MEASURING RAILWAY TRAFFIC PUNCTUALITY FROM THE PASSENGER'S PERSPECTIVE

Riikka Salkonen. Department of Business Information Management and Logistics, Tampere University of Technology, Finland. tel. +358 40 849 0341, email. riikka.salkonen@tut.fi

Jouni Paavilainen. Department of Business Information Management and Logistics, Tampere University of Technology, Finland. tel. +358 44 5542782, email. Jouni.paavilainen@tut.fi

ABSTRACT

Punctuality is an important success factor for railway traffic systems, and it is one that largely affect on passengers. Measuring punctuality in railways has many different applications. It can provide a measurement of quality, and can be used for example in individual investment projects or in scheduling. This article discusses punctuality from the point of view of the passenger and also discusses the current state of research on the subject. Previous studies made by the authors have noted that the customer's point of view is inadequately studied in railway traffic and that punctuality has been neither extensively measured nor systematically monitored from the passenger's perspective. Accordingly, this study focused on measuring the experienced punctuality of passengers rather than that of trains.

Nowadays, customer management is increasingly important in all fields. Railway actors have to be able to follow how railway customers' punctuality evolves from the customers point of view. While development of punctuality measurements in Finland has been slow, this is also the norm in the international field. Methods of measuring punctuality in most countries are simple, concentrating solely on measuring the deviation of scheduled stops and counting the percentage value of punctual trains. Also, threshold values of punctuality vary between countries and common uniform measurement methods are missing.

The main goal of this study is to explain the usefulness of punctuality measurements that take passengers into account. First, the article provides a general outline of punctuality measurements based on a literature review, followed by a brief discussion of the different possibilities for measuring punctuality. The article describes the specific features of punctuality measurement in Finland and considers the ways in which these passengers' punctuality measurements might be put into practice. Railway punctuality has been

measured in Finland since 1992. However, trains, not passengers have been considered the key indicators in punctuality and quality measurements.

Newer, more diversified indicators are needed in order to measure punctuality — indicators that measure punctuality from different perspective than we are used to. This article focuses on the passenger's perspective and on methods for measuring punctuality in Finland. Passenger punctuality measurements provide the railway industry with new ways of approaching and measuring punctuality. This kind of indicator can be used to monitor overall passenger service quality as well as to measure customer satisfaction. Further research is needed to empirically test the passenger punctuality measurements.

Keywords: train punctuality, punctuality measurements, quality of service

INTRODUCTION

Railway punctuality describes the accuracy and reliability of train traffic. It is a well-known indicator among actors of the field and among passengers, and is often easily measurable. Olsson & Haugland (2004) state that in the railway industry, punctuality is a key performance indicator affected by several factors.

This paper describes punctuality from the passenger's perspective; for passengers, punctuality is an indicator of the quality of a journey. Railway traffic punctuality is often discussed in public, and high requirements are placed on the reliability of train schedules. Because passengers tend to associate punctuate so strongly with quality, we focus here on quality rather than overall performance and attempt first to describe what "quality" means when describing railway traffic and how punctuality has become a part of it. The paper goes on to discuss the theory of punctuality measurement, and we present current practices in Europe and also, more specifically, in Finland. Finally, the paper presents possibilities for measuring railway traffic punctuality from the passenger's perspective and discusses how these measurements could be realized in the Finnish railway industry.

Punctuality as a part of quality

Quality of service (which includes punctuality) can be improved by better understanding the current situation and its shortcomings. The first challenge relates to the determination of the quality. Determining the elements that make up quality is the first step towards overall improvement. Cavana et al. (2007) defines quality as *a* global estimate or opinion, which describes the quality or the superiority of service. This quotation illustrates the importance of finding out how customers estimate their own opinions.

In general, quality refers to the fulfillment of a customer's needs in an efficient and viable manner. In the context of railway traffic and punctuality, this can be understood to mean that a 100 percent level of punctuality cannot be pursued without taking into account cost-

effectiveness. Quality of railway traffic can mean many things, such as a high level of service or safety. The following four important factors ensure the quality of rail operations: security, punctuality, effective capacity utilization and cost-effectiveness. Punctuality, in particular, is crucial to the quality of rail transport. (Salkonen 2008) Additionally, equipment condition and travel convenience affect the quality of the railway traffic, and these also particularly affect the customer satisfaction.

Generally, these interest groups determine the quality of rail operations. The most important interest groups in railway traffic are the customers—those with needs, requirements and expectations. In this paper we focus specifically on passengers as customers. Quality cannot be determined only by the effectiveness of the internal operation. Since the customer's perspective is a precondition for determining quality, better understanding customer satisfaction is extremely important for developing the quality of rail operations.

Coping with the rail transport market in the long term depends on the ability to monitor, strengthen, and improve the quality of services and experiences. Therefore, punctuality needs to be taken into account when planning new developments. Punctuality contributes to quality control. (Salkonen 2008)Railway traffic punctuality measurements need to be developed so that they are more able to meet the requirements of quality control.

Punctuality and combined measurements of quality and punctuality

Railway traffic punctuality is an essential part of the quality of service that passengers experience. Relatively often, quality measurements include studies of punctuality. For this reason, many studies measure quality of service holistically, rather than focusing specifically on punctuality (for example Nathanail 2008). Measurements of railway traffic quality have been taken by international railway organizations such as the UIC (International Union of Railways), CER (Community of European Railway and Infrastructure Companies) and CIT (International Rail Transport Committee).

Almost every European country or operator measures punctuality in railway traffic. These measurements have been in everyday use since the 1990s. Punctuality is often measured as part of the wider measurement of quality. Railway traffic punctuality measurements are needed for several purposes. (Skagerstad 2004) presents three main applications for information about punctuality:

1. providing information
2. control and decision-making
3. improvement and project-planning

Measuring railway traffic quality is an important and useful instrument for upper management in supervising operations. Measurements of punctuality can also be part of a larger study of quality in a system. (Nathanail 2008) Carey (1999) argues that measuring punctuality

produces important information for planning, management, traffic control, communication and the marketing of services. In turn, customers use information about railway punctuality when planning trips. Punctuality information is also used for determining the quality of service. Carey (1999) states that often the production of the punctuality information is based on regulation or is required by the law.

Several methods are used in order to measure punctuality, and from these methods heuristic and ad hoc methods are the most general. An example of a heuristic method would be determining the percentage value of trains arriving on schedule compared to a certain limit value. Simulation methods are more time-consuming, while analytic methods are suitable only for simple systems. (Carey 1999, Paavilainen, Salkonen 2010) Measurements of punctuality have been taken from perceived information, in which cases measurements can only be carried out afterwards.

Railway traffic punctuality has often been measured with an independent indicator in which predefined and accepted criteria are used to define the deviations. In this measurement, delay refers to a negative deviation from the schedule, and the common unit of measure is the minute. The measurement of punctuality is possible in all the junctions that have scheduled arriving or departure times, not only at the destination. (Olsson, Haugland 2004)

The term "reliability" has often substituted for "punctuality" in documents evaluating railway traffic and punctuality. Reliability describes the probability that the passenger can plan his or hers arrival time at the destination. Often, "punctuality" and "reliability" are used synonymously. (Hooghiemstra, Teunisse 1998) The term "reliability" is often also used to describe the current state of train traffic punctuality, and this is why the same methods are used both in measuring punctuality and in measuring reliability.

The information obtained from measuring punctuality can be used for a detailed examination of traffic throughout a journey. For example, with the help of punctuality data, it is possible to measure the quality of traffic control, identify faults and the weaknesses of the network, as well as to correct these factors that influence punctuality. Punctuality and reliability can be classified according to train type, dealt with one train at a time, or reviewed as part of larger patterns of traffic. (Salkonen 2008)

Basic information about Finnish railways

This paper assesses railway traffic punctuality measurements and their implementation on Finnish railways. However, before we proceed, a short introduction on the current railway situation in Finland is necessary.

The Finnish rail network (Figure 1.1) is about 5900 kilometers long, linking 353 operating points to each other. As Figure 1.1 shows, about 90% of the track is monorail, and about 45% is electrified. This share of the percentage of monorail track is high compared to the rest of Europe. It influences the bypassing and meeting of trains, and also poses challenges as traffic volumes increase. The track network operates a daily commuter service of 890

trains, 310 long distance trains and about 500 freight trains. The personal trains typically travel no more than 220 km/h and freight trains travel no more than 120 km/h (The Finnish Transport Agency 2010).

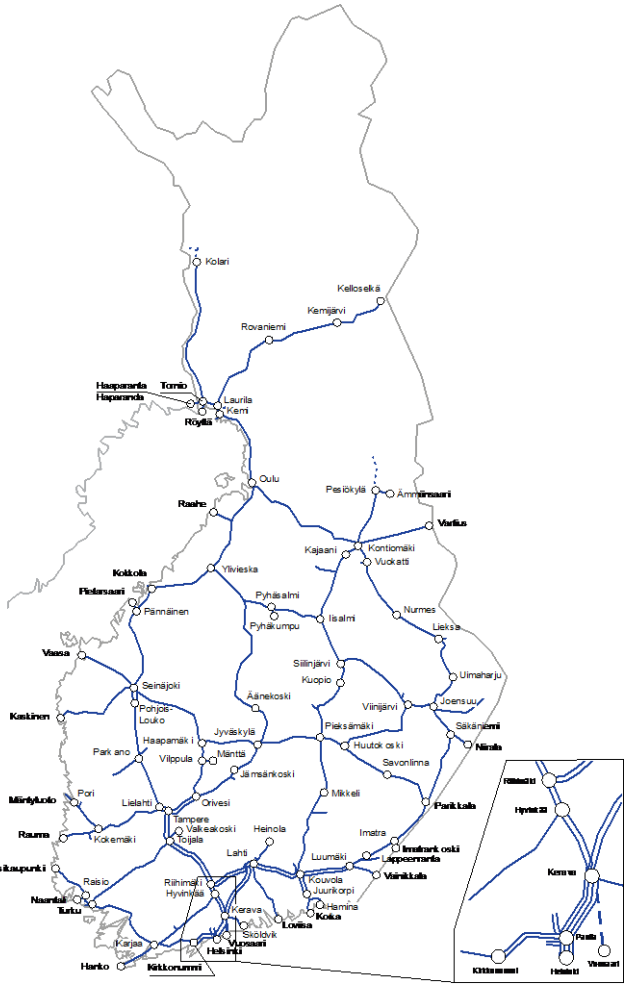

Figure 1.1 – The Finnish rail network

80% of train-kilometers accrue on long distance passenger transport, but when measured by the number of trips, 80% will be made in the Helsinki metropolitan area commuter services. The rail's share of the domestic freight market has been considered high by international standards, while the share of passenger transport by rail is roughly equivalent to the international average. (Salkonen 2008)

According to the railway operator VR-Group Ltd, the most important customer groups of long-distance rail traffic are leisure travellers, business travellers, and students. In commuter traffic, passengers are most commonly commuters as well as business and leisure travellers.

Punctuality in Finland has been relatively consistent over the past five years. Changes in the yearly level of railway punctuality have been small (less than 3%). Still there are changes in monthly levels. (The Finnish Rail Administration 2009) The Finnish Transport Agency's Rail

Department measures punctuality in collaboration with the currently only rail operator, VR-Group Ltd.

Railway punctuality has been measured and recorded ever since 1992. Since the 1990s, railway traffic has increased, but hardly any changes have been done to measure punctuality. The principles of railway punctuality measurement have stayed the same, but much has happened in society and in the passenger's experience to increase the value of time.

Today, the common target is punctuality, and the rail administrator and operator are both committed to this target. For several years, this target has been that 90% of trains arrive at the final destination on time. Delays of more than 15 minutes have also been calculated. Roughly speaking, about one third of the passenger traffic delays are caused by an infrastructure manager, one third by a railway operator, and one third by external reasons. (The Finnish Rail Administration 2009)

PREVIOUS RESEARCH

The punctuality of railway traffic has been extensively researched with a wide literature review confirming earlier knowledge that had been collected in a more pragmatic study with the literature review. The earlier pragmatic study concentrated on the measurement of punctuality in Finland. With the help of the comprehensive literature review, it became possible to survey the international research related to this topic and to deepen our understanding of the materials collected before. The purpose was to uncover how punctuality had been measured in railways and find out how the passenger's perspective had been taken into account.

Literature review

The literature research adopted a grounded theory method. With this method we obtained from the subject of railway traffic punctuality a versatile literature review as well as a bibliometric analysis. Glaser and Strauss developed the grounded theory between of 1960s and 1970s. It is a material-based theory that is especially meant for use as a method of analysis in qualitative studies. The basic principle of the method is that the material is examined and analysed without advance expectations, study questions, or hypotheses. The literature review on railway traffic punctuality was released in 2009. ((Glaser, Strauss 1967, Glaser 1978)

In this study we reviewed over 60 articles that relate to passengers and railway punctuality. We studied how punctuality can be estimated through customer satisfaction and the types of customer groups that exist when studying railway traffic punctuality. We also studied how customers experience punctuality. We found that real-time informing as well as communication about expected punctuality is often connected to the studies of customers' experiences concerning punctuality. (Salkonen, Paavilainen & Mäkelä 2009)

The literature research on rail punctuality showed us that few studies examine passengers. It shows that there is an obvious lack of research on measuring punctuality in a way that takes into account the passengers. In the literature review we found that even though there is little research on this subject, there are several studies of customers and punctuality that are connected to larger questions such as the value of time and the improvement of quality of service. (Salkonen, Paavilainen & Mäkelä 2009)

It is possible that some of the material concerning punctuality measurements from the passenger's perspective is simply not available to researchers. The subject concerns operators' inter-company performance measurements, and so documents concerning information about passenger flows may be guarded or incomplete. Olsson & Haugland (2004) have encountered this problem, and they state that different railway authorities and operators do possess material on punctuality, but the material is not publicly available.

We discovered that railway traffic research concentrates on modeling and simulations and on the point of view is on infrastructure and trains. This is true also in Finland, where the passenger's perspective is only on its arrivals. (Salkonen, Paavilainen & Mäkelä 2009)

National punctuality research and development

For a long time, the development of railway traffic punctuality in Finland has been pragmatic and focused on eliminating factors that may negatively influence punctuality. First, attempts to move forward in measuring rail punctuality were taken in 2008 when the Finnish Rail Administration commissioned two studies concerning the different ways to measure punctuality. (Salkonen 2008, Mukula 2008) This paper refers to the latter study, written by the author.

The local rail administrator has begun releasing a yearly punctuality report, which includes basic information about the reasons behind unpunctuality and also describes punctuality levels for the previous year. This is relatively new report, first published in 2009. The report focuses on the punctuality of long-distance passenger traffic and on commuter traffic in the Helsinki area, as well as on freight traffic punctuality. It emphasizes the effect of track maintenance on punctuality and also describes the effects of the entire railway sector's actions on punctuality. (The Finnish Rail Administration 2009)

The report also provides a short international comparison of railway traffic punctuality, illustrating the differences between countries in measuring punctuality and the thresholds used in these measurements. (The Finnish Rail Administration 2009)

MEASURING PUNCTUALITY

In order to better understand how punctuality is measured, we describe current practices from Finland and Europe and analyze the differences between them. We also identify the

weaknesses and strengths of these measurements (especially from the viewpoint of Finland) and represent the passenger's perspective concerning punctuality.

Measuring railway traffic punctuality

Even though international organisations have announced some guidelines for measuring the quality of railway traffic punctuality, there is still a lack of international norms concerning the subject. In Europe, the basic principles for measuring railway traffic punctuality are generally consistent, but there are still enough differences that reliable benchmarking between different countries is not possible. For example Nathanail (2008) denotes that a general weakness in Europe is the lack of goals concerning railway traffic punctuality. He argues that setting targets to improve the quality as a whole will assure that one sub-region will not improve at the expense of another.

In Finland, punctuality is measured as an absolute value. Measuring a delay in minutes is independent of performance factors such as a journey´s length. There are also relative measures of punctuality. In a relative measure, performance is taken into account. Using relative punctuality measurements is closer to the way that industry measures punctuality. Changes in the production are taken into account and the results are proportionate to production.

In measuring punctuality, the problem becomes how to determine the criteria for a "suitable performance." Some of the possible performance indicators that describe the production of railway traffic are, for example, person kilometers or ton kilometers, travel time, or the number of the stops (stations) (Nyström 2005). However, in a relative measure, which takes performance into consideration, we have to make sure that it is not possible to distort punctuality results with changes in the performance. An example of this could be that removing carriages increases punctuality—an example that reduces one of the variables.

Rietveld et al. (2001) denote that a common measure of punctuality or reliability is the probability *P* that the vehicle arrives *x* minutes late. They also present several other definitions:

1. the probability of an early departure
2. the mean difference between the expected arrival time and the scheduled arrival time
3. the mean delay of an arrival given that one arrives late
4. the mean delay of an arrival given that one arrives more than *x* minutes late
5. the standard deviation of arrival times

6. adjusted standard deviation of arrival times and various other more complex measures that represent the seriousness of unreliability

Punctuality can be understood as the punctuality of passenger traffic or as the punctuality of freight transport. It is common to view these together and monitor the punctuality of the whole railway traffic system. Olsson& Haugland as well as Hansen (Olsson, Haugland 2004, Hansen 2001) argue quite the opposite of Rietveld et al. (2001)—they argue that the most common way to measure punctuality is to calculate the percentage of trains arriving at the final station on time within the given time limits. This is also the basis of the Finnish punctuality measure.

There are also methods that can be used to calculate punctuality in advance. These methods are based on the probabilities, the expected delays, or the properties of the infrastructure. The calculation is performed with the help of mathematical diagrams. Mathematical models can be used to count the amount of the train´s delay as well as secondary delays. However, modeling the punctuality of railway traffic is difficult. For example, in a normal situation the train cannot leave the station before the scheduled departure time, even if the system would be ready for the train. (Carey 1999, Goverde 2005) In mathematical models, punctuality can be emphasized according to different factors such as the speed of the train or the expected number of passengers.

Measuring the punctuality of realized traffic compared to the schedule is actually quite simple. However, more information on punctuality is also needed. Exact indicators of punctuality as well as more proactive information are needed. In practice, calculating punctuality measurements is a fairly crude and rough process. (Carey 1999)

With the help of a simple indicator, it is possible to obtain basic, useful information about the reliability and punctuality of the schedule. This is seen as the advantage of the current punctuality indicator in Finland. It is simple, mathematically easy and describes the basic information about punctuality. However, Wu & Caves (2002) states that this kind of an indicator is suitable only for pre-examination of traffic and schedules. Additionally, indicators that produce more substantial information are needed.

Even though the punctuality of railway traffic has been measured using simple or complex indicators, we need to pay some attention to the exactness of the measurement and to factors such as the location of the measuring devices. The most basic information concerning punctuality is the train's arrival at the station. Sometimes the measuring devices are located quite far from the station, and this can distort the results. (Hansen 2001)

Those things presented before are not the only ones that can distort the punctuality results. Olsson & Haugland (2004) argue that punctuality improves when a destination station is approached. On this basis, punctuality at the destination station can be better than punctuality during the trip. Currently in Finland, we only measure punctuality at the final station. Our research shows that there is a clear weakness in the Finnish measurement of

punctuality; the delay during the trip does not affect the calculated punctuality of a train. The passenger flows are not often homogenously divided between the stations of departure and the destination and can be significantly different at some parts of the train's journey.

We have demonstrated some of the weaknesses of the Finnish method of measuring punctuality. It is clear that many punctuality indicators all over the word are defective but unfortunately, they are still in use every day. From our perspective, one of the biggest weaknesses is the lack of consideration of the passenger's perspective. In the next table (table 1.1) we present the strengths, weaknesses, opportunities and threats of the current Finnish punctuality indicator.

Table 1.1 – SWOT-analysis of the current Finnish punctuality indicator

Strengths	**Weaknesses**
• comparability • continuity of the measuring • general European way • simplicity	• does not take into account the passenger flows • manual registration of the unpunctuality factors • the calculation of punctuality percent only at the destination • representation of the size of the delay • utilisation of the information
Possibilities	**Threats**
• adding interpretation and analysis of the information • more precise investments • monitoring passenger experiences	• too much unanalyzed information • information from the factors of uncertainty/about the sources of errors

On the basis of the literature review we can say that some on the European punctuality indicators suffer from the same weaknesses as the Finnish one, but they possess the same strengths. Even though we have not found references from the literature where one would have represented the development of punctuality indicator, a criticism has been presented towards the present performance measurements. In our opinion, this also promises a slow change in the prevalent way of measuring punctuality.

Gelders et al. (Gelders et al. 2008) criticize the punctuality measurement because, among other things, they take into account the whole network, while the reasons of unpunctuality are often very local. Railway traffic punctuality measurements are considered a controversial subject.

The passenger's perspective on punctuality measurements

Measurements of punctuality as well as measurements of passengers' experiences and satisfaction lack common guidelines. It could be difficult to create international guidelines because the expectations of railway passengers vary among different countries; however, it might be possible to create guidelines for Europe. It has been found that Europeans have similar expectations concerning railway traffic. (NEA Transport Research And Training 2003)Non-European countries may not be comparable; for example, in Japan, passengers' expectations are much higher than those found in Europe.

Significant differences also exist among passengers of the same transport system in the same country. Different customer groups have different demands, and as a result, customer satisfaction forms through different criteria. Frequent users of public transit have adapted their expectations through their experiences with the quality of the service. They are not as dissatisfied with the service as those customers who travel occasionally. (Andreassen 1995)

Considering the passenger's perspective is quite a new concept for studying railways, and it is not clear how different perspectives should be taken into account. Nathanail (2008) argues that the passenger´s perspective could be taken into account by comparing the results into targets. This way passenger could receive compensation every time that these targets are not realized. An example of "compensations" Nathanail (2008) would be price reductions. Compensations could be determined through the quality of measurements, and more precisely, through measurements of customer satisfaction as indicators of quality.

Indicators that measure customer satisfaction already exist in several countries. These indicators often include measurements of performance. As an example of indicators such as these, Nathanail (2008) discusses countries like Spain, Singapore and Slovenia. Even though examples like these already exist and are in use, they have not yet been applied in Finland. It is obvious that the rail operator measures customer satisfaction at some level, but the results have not been connected to the measurement of performance.

The question remains: why has punctuality been measured? In Belgium and the Netherlands, railway companies measure punctuality only at stations, although they have already in use a modern train-tracking system that provides information about punctuality throughout the journey. This also is found to be methodologically wrong because the passengers depart before the final station. From a customer's perspective, it is worse if the train is late atthe station, where several passengers are changing to another train or another form of transport, that if the train is late at the destination, where travel chains terminate. (Gelders et al. 2008)

Nathanail (2008) describes how the quality of rail traffic is observed and controlled in Greek railways and discovers that the quality of rail transport measures will be needed before we can obtain information about the customers' perspective about quality. Nathanail (2008) invokes the basic theories of marketing, arguing that information about travelers' satisfaction and loyalty is needed to guarantee competitiveness. These can also be used to improve the

quality of service. Nathanail (2008) also states that the passenger's experience is not always the most appropriate measure of quality of service or rail punctuality.

Nathanail (2008) states that customer satisfaction is composed of experienced service and of the perception of it. On this basis, it can be concluded that one should also try to contribute to the perceived image of rail punctuality and create an active role in it. Nathanail´s (2008) article refers to customer satisfaction and the quality measurement manual: *Transportation Research Board. 1999. A handbook for measuring customer satisfaction and service quality. TCRP Report 47.*

Gelders et al. (Gelders et al. 2008) suggest that measuring the effects of performance helps managers to make the best decisions from the company´s and society´s viewpoint. Good communication about performance indicators can also serve as a marketing means, improving the company's reputation.

Andreassen (1995) denotes that customer satisfaction can be enhanced by giving passengers feedback and by taking the satisfaction into account when evaluating the service. Andreassen (1995) also state that indicators of passenger´s satisfaction produces one-sided information and in case this measure is used, it should be done through several indicators. This means that punctuality cannot be measured only by asking the satisfaction of customers and that more versatile indicator is needed.

Punctuality and its correlation with customer satisfaction have been identified in the research done by NEA (NEA Transport Research And Training 2003). They created a trans-European benchmarking, and as part of this comparative study, they presented the link between customer satisfaction and punctuality. The results found by the study of the correlation between customer satisfaction and punctuality are only preliminary, but they state that a high level of punctuality correlates with customer satisfaction, while a low level of punctuality correlates with poor customer satisfaction.

On the basis of the literature review, we can perceive that with regard to railway traffic, the measuring punctuality from the passenger´s perspective and taking customer experience into account is becoming more of a common practice. For example, Gelders et al. (2008) describe a situation in the Netherlands in which customer satisfaction and punctuality are measured at the same time.

We did not find studies measuring punctuality that also accounted for passenger flows. This information could be hard to gather, for it is mostly collected by the operators and is hardly ever published publicly at the required level of exactness.

International practices

In European comparisons, punctuality measurement methods are found to be quite similar and so we decided not to represent those in this paper. The benchmarking on current punctuality measurements is presented in more detail in the final report of NEA (NEA

Transport Research And Training 2003). Here we are interested in representing a few examples that differ from the Finnish method of measuring punctuality, especially in a way that takes its passengers into account.

The most common way to measure the punctuality of railway traffic is to use a regular quantity—time. In this way, the measurement of the punctuality is standardized; however, different countries and organizations have their own ways to measure the same matter. In Belgium and the Netherlands, railway traffic punctuality has been measured by the deviation of the timetable when trains are entering the station. In addition, railway traffic punctuality has been taken into account in several indicators of quality; in Belgium, punctuality has also been reported as a score given by passengers every third day of the year. (Gelders et al. 2008)

In Belgium, the local rail administrator does not measure punctuality from the passenger's perspective. Rather, an organization of the public transport customers (l' Association des Clients des Transports Publics, ACTP) takes annual measures of punctuality experienced by the passengers.

Several studies have noted that from the passenger's perspective, punctuality should not be measured only at the final station; however, it is not obvious where and when punctuality should be measured. In Greece, the reliability of the timetable was estimated by using degrees from 1 to 10. In order to get grade 10, the long distance train should be on time or no more that 10 minutes late from the final destination, and the regional train no more that 5 minutes late. Using this calculation, the railway operator in Greece managed to obtain excellent results. (Nathanail 2008) Unfortunately, from the passenger's perspective, this is not a useful indicator because it does not actually take into account the passengers; instead, it measures the movement of train. Still, Nathanail (2008) notes that this measurement is the most significant to passengers.

We maintain that punctuality should be measured during the whole journey and especially at the stations where many passengers leave the train. Many European railway systems already include advanced train traffic tracking systems that can produce the needed information.

Another example of punctuality measurement based on customer satisfaction comes from Sweden. In Stockholm, regional traffic punctuality is also measured according to experienced punctuality. This result is based purely on customer satisfaction. (Salkonen 2008)

In our opinion, the most interesting example of the passenger's perspective in railway traffic punctuality comes from the UK, from an independent public body called the Passenger Focus. (Passenger Focus) Passenger Focus is an independent public body set up by the government to protect the interests of Britain's rail passengers. Passenger Focus consults 50,000 passengers a year to produce the National Passenger Survey (NPS), which is a network-wide picture of passengers' satisfaction with rail travel. Passenger Focus asks

passengers about the handling of delay situations and about experienced punctuality (among others).

On the basis of this literature, we can conclude that it is not easy to define how to take into account the passenger's perspective on punctuality measurements. Some basic principles do exist: to measure passenger flows or to ask passengers about their expectations and satisfaction. Before these can become realities, a questionnaire study should be done to define passengers' needs and expectations. Exact data on passenger flows should also be made available.

RESULTS AND DISCUSSION

This article described how and why punctuality is measured according to railway traffic. It focused on the passenger's perspective and on measuring methods currently used in Finland. Passenger punctuality measurements give the railway industry new ways to approach and measure punctuality. This kind of indicator can be used to monitor overall passenger service quality as well as to measure customer satisfaction.

The literature review showed us that the passenger's perception of transit punctuality is an infrequently studied subject. The existing study concentrates mainly on customer satisfaction and on the measurement of quality at a more general level. There are only a few special indicators in use that take passengers into account, even though the literature frequently cites the need for such indicators.

Determining punctuality measurements according to the passenger's perspective requires attending to train schedules, passengers, and passenger flows. Punctuality could be calculated:

- as a percentage of the passengers arriving on time at the station
- as the sum of the delay minutes experienced by the passengers (station-specific or as a whole network)
- as passenger satisfaction concerning punctuality or on the handling of the delays

Simple indicators have their merits, but they still do not correct all the weaknesses and threats of the current method of measuring punctuality. Also, measurements of punctuality should take into account the volumes of traffic on the network; greater volumes of traffic produce greater challenges concerning traffic delays.

Customers make their voices heard through complaints or compensation requests. By monitoring the changes in customer feedback, one can evaluate the performance of passenger services. When using customer satisfaction as a tool of measurement, one must remember that different passenger groups have quite different expectations about punctuality and about overall quality of service.

An example from Greece helps illustrate the complexity involved in punctuality measurements. They estimated six criteria of performance, one of which described the

punctuality of schedules. However, the punctuality of schedules was calculated with the help of realized train traffic information, for information collected through customers' experiences was considered too uncertain. It would not have been possible to produce a general view of the present situation with the help of customer interviews because the passengers' experiences are individual, and often, their recurring density is too sparse. (Nathanail 2008)

Thus far in our literature review, we have surveyed the international field in measurements of punctuality and have perceived a notable shortcoming research about passenger perception of transit punctuality. After conducting a study concerning the needs of different actors in railway industry on the topic of punctuality, we have noticed that the information on punctuality experienced by the passengers is needed for many purposes. We have found that the discussion concerning indicators that best account for passengers has begun in Finland.

The next phase of this research is to take the study to a more concrete level and clarify how such an indicator could be implemented and how information such as the quantity of passengers will be obtained. Research must be completed alongside with the more pragmatic work. While focusing on the passenger's perspective, we still have to remember that the overall quality cannot be examined solely through an account of the passengers—current punctuality measurements are also necessary.

We believe that the passenger's perspective will be emphasized in the future and that passengers' demands have already tightened. This means that we need to continue studying this subject and use it for performance measurements. The customer's point of view has gained prominence in all fields in Finland and also in the field of railway traffic. Certainly, in this industry, a customer's perspective has to be taken into consideration to retain competitive ability. Our research seeks to provide practical advice for local rail authorities in its development work and point out to the operator that the passenger perspective should be emphasized.

CONCLUSIONS

New indicators of punctuality require setting new objectives. While earlier objectives are still useful as objectives, new types of indicators with more customer-oriented goals have to be set.

It is important to produce information about punctuality that can be used to identify the weaknesses of the operation and to improve punctuality. Customer relations management and communication of customership are areas where it is possible to utilize punctuality information in the future more so than today. To produce essential information on punctuality, we need to develop several indicators that are able to approach the same factor from multiple points of view. The passenger's perspective is only one of these.

In Finland, the present method of measuring punctuality requires development. The situation is similar in other parts of the world, and the lack of a common international basis on which to

measure punctuality requires immediate attention. It is not easy to create indicators that collect information from several information systems and several authors. We will need more time and research to solve this matter. International experiences shed some light on how to execute punctuality measurements from the passenger's perspective. They also provide us with a basis from which to open the discussion about the subject in Finland. However, we have noticed that punctuality information that has been collected from the customer's point of view would be of use outside of Finland. The challenge is not only ours—it should be shared internationally.

Finally, we should remember that as measured parameters in railway traffic, quality and punctuality have only been in use for the last 20 years or so. In the history of railways this is not a long period. We believe that in the future, punctuality indicators will surely develop in a more customer-oriented manner, but this development could take several years.

ACKNOWLEDGEMENTS

This paper is a result of a long-term research program conducted in cooperation with the authors' university and Finland's National Rail Administration, currently a part of the Finnish Transport Agency. Thanks are due to Miika Mäkitalo and Heli Mattila at the Finnish Transport Agency for supporting the research.

REFERENCES

Andreassen, T.W. 1995, "(Dis)satisfaction with public services: the case of public transportation", *Journal of Services Marketing,* vol. 9, no. 5, pp. 30-41.

Carey, M. 1999, "Ex ante heuristic measures of schedule reliability", *Transportation Research Part B: Methodological,* vol. 33, no. 7, pp. 473-494.

Cavana, R.Y., Corbett, L.M. & Lo, Y.L.(. 2007, "Developing zones of tolerance for managing passenger rail service quality", *International Journal of Quality & Reliability Management,* vol. 24, no. 1, pp. 7-31.

Gelders, D., Galetzka, M., Verckens, J.P. & Seydel, E. 2008, "Showing results? An analysis of the perceptions of internal and external stakeholders of the public performance communication by the Belgian and Dutch Railways", *Government Information Quarterly,* vol. 25, no. 2, pp. 221-238.

Glaser, B.G. 1978, *Theoretical sensitivity: advances in the methodology of grounded theory,* Sociology Press, Mill Valley.

Glaser, B.G. & Strauss, A.L. 1967, *The discovery of grounded theory: strategies for qualitative research,* Aldine, New York.

Goverde, R.M.P. 2005, *Punctuality of railway operations and timetable stability analysis*, Delft University of Technology.

Hansen, I.A. 2001, "Improving railway punctuality by automatic piloting", *2001 IEEE Intelligent Transportation Systems Proceedings*, pp. 792.

Hooghiemstra, J.S. & Teunisse, M.J.G. 1998, "Use of simulation in the planning of the Dutch railway services", *Part 2*IEEE, Piscataway, pp. 1139.

Mukula, M. 2008, *Aikataulusuunnittelu ja rautatieliikenteen täsmällisyys*, Ratahallintokeskus, Helsinki.

Nathanail, E. 2008, "Measuring the quality of service for passengers on the Hellenic railways", *Transportation Research Part A: Policy and Practice,* vol. 42, no. 1, pp. 48-66.

NEA Transport Research And Training 2003, *Bob Railway Case Benchmarking Passenger Transport in Railways*, Rijswijk, The Netherlands.

Nyström, B. 2005, *Punktlighet, Forskningsrapport*, Luleå Tekniska Universitet.

Olsson, N.O.E. & Haugland, H. 2004, "Influencing factors on train punctuality – results from some Norwegian studies", *Transport Policy,* vol. 11, no. 4, pp. 387-397.

Paavilainen, J. & Salkonen, R. 2010, *Toward in-depth analysis of train punctuality data*.

Passenger Focus . Available: http://www.passengerfocus.org.uk/ [2010, 02/03] .

Rietveld, P., Bruinsma, F.R. & Van Vuuren, D.J. 2001, "Coping with unreliability in public transport chains: A case study for Netherlands", *Transportation Research Part A: Policy and Practice,* vol. 35, no. 6, pp. 539-559.

Salkonen, R. 2008, *Rautatieliikenteen täsmällisyyden mittaamine*n, Ratahallintokeskus, Helsinki.

Salkonen, R., Paavilainen, J. & Mäkelä, T. 2009, *Rautatieliikenteen täsmällisyystutkimuksen kirjallisuuskatsau*s, Ratahallintokeskus, Helsinki.

Skagerstad Ragnhild 2004, *Kritiske prestasjonsindikatorer i jernbanedrif*t, Jernbaneverket, Oslo.

The Finnish Rail Administration 2009, *Rautatieliikenteen täsmällisyys 2008 (Railway traffic punctuality 2008*), The Finnish Rail Administration, Helsinki.

The Finnish Transport Agency 2010, *F 8/2009 Description of the rail network 1.1.201*0, The Finnish Transport Agency, Finland.

Wu, C. & Caves, R.E. 2002, "Towards the optimisation of the schedule reliability of aircraft rotations", *Journal of Air Transport Management,* vol. 8, no. 6, pp. 419-426.