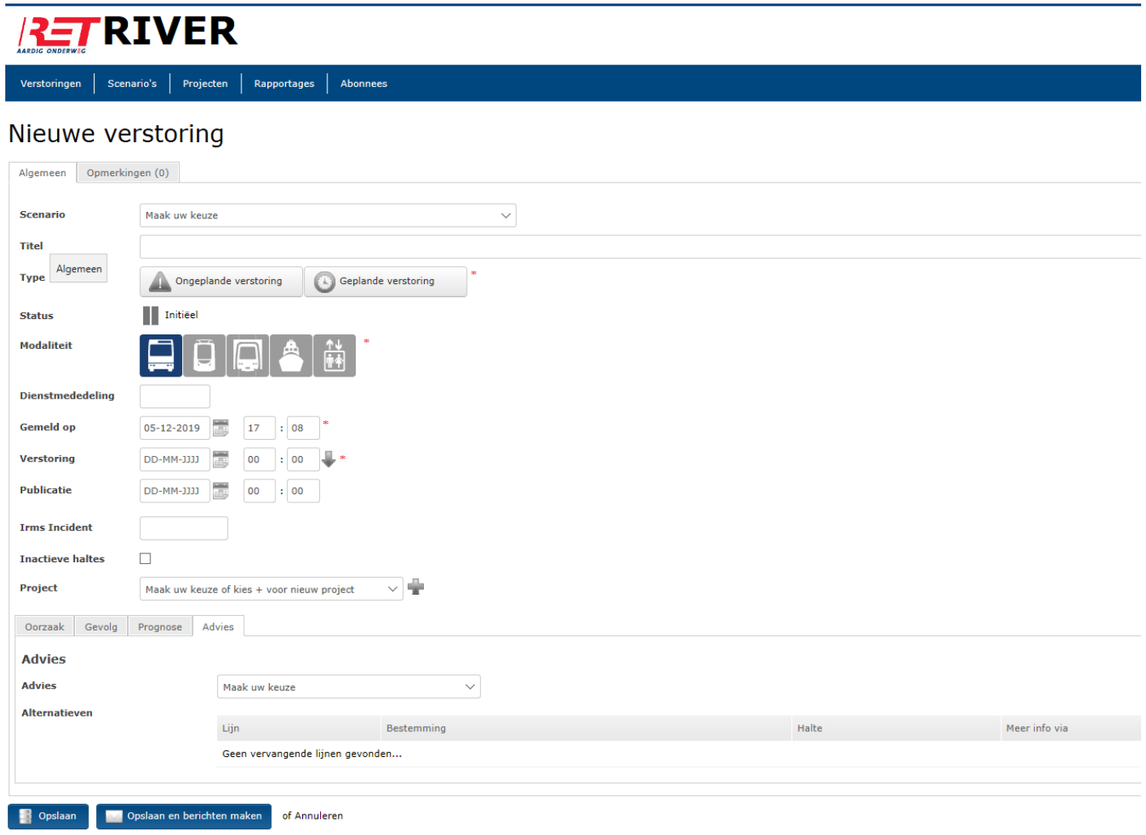




Appendix 2 : IRMS Classifications of incidents and Class (in Dutch)

Aard incident	Klein = Klasse 1 Duur verstoring: < 1 uur Media aandacht: Geen	Middel = Klasse 2 Duur verstoring: 1 - 2 uur Media aandacht: Mogelijk	Groot = Klasse 3 Duur verstoring: 2 - 4 uur Media aandacht: Lokaal / Landelijk	Zeer Groot = Klasse 4 Duur verstoring: > 4 uur Media aandacht: Landelijk / Buitenland
V Verstoring Vertraging	a. Stremming/verstoring door derden <60 min b. Stremming/verstoring door overige omstandigheden <60min c. Personeel/materieel tekort d. STS passage	a. Stremming/verstoring door derden 60-120 min b. Verstoring door overige omstandigheden 60-120 min c. Extreme drukte op metrostations met gevaar veiligheid	a. Stremming/verstoring door derden 120-240 min b. Verstoring door overige omstandigheden120-240 min c. Gedeeltelijke stilstand van een of meerdere lijnen	a. Totale versperring / algehele stilstand b. Staking / werkonderbreking
U Uitval tractiespanning	a. Uitval tractiespanning metro<60 min b. Uitval bovenleidingspanning tram < 60 min	a. Uitval tractiespanning metro 60-120 min b. Uitval bovenleidingspanning tram 60-120 min	a. Uitval tractiespanning metro 120-240 min b. Uitval bovenleidingspanning tram 120-240 min	a. Uitval tractiespanning metro >240 min b. Uitval bovenleidingspanning tram >240 min
S Storing Materieel & Infra	a. Defect materieel, stremming/verstoring <60 min b. Storing infra, stremming/verstoring <60 min	a. Defect materieel, stremming/verstoring 60-120 min b. Storing infra, stremming/verstoring 60-120 min	a. Defect materieel, stremming/verstoring 120-240 min b. Storing infra, stremming/verstoring 120-240 min c. Falen afstandsbediening / uitvallen spoorbeveiliging d. Uitvallen mobilofoon / portofoon e. Gedeeltelijke uitval EBS	a. Defect materieel, stremming/verstoring >240 min b. Storing infra, stremming/verstoring >240 min c. Falen meerdere afstandsbedieningen / uitvallen meerdere spoorbeveiligingssystemen d. Gehele uitval EBS
B Brand / Rook / Explosie	a. Kleine brand zonder gevaar b. Rookontwikkeling zonder gevaar	a. Brand met gevaar zonder gewonden b. Rookontwikkeling met beperking zicht	a. Brand met gewonden b. Brand in het metrosysteem, tram, bus of fastferry	a. Brand met doden b. Brand CVL
O Ongeval / Aanrijding met letsel	a. Aanrijding zonder letsel b. Deraillement op hoofdbaan met lichte schade c. Deraillement niet op hoofdbaan met lichte schade d. Persoonlijk ongeval zonder blijvend letsel	a. Aanrijding met letsel b. Deraillement op hoofdbaan met middelmatige schade c. Deraillement niet op hoofdbaan met middel schade d. Persoonlijk ongeval met blijvend letsel e. Zelfdoding	a. Aanrijding met zwaar letsel b. Deraillement op hoofdbaan met grote schade c. Deraillement niet op hoofdbaan met grote schade d. Persoonlijk ongeval met ernstig letsel e. Aanrijding railvoertuig met railvoertuig of railobject	a. Aanrijding met dodelijke slachtoffers b. Aanrijding met meerdere voertuigen en meerdere (zwaar) gewonden
G Gevaarlijke en/of Milieubelastende stoffen	a. Morsingen of emissies, lekkages van brandbare stof of chemicaliën zonder verontreiniging	a. Morsingen of emissies, lekkages van brandbare stof of chemicaliën met verontreiniging	a. Omvangrijke lekkage, leidingbreuk en het leegstromen van opslagtanks met vervuiling van riool, lucht en bodem en gevaar voor personen b. Externe lekkage	a. Brand/explosie in metro/station/tunnel als gevolg van lekkage, leidingbreuk of leegstromen opslagtanks b. Externe lekkage/brand onder Blaak (LPG tank)
A Agressie	a. Agressie melding met gevolg verstoring 10-60 min b. Personeel bedreigd	a. Agressie melding met gevolg verstoring 60-120 min b. Mishandeling personeel zonder ernstig letsel	a. Agressie melding met gevolg verstoring 120-240 min b. Mishandeling personeel met ernstig letsel c. Gewapende overval d. Oproer e. Bommelding	a. Agressie melding met gevolg verstoring >240 min b. Gijzeling c. Bommelding met ontruiming d. Gemeentelijk crisisbeheerplan door het bevoegd gezag in werking gesteld en RET daardoor diensten moet staken of omleiden
M Melding	a. Melding zonder effect op exploitatie b. Bijzonderheden evenement			

Appendix 3 : RIVER and text options "OPGA-principle" (in Dutch)

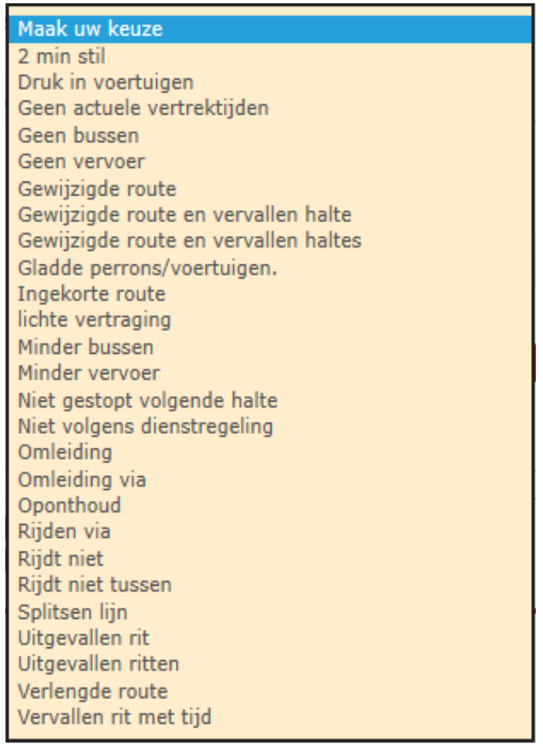


Cause of the incident (O)

Cause of the incident (O)

Cause of the incident (O)

Prognosis of the incident (P)



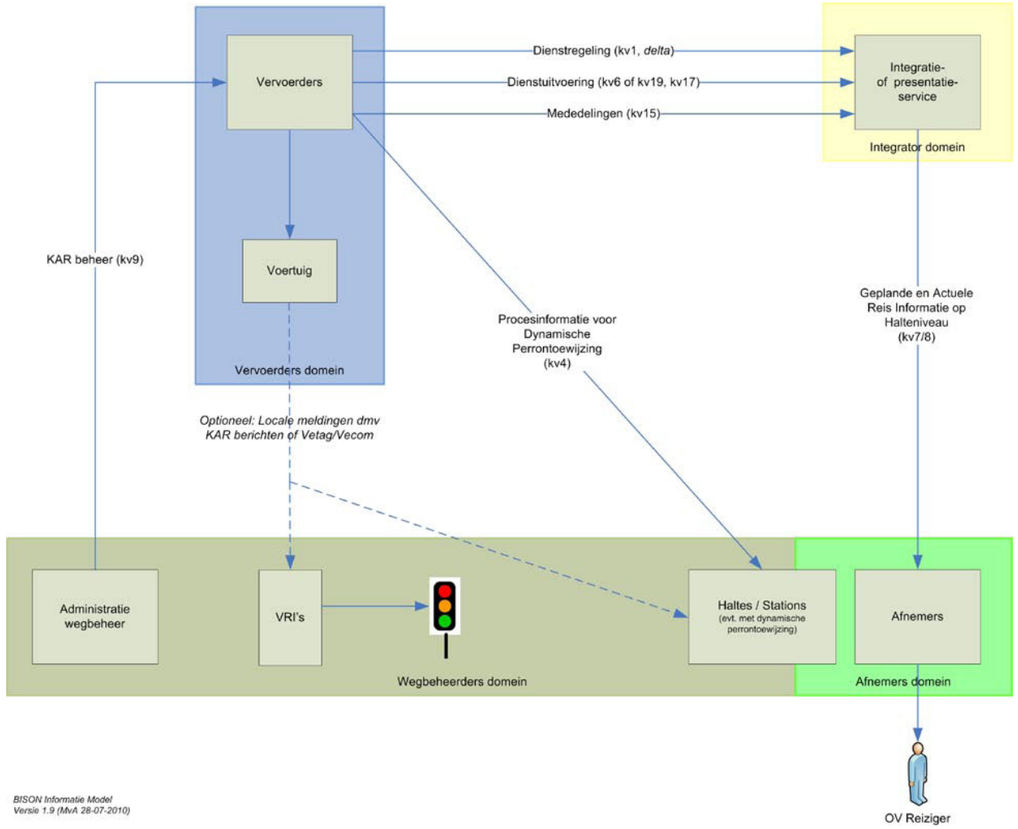
Consequence of the incident (G)

- Maak uw keuze
- Begrip
- Excuses
- Gebruik maken van de bus
- Gebruik maken van de metro
- Gebruik maken van de tram
- Gebruik RET realtime app
- In/uitstappen:
- Lopen
- Lopen naar
- Niet reizen
- Overstappen op
- Reizen met ander OV
- Reizen verder via
- Reizen via
- Bussen ingezet
- Enkele bussen
- Extra bussen
- Geen bussen
- Geen vervangend vervoer
- Metro's ingezet
- Pendelbus
- Rijden via omweg
- Route aangepast
- Tijdelijke dienstregeling
- Vervallen halte(s)
- Vervangende halte(s)

Advice (G)

- -
- Afwijkende vertrektijden
- Extra reistijd
- Extra reistijd en overstap
- Extra reistijd tot 05 min.
- Extra reistijd tot 10 min.
- Extra reistijd tot 15 min.
- Extra reistijd tot 20 min.
- Extra reistijd tot 30 min.
- Extra reistijd tot 45 min.
- Extra reistijd tot 60 min.
- Extra reistijd van tenminste 60 min.
- Meer informatie
- Nadere informatie
- Pendelbussen verwacht
- Volgens dienstregeling

Appendix 4 : KV information process (in Dutch)



Appendix 5 : Sensitising booklet (in Dutch)

Over jou

Naam

Leeftijd

Geslacht

Woonplaats

Beroep

Meest gebruikte Buslijn (en)

Link de uitspraken die passen jou als busreiziger:

Openbaar Busvervoer in Rotterdam

Ik reis met de bus in de regio Rotterdam omdat :

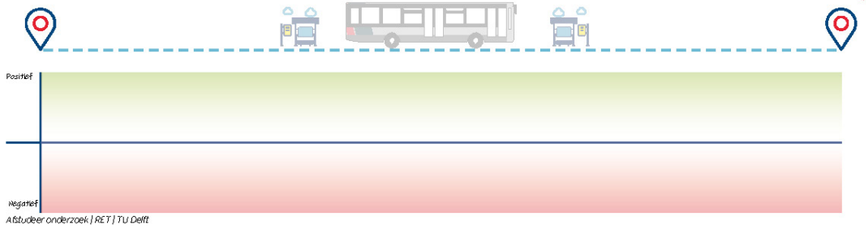
Een alternatief voor mijn busreis is :

Drie dingen die ik leuk/fijn vind aan het reizen met de bus :

Drie dingen die ik niet leuk/fijn vind aan het reizen met de bus :

Heenreis

Datum ...../...../2019



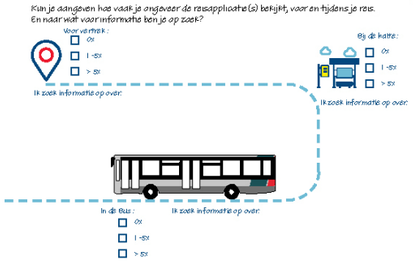
Afstudeer onderzoek | RET | TU Delft

Reisinformatie

A B C A B C A B C A B C A B C A B C A B C

A. Welke reisapplicatie(s) heeft u op je mobiele telefoon ?
B. Welke reisapplicatie(s) gebruik je voor het plannen van je busreis, voor vertrek ?
C. Welke reisapplicatie(s) gebruik je voor het bekijken van real-time reisinformatie ?

Geef een toelichting waarom je een voorkeur hebt voor (een) bepaalde applicatie(s) :



Reisinformatie

Ik ben benieuwd hoe jij de reisinformatie op deze digitale halteborden beschouwd. Hoe kijk jij naar de reisinformatie op deze digitale halteborden?

In de OV-wereld wordt het ook wel een DRIS-bord genoemd. DRIS is een afkorting voor Dynamisch Reizigers Informatie Systeem.

Het DRIS-bord geeft real-time informatie over de vertrektijd van mijn bus :

☐ Ja ☐ Nee ☐ Soms

Opmerking : _____

De informatie aangeven op de DRIS beschouw ik als :

Onbetrouwbaar — Betrouwbaar

De informatie aangeven op mijn reisapp beschouw ik als :

Onbetrouwbaar — Betrouwbaar

Afstudeer onderzoek | RET | TU Delft

Voor het verkrijgen van real-time reisinformatie bij de bushalte maak ik het liefst gebruik van :

☐ DRIS ☐ App ..... ☐ Website ..... ☐ .....

Is de vertrektijd aangedaad in minuten voor jou voldoende informatie ? En bij een verstoring?

☐ Ja, en bij een verstoring ook. ☐ Ja, maar bij een vertraging niet.

☐ Nee, en bij een verstoring ook niet.

Een ervaring, of opmerking die je wilt delen over deze DRIS borden en de informatie die erop getoond wordt :

Verstoringen - Logboek 1

_____ _____ * Datum (Dag van de week) en Tijdstip (indicatief)

Vanaf: Huis / Werk /

Onderweg naar :

Op welk moment werd je er van bewust dat er een verstoring was?

Via welk kanaal ?

☐ App ..... ☐ Digitaalscherm in de bus ☐ .....

☐ Website ..... ☐ Buschauffeur

☐ DRIS-bord ☐ Medereizuger

Afstudeer onderzoek | RET | TU Delft

Was de oorzaak van de verstoringen bij jou bekend ? ☐ Nee ☐ Ja

Zo ja, wat is de oorzaak? En hoe kwam je aan deze informatie ?

_____ minuten vertraging _____ minuten vertraging

Welke gevolgen had de verstoring voor jou? En hoe voelde je je daarbij?

Verdere ervaringen / opmerkingen / plus-min punten die je wilt delen over deze verstoring :

Appendix 6 : Interview guide bus traveller (in Dutch)

Onderzoek naar de behoefte, waarden en opvattingen van busreizigers tijdens verstoringen

Onderzoeksopzet: diepte-interview (60/80 min)

Kennismaking: (5 minuten)

> Kort jezelf voorstellen
> Introduceren onderzoeksthema en de opzet voor de sessie doorlopen
> Goedkeuring vragen voor het opnemen audio
> Geruststellen: er zijn geen slechte antwoorden mogelijk, ik ben benieuwd naar jouw ideeën en ervaringen, probeer zoveel mogelijk hardop na te denken en ze toe te lichten

Persoonlijke informatie, introductie, en algemeen reisgedrag (15 minuten)

1. Persoonlijke informatie

1.1. Kan je kort iets over jezelf vertellen? (Werk,gezin,woon situatie)

2. Introductie

2.1 Kan je vertellen welke rol het openbaar vervoer speelt in jouw dagelijks leven?
2.1.1 Hoe vaak reis je met het openbaar vervoer?
2.2 In welke situaties reis je met de bus? Naar welke locatie reis je dan?
2.3 Kan je vertellen hoe je tegen de bus (van de RET) aankijkt?
2.3.1 Is dat anders dan voor de metro of tram?

3. Algemeen reisgedrag

3.1. Kan je mijn vertellen hoe je voorbereid op een reis het OV?
3.1.1. Welke middelen gebruik je hiervoor ? Waarom?
3.2. Kan jij mij toelichten hoe een normale reis voor jou verloopt?
3.2.1. Achterhalen wat de verschillende fases zijn, wat ze doen, welke middelen ze gebruiken en waarom?

Reisgedrag, ervaringen en behoefte tijdens verstoringen (30 minuten)

4. Reisgedrag tijdens verstoringen

4.1. Kan je voor mij terug denken aan een verstoring die je hebt meegemaakt met de bus
4.1.1. Wat voor een reis was het? (Recreatief, woon-werk, huishoudelijk)
4.1.2. Kan je mijn vertellen hoe de reis verliep?
4.2 We gaan nu de reis opdelen in kleine stukjes
4.1.3. Kan je mij vertellen hoe en wanneer je te weten kwam van de verstoring? (Waar keken ze, welke middelen gebruiken ze)
4.1.4. Kan je mij vertellen wat je daarna deed toen je op de hoogte was van de verstoring?
4.1.5. Kan je mij vertellen welke impact de verstoring had voor jou?
4.1.6. Kan je mij vertellen hoe je je voelde op dat moment?
4.2. Terugblik
4.2.1. Het voorbeeld wat je net hebt geven zou je zeggen dat een typische verstoring is geweest of een uitzonderlijke situatie? Gedraag je meestal zo?
4.2.2. Heb je iets geleerd van deze verstoringen? Hoe neem je dat mee in andere verstoringen?

Ideeen en oplossing voor de toekomst (15min)

5. Toekomst visie

5.1 Ik ben benieuwd naar als jij mag zeggen hoe de RET jou moet informeren over een verstoring hoe je dat dan zou willen? Waarom?
5.2 En wat zou er aan bijdragen dat jij een verstoring als minder vervelend ervaart?

Afronding en afsluiting(10min)

6. Post-interview vragen

6.1 Zijn er nog tip die je aan de RET wilt meegeven?
6.2 Is er iets wat je zelf nog wil vertellen/opmerken/aanvullen over reizen met het ov?

Bedanken.

Appendix 7 : Interview guide other actors (in Dutch)

Onderzoek naar de ervaring, behoefte, en opvattingen van RET medewerkers die betrokken zijn bij verstoringen in het openbaar bus vervoer

Onderzoeksopzet: diepte-interview (60 min)

Kennismaking: (5 minuten)

> Kort mezelf voorstellen
> Introduceren onderzoeksthema en de opzet voor de sessie doorlopen
> Goedkeuring vragen voor het opnemen audio
> Geruststellen, er zijn geen slechte antwoorden mogelijk, ik ben benieuwd naar jouw ideeën en ervaringen, probeer zoveel mogelijk hardop na te denken en ze toe te lichten.

Persoonlijke informatie, introductie werkzaamheden: (10 minuten)

1. Persoonlijke informatie

1.1. Kan je kort iets over jezelf vertellen? (Werk ,gezin, woon situatie)
1.2. Hoelang werk je al voor de RET?
1.3. Kan je in het kort uitleggen wat je functie is bij de RET?

Verstoringen in het openbaar vervoer en de reizger, heden/verleden: (30 minuten)

2. Verstoringen in het openbaar vervoer

2.1. Welke rol heb jij bij een verstoring in het openbaar vervoer?
2.2. Welke verstoringen zijn het lastige voor jou? Waarom?
2.3. Ben je tevreden over de manier waarop je kan bijdragen aan het oplossingen/ondersteunen van een verstoringen? (positieve en negatieve punten achterhalen)

3. De reiziger

3.1. Hoe neem je de reiziger mee tijdens het oplossen/ondersteunen van een verstoringen?
3.2. Ben je tevreden over de mate waarin je dat kan doen? (positieve en negatieve punten achterhalen)

4. Terugblik naar verleden

4.1. Is er een verstoringen bij die je erg is bijgebleven? Waarom?
4.2. Heb je iets geleerd van deze verstoringen? Hoe neem je dat mee in andere verstoringen / je werk?
4.3. Heeft de RET de afgelopen tijd (jaren) iets gedaan, waarvoor jij je werk tijdens verstoringen beter kan uitvoeren? Of zijn er juist zaken waardoor je je werkzaamheden minder goed kan uitvoeren?

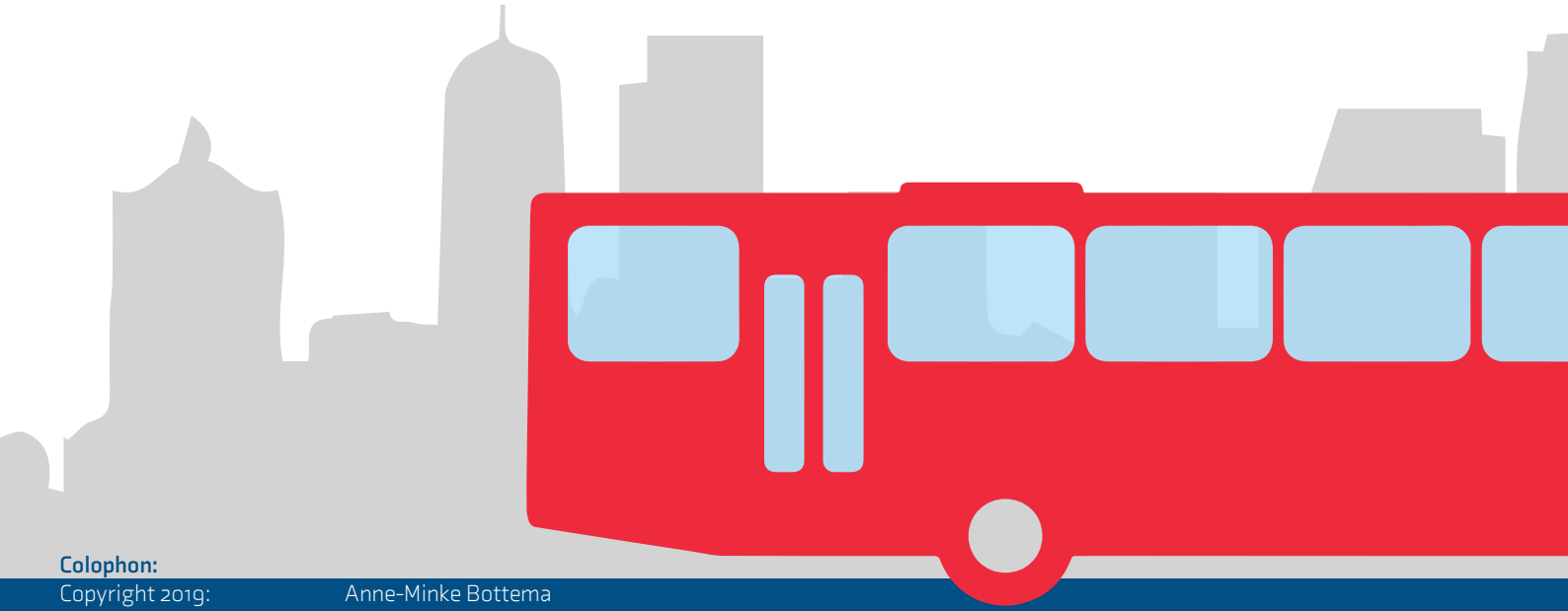
Toekomst (5 min)

5.1 Als je alles zou mogen veranderen aan je werkzaamheden, wat zou je dan morgen graag anders doen en waarom?
5.2 Wat is jou advies naar de RET wat ze zouden moeten doen om er voor te zorgen dat het cijfer van reisinformatie naar verstoringen omhoog gaat? En een reiziger een verstoring als minder vervelend ervaart?

Post-interview vragen (10min)

6.1 Is er iets wat je zelf nog wil vertellen/opmerken/aanvullen over de RET, je werkzaamheden of verstoringen?

Bedanken.



Colophon:
Copyright 2019: Anne-Minke Bottema
Design: Anne-Minke Bottema
Printing and binding: PrintEnBind