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Ex-post evaluation of a light rail line introduction

Realized service of line 15 in the Helsinki region

Venla Moisio

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Author Venla Moisio

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Thesis supervisor Associate Professor Miloš Mladenović

Thesis advisor MEng Teuvo Syrjälä

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Abstract

Big collective transport project introductions happen quite rarely, but when they do, they can have remarkable impacts on urban development and travelling habits of people. There is not much information about introducing and ex-post evaluating the introductions of big collective transport projects. However, the success of the introduction phase can affect whether the goals set for the project are met, so this study aims to fill that gap in research to some extent.

The purpose of this study was to gather information through expert interviews about how big collective transport project introductions should be organized and how they could be evaluated ex-post. Experts from different collective transport organizations who had been responsible for different project introductions were interviewed in the expert interviews. Besides getting the big picture from the expert interviews, the study focused on examining more closely how the introduction of the light rail line 15 in the Helsinki region in 2023 succeeded in terms of service. The examination was based on the service promises of light rail created by Helsinki Region Transport and the realization of the service promises was studied with a customer survey.

From the expert interviews, the most significant things to consider, risks and success factors of project introductions could be identified. Three ways to conduct ex-post evaluation for introductions came up, one of which was customer survey, which was also used in the case study. The other two were internal evaluation and validation through data. Based on the customer survey results the realized service of the light rail line 15 succeeded quite well in fulfilling the service promises. The other the service promises were fulfilled well, but due to numerous disturbances that have disrupted the operations during the first winter, the punctuality and reliability of the light rail did not succeed as well as other promises. During the study it was noticed that the introduction phase still needs clarification both in terms of what things can be affected during the phase and when the phase is defined to end. The ex-post evaluation of introductions can be developed to be better suited to its purpose when these open questions are solved.

Keywords collective transport, ex-post evaluation, project introduction, light rail

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Tiivistelmä

Suuria joukkoliikennehankkeita otetaan käyttöön suhteellisen harvoin, mutta kun tällainen käyttöönotto tapahtuu, voi sillä olla merkittäviä vaikutuksia kaupunkikehitykseen ja ihmisten liikkumiseen. Suurien joukkoliikennehankkeiden käyttöönottoja ja niiden jälkiarviointia ei ole juurikaan tutkittu. Kuitenkin käyttöönottovaiheen onnistuminen voi vaikuttaa siihen saavutetaanko projektille asetettuja tavoitteita, joten tämä työ pyrkii omalta osaltaan täyttämään tuota tutkimusaukkoa.

Työn tarkoituksena oli asiantuntijahaastattelujen kautta kartuttaa tietoa siitä, miten suurten joukkoliikennehankkeiden käyttöönottoja kannattaisi järjestää ja kuinka niiden jälkiarviointia voidaan tehdä. Asiantuntijahaastatteluissa haastateltiin eri joukkoliikenneorganisaatioiden edustajia, jotka olivat olleet vastuussa eri joukkoliikenneprojektien käyttöönotoista. Haastattelujen kautta saatavan yleiskuvan lisäksi työssä keskityttiin tarkastelemaan tarkemmin Helsingin seudulla vuonna 2023 käyttöönotetun pikaraitiolinjan 15 käyttöönoton onnistumista liikennepalvelun näkökulmasta. Tarkastelu pohjautui Helsingin seudun liikenne -kuntayhtymän pikaraitioliikenteelle luomiin palvelulupauksiin, joiden toteutumista pikaraitiolinjan 15 kohdalla selvitettiin asiakaskyselyn avulla.

Haastattelujen pohjalta voitiin tunnistaa merkittävimpiä käyttöönotoissa huomioitavia asioita, riskejä ja menestystekijöitä. Kolme tapaa tehdä käyttöönottojen jälkiarviointia nousi esiin, joista yksi oli tapaustutkimuksessakin käytetty asiakaskysely. Kaksi muuta olivat sisäinen jälkiarviointi ja validointi datan kautta. Asiakaskyselyn tulosten perusteella pikaraitiolinjan 15 toteutunut palvelu onnistui hyvin pitkälti täyttämään palvelulupaukset. Muilta osin lupaukset täyttyivät hyvin, mutta ensimmäisenä talvena liikennöintiä haitanneiden lukuisten häiriöiden takia pikaraitiolinjan täsmällisyys ja luotettavuus olivat muita palvelulupauksia heikommalla tasolla. Työn aikana havaittiin, että käyttöönottovaihe kaipaa vielä selkeyttämistä sekä sen osalta, mihin asioihin siinä vaiheessa voidaan enää vaikuttaa, että milloin sen katsotaan päättyvän. Käyttöönottovaiheen jälkiarvioinnista voidaan kehittää tarkoituksenmukaisempaa, kun nämä avoimet kysymykset ratkaistaan.

Avainsanat joukkoliikenne, jälkiarviointi, projektin käyttöönotto, pikaraitioliikenne

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Preface

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Venla Moisio

1 Introduction

Collective transport systems are developed around the world to answer people's need to move and encourage them to move in a more sustainable way. The construction of new collective transport projects is justified by the objectives these projects are supposed to achieve. (Mackett & Edwards, 1998) These objectives often include attracting new customers, increasing ridership (Dent et al., 2021), travel time savings (Ingvardson & Nielsen, 2018), stimulating urban development (Olesen, 2014), and encouraging a modal shift and having positive environmental impacts (Mackett & Edwards, 1998). Whether the objectives set for the projects have been achieved can be assessed by ex-post evaluation (Meunier & Welde, 2017). If an ex-post evaluation of the realization of project objectives is done, it is usually done for the whole project (Nicolaisen & Driscoll, 2016), so the different phases of a project are not evaluated separately even though they can have different impacts on the final outcome.

Transport projects start with initiation, after which comes the planning phase. Planning is followed by the construction phase, after which the test and commissioning phase starts. After the test and commissioning phase is completed, operations can start. (Broersen, 2019) The success of the commissioning phase of a project has not been studied a lot on its own, even though it is the phase when the collective transport service is realized and thus it can have a big impact on how the objectives of the project are achieved. In this study the focus will be on the commissioning, or in other words introduction phase of a project in order to narrow the research gap. In this study the commissioning phase will be called the introduction phase, as the term commissioning is used mainly in construction and the focus of this study is on the realized service rather than on the infrastructure. As the terminology has not been established, introduction was chosen for this case.

Big collective transport project introductions do not happen very often in the Helsinki region, but when they do, they can have remarkable impacts on the travelling habits of people and the urban development. As these introductions happen quite rarely, there is quite little information about them. Without shared knowledge, it is hard to learn from others' successes and challenges and develop the system of introducing new projects. The Helsinki region faces many big project introductions in the future, so it would be useful to have a clearer image of what these introductions include and how their success can be evaluated. For Helsinki Region Transport (HSL) and other collective transport authorities to succeed better in future introductions, this thesis gathers knowledge about how collective transport project introductions have been organized and evaluated ex-post and how the system could be developed. To analyse the introduction phase further, this study includes

a case study of the introduction of the light rail line 15 in the Helsinki region. The goal of the case study is to examine whether the introduction of the light rail line 15 was successful in terms of how the service was realized.

The research questions and their subordinate questions this thesis aims to answer with qualitative and quantitative methods are:

- What should be considered when organizing the introduction of a big collective transport project?
    - What kind of information is needed beforehand about the factors impacting the introduction of a project?
    - What kind of risks should be taken into account when organizing introductions?
- How can the ex-post evaluation of a big collective transport project introduction be done?
    - What could be developed in the ex-post evaluation system?
- Does the realized service of the light rail line 15 correlate to what was planned?

To find out how to organize introductions of big collective transport projects and how ex-post evaluation of the introductions can be done, interviews with experts that have been responsible for introductions in different organizations were conducted. An ex-post evaluation for the introduction of the light rail line 15 was performed, focusing on whether the realized service correlates to what was planned. This was done by first studying the service promises that were set for the light rail and then studying to what extent the goals were reached through a customer survey. For some of the service promises operation data was used to help complement the customer survey results.

The perspective of this work is of the Helsinki Region Transport (HSL), which plans and orders the collective transport in the Helsinki area. The ex-post evaluation of the introduction of the light rail line is based on the service promises set by HSL for light rail projects, which means that the focus in this study is on the service, not on the infrastructure. Therefore, the ex-post evaluation concerns how well the planned service has been realized, not how the infrastructure project succeeded. Also, the scope is limited to examining the introduction phase only, excluding for example the evaluation of the planning and construction phases.

The thesis starts with an overview of theoretical background in chapter 2, focusing on conducting ex-post evaluation in the transport sector, objectives and impacts that collective transport projects have and service quality in collective transport. In chapter 3 background information about the case study, light rail line 15, is presented to offer an understanding of the project and its

goals. The service promises of light rail by HSL are introduced and the parts of the realized service that can be examined by analysing already available information will be presented. Research methods and materials are presented in chapter 4. Chapters 5 and 6 are dedicated to interview results and survey results. In chapter 7 there will be discussion about the findings and limitations of this study, as well as future research and development ideas to conclude the study.

2 Theoretical background

2.1 Ex-post evaluation in the transport sector

Project evaluations are done both before and after project implementation. Ex-ante evaluations, that are done before the implementation of a project, are used to help with planning and project selection. Ex-post evaluation, on the other hand, means the assessment of the value of a completed project. Included in ex-post evaluation is assessing whether the goals of the project have been met, which determines the success of the project. However, determining the success is not unambiguous, because the definition of success can vary depending on the evaluator. (Meunier & Welde, 2017) Cost-benefit analysis is a widely used assessment method both in ex-ante and ex-post evaluations. Environmental impact assessments are also quite common, but they affect decision-making less than cost-benefit analysis. (Nicolaisen & Driscoll, 2016)

In general, the emphasis in transport projects is more on the ex-ante project assessment, than on the ex-post evaluation. Before a project the impacts of the project are usually assessed thoroughly but the resources put to ex-post evaluation often do not correlate with those put to ex-ante activities. However, transport projects are very costly, so it would be beneficial to evaluate if the resources put into them were used well. That can help in the future when new projects are selected and planned. Also, ex-post evaluation can give useful information to develop better ex-ante assessment methods. (Meunier & Welde, 2017) The focus in ex-ante assessment of transport projects is usually on construction costs, travel time savings and safety, which can all be given a monetary value and thus can be used in cost-benefit analysis. There are other factors that can be considered as well, but if it is hard to assess their value economically, they have less impact on the cost-benefit analysis. (Nicolaisen & Driscoll, 2016) However, it has been researched that other than economic factors tend to have an influence on decision-making about transport projects as well, because often the chosen project is not the optimal solution based on the cost-benefit analysis. These factors, such as regional development and social accessibility are not included in ex-ante evaluations, but they still affect the decision-making process. (Meunier & Welde, 2017)

Some countries have established a system for ex-post evaluations in the transport sector, most OECD countries at least. For example, Norway, France, Australia, and the UK have schemes for ex-post evaluation of transport projects. (Nicolaisen & Driscoll, 2016) For example, in Norway the ex-post evaluation system is based on an OECD-model and it evaluates the

three levels of success defined by Samset (2003, as cited in Meunier & Welde, 2017); operational success, tactical success and strategic success. In the Norwegian ex-post evaluation system, the evaluation criteria are efficiency, effectiveness, impact, relevance, sustainability and value for money. (Meunier & Welde, 2017)

There are challenges that have restricted the use and utilization of ex-post evaluation. Even though ex-post evaluations of transport projects are done globally, there is no systematic and standardised way of doing it. That makes it hard to compare the results when the way of conducting ex-post evaluation varies. Many of the ex-post evaluation schemes are intended for road projects. Another challenge in carrying out ex-post evaluation is the lack of data. Usually transport projects involve many different stakeholders, and data collection and archiving are not systematized between the stakeholders. To enable comprehensive and comparable ex-post evaluations, data collection and archiving standardization would be needed. (Nicolaisen & Driscoll, 2016)

Measuring project success by ex-post evaluation can be limited, if all the factors that affected the building decision were not clearly stated in the ex-ante evaluation. As the ex-post evaluation of a project is done to see to what extent the assessed costs and benefits were achieved, it does not include factors that were in the background of the decision but were not assessed, such as the before-mentioned regional development and social accessibility. Thus, ex-post evaluation has limited possibilities to measure the success of the project as a whole if all the impacting factors were not included in the ex-ante evaluation in the first place. (Meunier & Welde, 2017)

2.1.1 Choosing reference points

One factor that has an influence on ex-post evaluation results not being comparable and very reliable, is the fact that the chosen reference points for before and after the project vary. There are differences on reference points used in ex-post evaluations between countries that have ex-post evaluation schemes. For example, in France when comparing cost estimates to final costs, the cost estimates that are used have been calculated early in the process. It means that the cost estimates are not that certain. There is quite a difference compared to the Norwegian style, where cost estimates are refined often during the planning process before they reach a point that will be used as a reference point for the before situation in the ex-post evaluation. Choosing a more recent reference point for the estimations improves the certainty of the estimations. (Meunier & Welde, 2017)

Nicolaisen & Driscoll (2016) also highlight the challenge with choosing reference points. According to them, in most guidelines the decision to fund a

project is determined as the reference point for the before situation. Still, the situation is not always clear as there can be multiple project assessment documents to choose from and it might not be known which is the correct one. (Nicolaisen & Driscoll, 2016) They do not however offer any recommendation about what the right point of time for evaluation would be. There are quite few recommendations for reference points presented in literature (Olsson et al., 2010). One is presented by Andersen et al. (2007), according to them the ex-post evaluation of project should not be done too early, meaning within a year after the implementation, but neither not too late, meaning more than four years after the implementation. An optimal point of time for ex-post evaluation should thus be about two years after the implementation of the project, but it varies to some extent between different projects. Within two years, the benefits of the project should have realized and it should be possible to exclude the impacts of the project from other influences. (Andersen et al., 2007) Another recommendation is presented by Flyvbjerg (2005) who argues that a year after the opening of the project would be a good reference point for the after situation, but that is mostly due to constraints with data availability (Flyvbjerg, 2005).

Reference points can be chosen by project stakeholders to fit their agenda. Olsson et al. (2010) examined four railway projects in Norway and how the success of the projects varies depending on the choice of reference points. They used performance measurement in their ex-post evaluations, comparing punctuality, frequency, travel time and number of travellers year-by-year before and after the four projects. The results showed that for the most cases, the choice of the reference points affects whether the project is seen as a success or a failure. Therefore, it should be noted that it cannot be granted that the results from ex-post evaluations represent the whole truth about the success of a project. Conducting evaluations with multiple reference points would give a more comprehensive and reliable view of the success of a project. (Olsson et al., 2010)

2.2 Collective transport project objectives and impacts

Improvements on collective transport systems are made to bring about positive impacts for cities (Mackett & Edwards, 1998). A common objective for developing and extending the collective transport system is to attract new customers and at the same time keep the existing customers using the collective transport services, in other words to increase ridership (Dent et al., 2021). Other common objectives for collective transport projects include travel time savings (Ingvardson & Nielsen, 2018), urban development, positive environmental impacts, encouraging modal shift and reducing traffic congestion (Mackett & Edwards, 1998). Objectives for light rail projects are similar as mentioned above for all collective transportation projects, but

what is especially emphasized in the case of light rail projects is their ability to improve the collective transportation network, reduce congestion and stimulate urban development (Olesen, 2014). During the recent years, the objectives for light rail projects have shifted to emphasize especially urban development and economic growth. The focus is thus not so much on improving accessible and affordable collective transportation options for everyone. Focusing on urban development and increasing land value can even have an opposite effect on the transit accessibility of low-income groups that cannot afford to live in areas where land value increases. (Olesen, 2020)

It has been criticized by some researchers that collective transport projects often do not achieve their objectives, which can have an effect on whether the projects are actually cost-effective public investments. According to Mackett & Edwards (1998), many projects do not achieve their desired impacts to the extent that was planned or forecasted. Based on their research, many projects had not been able to for example reduce congestion as was planned. However, there are projects that have achieved their objectives, for example in Miami there were reductions in congestion and air pollution after opening a metro and a light rail line. (Mackett & Edwards, 1998) More examples of project objectives and actual impacts are presented in the section 2.2.1.

The impacts of projects can be overestimated to make the projects seem more attractive in order to justify their construction (Pickrell, 1992). Edwards and Mackett (1996) have studied the decision-making process for light rail in the UK and discovered that decisions made to build light rail lines are often justified by the positive image of light rail and the objectives of relieving congestion and boosting urban development. The circumstances for decision-making in the UK were in favour of light rail, even though it might not always be the best solution for the local context. (Edwards & Mackett, 1996) The decision-making process for light rail in the U.S. has also been criticized. Pickrell (1992) presents, that none of the rail transit projects studied in the U.S. were able to achieve their forecasted ridership levels and stay in the budget. Pickrell argues that the difference between the forecasted and actual ridership cannot be explained only by inaccurate, over-, or underestimated inputs in the forecasts. These inputs include demographic factors, rail service, fares, feeder bus service and costs related to cars. Possible explanations for such inaccurate forecasts could be non-optimally structured forecasting models and unintended or intended interpretation of the outputs. It seems that decision-makers' optimistic view of the positive impacts of rail transit, in other words the optimism bias, can allow them to promote rail projects often without accurate information on the possible impacts. (Pickrell, 1992)

The results of Edwards and Mackett (1996) and Pickrell (1992) are from the 1990s and before that, when the forecast methods were probably not as good

as nowadays. According to Nicolaisen and Driscoll (2014), demand forecasts have become more accurate to some extent, but there still exist challenges. Even if the forecasting models become more sophisticated and accurate, it won't help if the optimism bias still exists. (Nicolaisen & Driscoll, 2014) Flyvbjerg, Skamris Holm and Buhl (2005) point out that political motives can explain the forecast inaccuracies for rail projects, whereas for road projects they do not play that big of a role. Besides improving the forecasting methods, increasing transparency and accountability could help demand forecasts and thus project objectives to become more accurate and achievable. (Flyvbjerg, Skamris Holm, & Buhl, 2005)

According to Ingvardson & Nielsen (2018), the impacts that collective transport projects have depend on how much the project improves the transport system, how well it fits the local context and how it can compete with car traffic. Whether the project is a bus rapid transit, light rail or heavy rail project does not play that big of a role. (Ingvardson & Nielsen, 2018) Studying the impacts of collective transport projects has its limitations, because other factors affect the travel behaviour of people besides the opening of a new line. For example, changes in policies, land-use (Lee & Miller, 2022), fares and service on other collective transport lines and system-wide trends influence travel behaviour as well. Therefore, it can be challenging to examine the impacts that an introduction of a new collective transport project has on its own. (Lee et al., 2017)

2.2.1 Examples of objectives and impacts from Los Angeles and Amsterdam

The impacts of new collective transport projects on the collective transportation system and travel behaviour have been studied in many places. For example, in Los Angeles two light rail traffic lines were opened in 2009 and 2012 with the intention of reducing emissions by investing in sustainable modes of transportation and focusing development along transit corridors. Bus services changed in the transit corridors of the new lines as well as system widely when the new light rail lines opened. For the other light rail line, the decrease in the bus service was so remarkable that as a result the net transit ridership in the area decreased during the year following the introduction of the light rail line. However, for the other light rail line, the net transit ridership in the area increased during the year following the introduction. In that area the bus service was not decreased as much. Therefore, the changes that new lines cause to the transport service as a whole have to be considered comprehensively to ensure that existing customers can continue using the service. (Lee et al., 2017)

A new metro line was opened in 2018 in Amsterdam and its opening caused significant changes in other collective transport modes since it replaced tram and bus lines and the network had to be adjusted. The aims for the new metro line were to increase capacity, shorten travel times and improve reliability and accessibility. These improvements could have an impact on for example modal shift. The opening of the metro line resulted in an increase of 4 % in ridership considering the whole collective transport network. Changes were made to bus and tram lines, which was the case also in Los Angeles (Lee et al., 2017), but in Amsterdam the impacts on ridership were not similar. The 4% increase in ridership indicates that a modal shift has happened, even though it is not known from which modes travellers have shifted to using collective transport, and there may also be induced demand that has developed due to the new line. (Brands, Dixit, & Oort, 2020)

Besides the goal associated with ridership, the new metro line in Amsterdam could also achieve its other aims. Total travel time was reduced, even though some travellers experienced an increase in their travel time, more travellers experienced a decrease. Most travellers had approximately the same travel time before and after the new metro line. The results about the number of transfers are twofold. Travellers who have used collective transport before the new metro line experienced a small increase in the number of transfers, whereas new travellers often live close to the new metro line and thus among them the number of transfers decreased. In total the number of transfers decreased. What comes to reliability, it was also slightly improved when considering the whole network. Reliability was determined by variation in travel times. The study was done quite soon after the metro line was opened, which limits its ability to fully examine the impacts, so the authors suggest conducting another analysis about a year after the opening. (Brands, Dixit, & Oort, 2020)

2.2.2 Examples of impacts on modal shift

When new collective transport projects are promoted and planned, reducing the need for a private car is often an important target. The modal shift from private cars to collective transport would help to reduce traffic congestion and have a positive environmental impact. (Ingvardson & Nielsen, 2018; Mackett & Edwards, 1998) Ingvardson & Nielsen (2018) concluded in their review article, that collective transport systems around the world, e.g., in Nantes, San Diego and Copenhagen, have resulted in a modal shift from car traffic. The article presents that both bus rapid transit and light rail transit systems can bring about a modal shift if the system is of good quality. (Ingvardson & Nielsen, 2018)

Senior (2009) studied changes in travel behaviour in Manchester as a result of opening a light rail line. In the new light rail line's corridor in Manchester there was at least as much switching to light rail from cars as buses, which indicates that the light rail line was able to cause a modal shift. However, there are differences between the former car users and former bus users on how frequently they use the new light rail line. Former bus users tend to use light rail more frequently whereas the former car users' light rail usage is less frequent. The new light rail line has had a bigger impact on modal shift on off-peak and leisure trips than on commuting trips during peak times. All in all, the results from Manchester are opposite to the traditional view that rail projects usually cause a modal shift only from buses but not cars. Even though there occurred a modal shift, it did not have a remarkable impact on congestion since the modal shift was not so significant on commuting trips. (Senior, 2009)

Wang et al. (2023) have studied how a new rail transit line in Hong Kong impacted travel behaviour, especially mode share. Rail transit ridership increased after the opening of the new line, but they studied where the growth came from and whether there were different impacts on home-based trips and all trips. Their results showed, that as rail mode share increased, the bus mode share decreased for both home-based and all trips, so the increase was mostly because of a modal shift from buses to rail. Considering all trips, the total number of trips increased. Therefore, the increase in rail mode was mostly the result of increased travel demand and modal shift from bus to rail. The new rail line did not have a remarkable impact on car use, so it did not cause a significant modal shift from private cars. However, the modal share of collective transport is already very high in Hong Kong, so it is a relatively small number of car trips that could be affected. (Wang et al., 2023) Other studies from China offer similar results. In Beijing a metro expansion had an impact on mode choice for commuting trips, but the modal shift to the metro was from walking, cycling and bus transit. Private car usage for commuting was not affected by the metro expansion. (Wu & Hong, 2017)

The relationship between collective transport ridership and car usage is not simple. Even though some car drivers would shift from driving to collective transport, it does not necessarily mean that total car usage would decrease. As congestion is relieved, it may cause new car trips to be made as there is more space on the roads. (Mackett & Edwards, 1998) Accomplishing a modal shift from cars to collective transport is thus a complex task, and introducing a new collective transport line or system has limited possibilities to have the needed impact on its own. For example in Manchester, to cause a modal shift also on commuting trips, other measures, such as restrictive policies on car use would have been needed besides opening the new light rail line (Senior, 2009).

2.3 Service quality in collective transport

2.3.1 Service quality attributes

Customer satisfaction is an important field of study since researching the topic can give valuable information about how to attract more users to collective transport services and also how to keep the current users satisfied. Customer satisfaction has been researched by determining service quality attributes. Eboli & Mazzulla (2007) use 16 service quality attributes in their study of how the attributes affect customer satisfaction with a bus service in Italy. The service quality attributes used are bus stop availability, route characteristics, frequency, reliability, bus stop furniture, overcrowding, cleanliness, cost, information, promotion, safety on board, personal security, personnel, complaints, environmental protection and bus stop maintenance. (Eboli & Mazzulla, 2007) Other researchers use similar lists of attributes with some differences in attributes and their wording. For example, Mouwen (2015) includes also travel speed and ease of boarding and alighting on the list.

According to the study of Mouwen (2015) in the Netherlands, the most important service quality attributes to collective transport users are on-time performance, travel speed and service frequency. These attributes have the most impact on overall satisfaction. Besides them, also driver's behaviour and vehicle tidiness are important in terms of overall satisfaction. Mouwen's study also emphasizes that which attributes people value the most and how satisfied they are depends on customer characteristics, past experiences, and context. For example, if a person has encountered a negative social safety experience, it affects the satisfaction with attributes that are related to safety. (Mouwen, 2015)

The overall customer satisfaction depends on how satisfied people are with the different service quality attributes and how much weight they give to the attributes (Abenoza, Cats, & Susilo, 2017). However, the way the quality attributes influence travel satisfaction is quite complex since the attributes interact with each other. Sukhov et al. (2021) studied how the service quality attributes interact with each other and affect overall travel satisfaction in a Swedish city before and after improvements were made in the city's collective transport services. The service quality attributes included in the study were reliability/functionality, information, courtesy/simplicity, comfort, and safety. The study found out that a good level of safety was necessary to reach a high overall travel satisfaction before the improvements. After the improvements were made, besides safety, also satisfaction with functionality/reliability, courtesy/simplicity and comfort were necessary for that. The study confirmed that no quality attribute can result in high overall satisfaction

alone, so the attributes interact with each other, and people need to be satisfied with multiple attributes to experience a high overall travel satisfaction. However, there are different combinations of the attributes that can result in as high overall travel satisfaction. The situation was still different before and after the improvements. Before the improvements, three combinations of attributes that result in high overall satisfaction could be indicated. After the improvements, it was discovered that all service quality attributes except information had to be satisfactory in order to experience a high overall travel satisfaction. It demonstrated that travel satisfaction is also contextual, which makes it even more complex. As changes happen in services, it affects people's expectations for the services, which in turn has an impact on satisfaction with the service. (Sukhov et al., 2021)

The quality of service can be examined from the perspective of desired quality as well as from the perspective of perceived quality. Both perspectives are important to consider in order to understand customer satisfaction. Examining desired quality gives information about what users want or expect from the collective transport services. By developing perceived quality to be as close as possible to desired quality transport authorities can increase travel satisfaction and ridership. According to the study of dell'Olio et al. (2011), the most important service quality attributes in terms of desired quality were waiting time, cleanliness, and comfort. Different categories of users have different desired quality attributes to some extent. (dell'Olio, Ibeas, & Cecin, 2011)

To summarize, the service quality attributes found from the literature (Abenoza, Cats, & Susilo, 2017; Eboli & Mazzulla, 2007; Mouwen, 2015; Sukhov et al., 2021) were:

- Punctuality and reliability
- Service frequency
- Travel speed
- Stop availability
- Route characteristics and network
- Stop furniture
- Bus stop maintenance
- General information
- Information on planned changes
- Information on unplanned changes
- Safety at stops
- Ease of boarding and alighting
- Ride comfort and seating capacity
- On-board noise
- Vehicle tidiness

- Safety on board
- Personal security
- Personnel and driver's behaviour
- Customer interface
- Environmental protection
- Ticket prices
- Ticket-selling network

2.3.2 Market segmentation

Collective transport users and non-users are not a homogeneous group of people, instead there exists differences between what people need and value. How the importance of service quality attributes varies between different types of customers has been studied quite a lot. Some studies have included only current users of collective transport, and some also potential users. Market segmentation helps to understand what different types of customers and potential customers value, and how to best answer their needs. (dell'Olio, Ibeas, & Cecin, 2011; Mouwen, 2015) Customers can be segmented based on many characteristics. Mouwen (2015) used age, travel mode, grade of urbanization in the place where the person was surveyed and whether the person had encountered a negative social safety experience as characteristics. Abenoza et al. (2017) did the segmentation based on socio-demographic factors, travel patterns and accessibility measures.

Abenoza et al. (2017) studied the service quality attributes valued by current and potential users of collective transport in Sweden and they found many differences on overall travel satisfaction and the individual service quality attributes between different groups of people. They were able to identify five different groups of travellers, which were inactive travellers, long distance commuters, urban motorist commuters, rural motorist commuters and students. The share of groups varies geographically in Sweden, so collective transport authorities in different regions can utilize the knowledge about what kind of travellers live in their area and develop their services accordingly. The results indicated for example that frequent users are more satisfied with collective transport services than people who do not use the services. The segments inactive travellers and students include the more frequent users. These segments include people who have no other possible travel mode available, and they are also more satisfied with the services than people who have other options as well. Inactive travellers have the highest overall satisfaction, whereas rural motorists have the lowest. The most important quality of service attributes in general were customer interface, operation, network, and length of trip time. However, the importance of different quality of

service attributes was quite similar between the groups, even though some differences exist. (Abenoza, Cats, & Susilo, 2017)

According to Mouwen's (2015) study, all the four characteristics that were examined affected the composition and level of satisfaction to some extent. For example, what comes to age, the elderly users of collective transport value service frequency, price, and on-time performance more than younger users. On the other hand, younger users value a good ticket-selling network more. In general, older users are more satisfied with the service, both overall and when examining on attribute-level. The elderly are especially satisfied with the price attribute, which might be explained by discount ticket prices for the elderly. The one attribute that young people are more satisfied with than the elderly is the ease of boarding and alighting. Considering mode choice, it affects how important people think on-board information on delays is. Metro users value on-board information more than bus users, but with driver's behaviour it is the opposite. What comes to overall satisfaction with the collective transport service, bus users are generally more satisfied than users of rail services. Possible explanations for that include higher expectations for rail services and contextual factors during the time of the study, which affected regional train services negatively. Even though differences were found between user groups, the differences on the composition of travel satisfaction were not that significant between different groups of users (Mouwen, 2015), a finding that Abenoza et al. (2017) also confirmed.

Also, according to Dell'Olio et al. (2011) the desired quality of a collective transport system varies with user category. They separated actual and potential users in their study, and actual users were grouped further by the frequency of bus use. They were able to find differences between how potential users and actual users value service quality attributes. For potential users journey time, waiting time and level of occupancy are important when making a choice about travel mode. Actual users value also comfort and cleanliness, which are attributes that potential users do not consider. Potential users seem to mostly care about attributes that are closely related to the journey and how long it takes. (dell'Olio, Ibeas, & Cecin, 2011)

3 Case study background

3.1 Light rail line 15

The light rail line 15 is the first light rail line in the Helsinki region. The building project was called Jokeri Light Rail, but the name of the operating line is light rail line 15. (HSL, 2023a) The light rail line 15 operates transversely in the Helsinki region, between Itäkeskus in Helsinki and Keilaniemi in Espoo. The track is about 25 kilometres long and it has 34 pairs of stops. About 16 kilometres of the line are located in Helsinki, and the remaining 9 kilometres in Espoo. (Raide-Jokeri, n.d.) A transversal light rail line appears in plans as early as in the beginning of the 1990s. However, a decision to build the light rail line was made in 2016. (FLOU, 2019) The construction started in 2019 and was estimated to be finished in summer 2024, but it was finished a year earlier, already in August 2023. The start date of operating on the light rail line 15 was 21.10.2023. (HSL, 2023b)

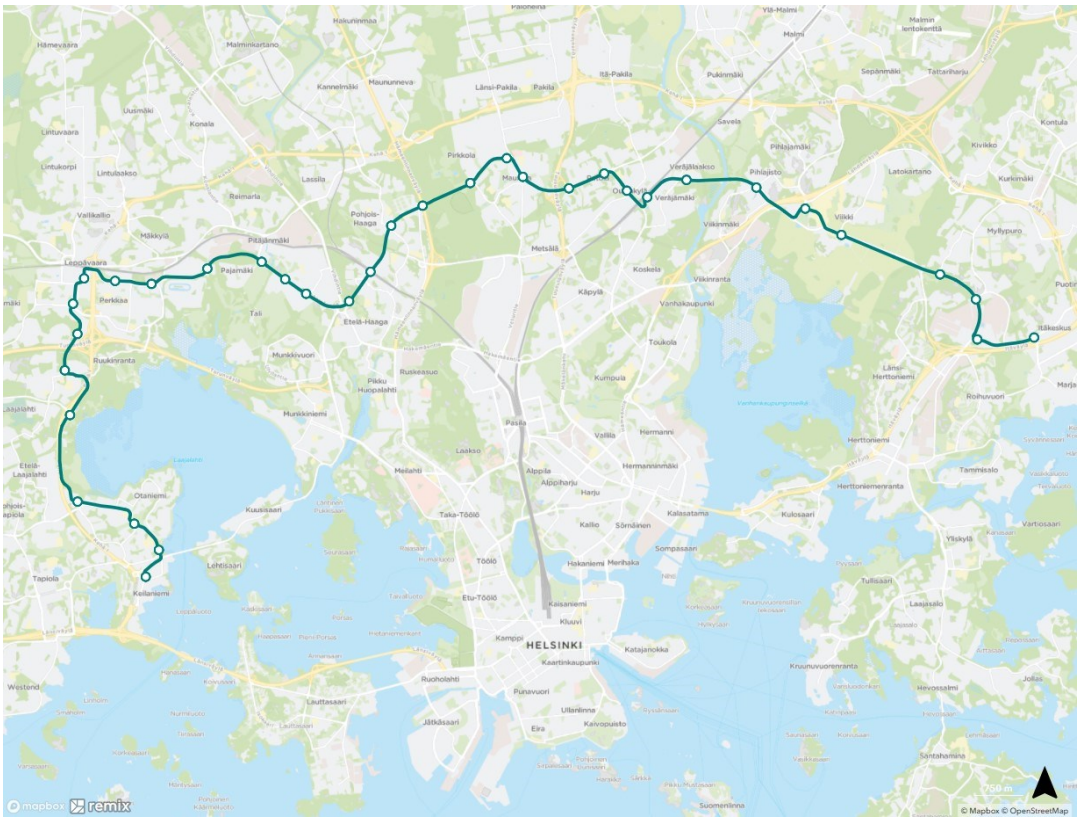

Figure 1. The light rail line 15 and its stop locations (HSL, internal database, 2023)

The light rail line 15 was designed to replace the most heavily trafficked bus line of the region, line 550 (HSL, n.d.-a). The trunk bus line 550 operated between Itäkeskus in Helsinki and Westendinasema in Espoo forming an

important transverse connection in the Helsinki region. The route of the light rail line 15 is almost the same as the bus line 550's route. In the eastern end, the light rail line follows the same route as the bus line, but in the western end there are some differences between them. The locations of the western termini are different, the light rail line's terminus is in Keilaniemi, whereas the bus line 550's terminus was in Westendinasema. The bus route passed through Tapiola on the way to Westendinasema, but the light rail line does not go there. There are some other smaller differences between the routes also around the Leppävaara area. (FLOU, 2019) The alternative of having the western terminus in Tapiola was also considered, but the routing through Otaniemi to Keilaniemi was estimated to be more feasible in terms of travel time and passenger numbers, since the areas are important and developing office and school locations (HSL, n.d.-a).

The trunk bus line 550 had a high number of passengers, which caused unpunctuality and variation in the headways. The bus line suffered from bunching, in which case the buses are unevenly loaded and their headways vary. These factors had lowered the quality of service on the bus line, since the service was unreliable and overloaded at times. (FLOU, 2019) On weekdays over 40 000 trips were made with the trunk bus line 550, and the volume was expected to increase up to about 91 000 trips on weekdays in 2030 (Raide-Jokeri, n.d.). To meet the growing demand on the line with bus traffic, buses would have had to operate with very short headways, the bus fleet would have had to be replaced with bigger buses with more capacity and the road infrastructure would also have had to be remodelled. However, operating with even shorter headways would not be an advisable solution, because shorter headways increase the risk of bunching, which was already a problem. (FLOU, 2019)

The light rail cars can carry more passengers than buses, so they have bigger capacity. It means that the light rail traffic does not need to operate with as short headways as the bus traffic would have to in order to offer the same capacity. Thus, in terms of transport, the main goals for the replacement of the bus line with the light rail line were to increase capacity and improve the reliability of traffic. Besides improving collective transport, the building of the light rail line also aimed at urban densification along the track and enabling sustainable growth. (FLOU, 2019)

Light rail traffic is a feasible solution for areas where there is no need for metro or heavy rail traffic in terms of capacity. Compared to tram traffic in the centre of Helsinki, light rail traffic has greater speed and bigger capacity. (HSL, 2017) Another light rail line is already being built to the Helsinki region, the Crown Bridges light rail. More are also planned, including the Vantaa light rail, the Vihdintie light rail, the Viikki-Malmi light rail and the

Tuusulanbulevardi light rail. Light rail traffic will be a part of the regional trunk network of rail traffic. (HSL, 2022)

3.2 Planned service

3.2.1 Service description of light rail by HSL

HSL has formed a service description of light rail traffic in 2017 to guide the planning processes of light rail projects. The service description includes a description of the service entirety of light rail traffic in the Helsinki region and the service promises and customer experience of light rail traffic. The contents of the service description are based on workshops arranged for both experts and customers. Over 100 people were involved in the workshops, where customer understanding and customer needs were gathered, and customer experience for light rail traffic was planned. A starting point for the service description and service promises was the service path of light rail traffic, which describes the different phases that form the customer's journey. (HSL, 2017)

There are four service promises of light rail in the service description, which express the value customers get from light rail traffic in exchange for their money. The differences between light rail and other modes of collective transportation are also defined in the service promises. Each of the service promises has three to four criteria describing the contents of the promise more precisely. (HSL, 2017) The service promises of light rail traffic, their criteria and the criteria descriptions are presented in figure 2.

Service promises of light rail	**Criteria of the promises**	**Criteria description**
Light rail traffic helps me get to my destination easily and fast	It feels fast to travel by light rail	The travelling speed of light rail traffic is high, 20-25 km/h. The speed is guaranteed with dedicated lanes and traffic signal priorities. The light rail car goes from one stop to another without stopping.
	Traveling by light rail does not need to be planned beforehand	Light rail traffic is frequent, and it starts early and continues past midnight every day. There are typically 10-minute headways, and during rush hour even 5-minute headways.
	The light rail stops are easily accessible	The light rail stops are located 700-900 m apart. They are easily accessible by foot from

		the neighbouring area or smoothly from intersecting lines. The stops are located close to dense urban areas and service clusters.
Light rail traffic is always reliable	Light rail traffic is punctual	The light rail traffic stays on schedule and does not get stuck in traffic. There is enough room on the stops, so that passengers can always get on and off easily and smoothly. The light rail car doesn't leave from the stops ahead of schedule.
	One can always fit onboard	One light rail car can fit over three times the number of passengers of a bus. There are plenty of spots for passengers with a stroller or a wheelchair.
	The passenger information is accurate	The passenger information on the light rail car and on the stops is up-to-date and accurate.
Light rail traffic is safe and accessible	Light rail traffic is safe to pedestrians and other traffic	The track, stops, and light rail cars are easy to notice. Places that are safe or need attention have been marked clearly.
	It is safe to use light rail traffic	It is safe to move in the stops and cars for all light rail traffic users.
	The light rail cars, stops and routes are accessible	All the doorways in the light rail car are threshold-free and there is a dedicated place for passengers with a stroller, a wheelchair, or a guide dog.
	The passenger information of light rail is accessible to all passengers	All real-time communication and information in the cars and stops are provided audiovisually.
Light rail traffic makes everyday life easier and uplifts one's mood	Light rail traffic reduces the need for using a private car	The frequent headways, long service hours and speed of the light rail traffic reduce the need for using a private car.
	Light rail cars are comfortable and in good condition	Light rail cars are quiet and their lightning, air conditioning and indoor temperature are suitable for the situation.

		The light rail cars and stops are kept in good condition, clean and tidy.
	Traveling by light rail feels pleasant	The light rail track is designed and built so that there are as few steep curves and slopes as possible. The drivers have been trained to drive in a way that feels smooth and safe.
	Traveling by light rail offers experiences	The light rail car has big windows and the scenery along the track is a part of the thought-out travel experience. There is a possibility to read, use a mobile device or otherwise enjoy oneself in the car to pass the time.

Figure 2. Service promises of light rail traffic (HSL, 2017).

The service entirety of light rail traffic has been divided into four parts, which are traffic and customer service, track, and the side of the track, stops and light rail car. These are closely connected to the service promises to customers, since they describe how the customer needs are met in the different parts of the service entirety. The contents of service entirety are very similar to the service promises and their criteria. (HSL, 2017)

In this thesis the service promises of light rail will be used as the goals of the introduction of the light rail line 15. They have clear descriptions, and their success can be measured in the ex-post evaluation. The description of the service entirety has very similar aspects, so there is no need consider them separately.

3.2.2 Project plan

The project plan for the Jokeri Light Rail is a document commissioned by the City of Helsinki, the City of Espoo, Finnish Transport Infrastructure Agency, and Helsinki Region Transport and prepared by WSP Finland Oy and Ramboll Finland Oy. The project plan was made to act as base for future plans and decisions. It includes information about the track, stops, connections, depots, and road arrangements. There are 33 stops on the line in the project plan. (WSP & Ramboll, 2015) In this study the focus is on the service, and not on the infrastructure, so only the parts of the project plan that concern the service directly will be presented here. These include driving time and headway.

In the project plan, the headway is planned to be 5-10 minutes on weekdays, and even 3-5 minutes at its most frequent traffic. Simulations were made with OpenTrack program to estimate the driving time using Transtech Artic -light rail cars. It was assumed that the light rail line has full traffic signal priorities and in intersections without traffic signalization the speed limit is 20 km/h. Stops were also given different stopping times depending on their estimated passenger numbers in the simulations. In dynamic simulations other factors, such as disturbances and differences between drivers were also taken into account. According to the dynamic simulations, the driving time of from one terminus to another would be 61 minutes. Based on the simulated driving time, the average speed of the line would be 24,6 km/h. In the project plan's key figures, it is stated that the average speed of the light rail line is 25 km/h. (WSP & Ramboll, 2015)

3.3 Coordination of the introduction

For coordinating the introduction of the light rail line 15 at HSL, a few working groups were formed. They included members from HSL as well as other stakeholder organizations. The top-level working group was the steering group, which had members from HSL, the city of Espoo, the city of Helsinki and Metropolitan Area Transport. Under the steering group operated two task forces, an external task force and an internal task force of HSL. The external task force's members were from HSL, city of Espoo, Jokeri Light Rail Alliance, and Metropolitan Area Transport. Other stakeholders also had their own internal task forces. The organization of the working groups from HSL's perspective can be seen in figure 3. (HSL, internal document, 2023a)

In the internal task force the members were from different parts of the Helsinki Region Transport organization, and they were responsible for different matters crucial to the introduction of the new line. Some of the different areas of responsibility included were for example coordination and introduction, rail traffic contracts, light rail traffic and schedules, passenger information, bus traffic, accessibility and communications (HSL, internal document, 2023a).

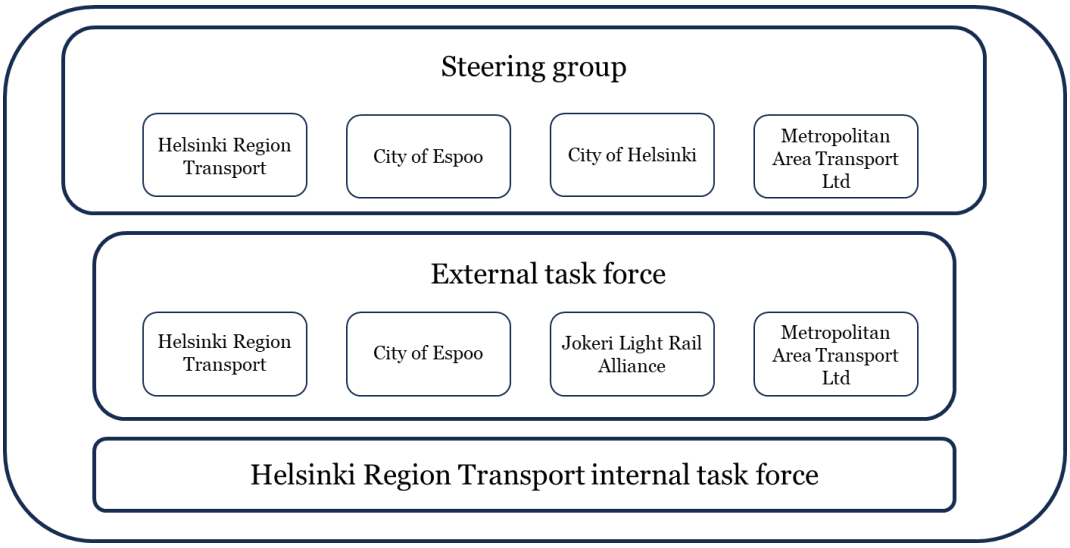

Figure 3. Organization of the working groups for the introduction of the light rail line 15 (HSL, internal document, 2023a)

When the working groups were formed, objectives for their operation were also determined. The objective for the task forces was to ensure a smooth start of operating, timeliness, up-to-date information and seamlessness between different constituent factors (HSL, internal document, 2023a).

3.4 Realized service

3.4.1 Speed

The driving time from one terminus to the other is 1 h 5 minutes (HSL, n.d.-b) and the track is about 25 kilometres long (Raide-Jokeri, n.d.), so the average speed is 23,08 km/h.

3.4.2 Service hours and headway

When the operating of the light rail line 15 started on 21.10.2023, the headway was 12 minutes. The most significant factor affecting the possible headway was the number of light rail cars. As the building project was finished about a year earlier than was planned, all the ordered cars were not yet available when the operating started. (HSL, 2023b) When new light rail cars arrive, the headway can be shortened gradually. The end goal is a 6-minute headway. (HSL, n.d.-d) The 6-minute headway is potentially to be achieved in summer 2024, when the operating was originally planned to start (HSL, 2023b).

The service hours are around 4:30-1:15 on weekdays and 5:30-1:15 on weekends (HSL, n.d.-d). It means that the first and last departures occur at those

times, so there is actually traffic until 2:30 on the line since the driving time from one terminus to the other is about 1 h 5 minutes (HSL, n.d.-b).

3.4.3 Accessibility

The light rail cars are accessible, as there are no thresholds in the cars and all the doors are accessible for example with a stroller (T. Visa, personal communication, 26.2.2024). The passenger information of light rail is quite accessible to all passengers based on the fact that there has not been very much feedback about it, so people have not had that much to complain about. The stops have audio passenger information. The only problem with the audio passenger information is at the termini, where the system is not able to tell from which platform the next departure will leave. (K. Maijala, personal communication, 8.3.2024)

3.4.4 Punctuality

During the first four months of operating the traffic on the light rail line 15 has been very punctual if there have not been any external disturbances on the tracks. Cars that have accidentally driven on the tracks have caused disturbances, but apart from those situations, the traffic has been punctual. (J. Stenmans, personal communication, 16.2.2024)

3.4.5 Passenger information

The accuracy of the passenger information is not measured at HSL. The passenger information that is shown is based on data produced by the system and it is shown as it is. The satisfaction with passenger information is measured in HSL's customer satisfaction surveys, where customers are asked about whether they receive enough information in disruption situations to facilitate their travelling and how well the signs at stops work. (J. Packalén, personal communication, 12.3.2024) In the latest customer satisfaction survey that was done in fall 2023 the light rail had the highest scores for these questions among all HSL's modes. 75 % of respondents from light rail were satisfied with the information in disruption situations and 91 % were satisfied with signs at light rail stops. (HSL, internal document, 2023b)

4 Research material and methods

4.1 Methodological framework

4.1.1 Triangulation of methods

This research has been conducted as a triangulation of two methods, expert interviews, and a customer survey. Methodological triangulation refers to combining different research methods (Flick, 1998), in this case a qualitative and a quantitative method. Expert interviews and a customer survey were chosen to give a broad view of introducing big collective transport projects and evaluating them ex-post. The combination of these two methods can offer more comprehensive results about ex-post evaluations of big collective transport introductions than one method alone. The framework of the study in figure 4 clarifies what is included in the study and how the contents are connected to each other. The green boxes represent the different phases of a project and the blue square defines the scope of the study. In this study, the focus is on the introduction phase and its impacts. In the case study, ex-post evaluation is done for the introduction phase of the light rail line 15, examining its realized service and impacts. The planning and construction phases also have an impact on the realized service and its impacts, but they are not studied here. Still, it must be kept in mind that how the service is realized does not depend on the introduction phase alone.

The pink boxes in figure 4 represent the research methods and the figure clarifies which parts of the project are studied with which methods. Operation data is however not an actual research method in this study, but it is included in the figure as some operation data is presented in the case study background and it is used in conclusions for evaluating the realization of some of the service promises. Expert interviews examine both the introduction phase and ex-post evaluation whereas the customer survey examines the realized service of the light rail line 15 and its impacts. The three main research questions are presented with yellow circles, that are connected to the parts that the questions are related to. Planned service, the blue box, refers to the service promises of light rail in this case.

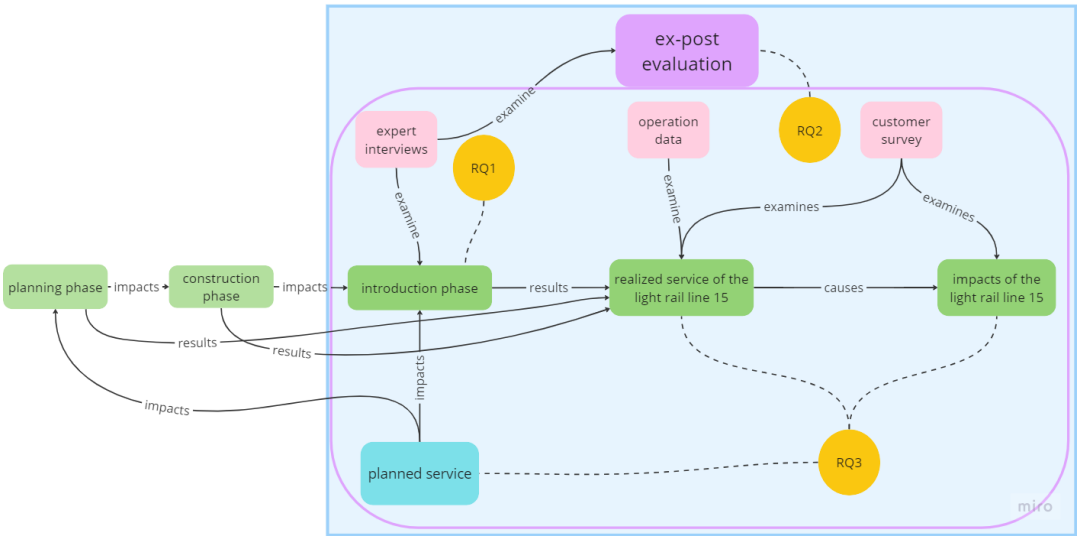

Figure 4. The framework of the study.

Through expert interviews, information could be collected about how different actors in the collective transport sector have carried out introductions of big projects and if and how they have evaluated the introductions afterwards. The best practices of ex-post evaluation of collective transport project introductions have not been researched, so the information only exist in the experts' heads as tacit knowledge or in uncoordinated documents. To form a better understanding of how introductions are carried out and evaluated ex-post, expert interviews were conducted. Based on expert interviews best practices can be written down and thus utilized better in upcoming project introductions.

The customer survey was chosen to be a part of the research to examine the case study, the ex-post evaluation of the light rail line 15 introduction. The purpose of the ex-post evaluation was to find out whether the service promises of light rail were accomplished in the introduction. Some of these goals could be studied based on available operation data (see chapter 3.4.), but data had to be collected to examine the goals concerning customer experience. Through the survey, customers could express their views and experiences of the new line. To see how HSL had succeeded to fulfil the service promises of light rail, the survey questions were based on the service promises from the service description of light rail by HSL.

The interviews and the customer survey were conducted quite simultaneously. They were prepared at the same time to support each other and to make sure that all the research questions were addressed by one or the other method. The interviews were conducted a bit before the survey, since the survey had stricter time limitations as other stakeholders were also involved in it.

4.1.2 Abductive reasoning

Abductive reasoning will be used in this research as a way of forming theory. Abductive reasoning is a process of developing new knowledge with the help of creativity or intuition. Based on the approach, creativity or intuition is needed in order to find something new. The process usually starts with observations from real life, after which a theory matching process starts. In theory matching process some suitable framework to fit the observations is searched for or theory can also be extended to fit the observations. The result of abductive reasoning process is a theory suggestion, a plausible conclusion, which may not be a logically necessary conclusion. In abductive reasoning it is important to try to identify which factors are related to a specific situation and which could be generalizable factors to all such situations. By recognising these general factors, new hypotheses and theory can be suggested. (Kovács & Spens, 2005)

4.1.3 Role of the researcher

The researcher has worked with the introduction of the light rail line 15 as a project assistant at HSL for the last seven months prior to the introduction. Therefore, some things in the thesis are based on personal experience and the perspectives have been influenced by the experiences of the researcher.

4.2 Expert interviews

Interviewing is a qualitative research method, where data is collected by having a more or less structured conversation with participants. The structure depends on the chosen interview style. (Hirsjärvi & Hurme, 2008) Semi-structured interviews have a prepared structure, but it is not mandatory for the interviewer to follow the structure precisely, which enables flexibility in the interview. It means that the interviewer has a set of questions to ask from the participants, but the order of the questions and which questions are asked might vary to some extent between participants. The interviewer can ask specifying questions depending on the interviewees' answers to make sure to get enough information from all participants. (Gillham, 2005) The questions asked in semi-structured interviews are usually open, meaning that the interviewees do not have a set of alternatives to choose from, which allows them to express their opinions freely (Hirsjärvi & Hurme, 2008).

Expert interview is one type of semi-structured interviews, where the interviewees are experts in the field of the research topic. The purpose of expert interviews is to collect, analyse and compare expert knowledge. In expert

interviews the focus is on the specific topic where the interviewees are experts in, and the interviewer is not as interested in the interviewee as a whole as might be the case in some other interview styles. (Flick, 1998) The participants must be selected carefully to ensure that their answers are useful considering the research (Saldana, Leavy, & Beretvas, 2011). In expert interviews there is usually a limited number of people who can be interviewed since the research scope clearly defines the possible interviewees who have experienced the event of interest. It causes limitations to research as the interviewees cannot be replaced. (Alastalo & Åkerman, 2010)

Since the purpose of expert interviews is to gather information about a specific topic of interest, the interviewer must make sure that the conversation stays in the topic. Therefore, it is essential for the interviewer to be familiar with the topic, so they can keep the conversation on relevant matters. An interview base with a set of questions to guide the conversation is also relevant in expert interviews for the same reason. (Flick, 1998) In expert interviews the question base is usually modified according to the interviewee, which also requires the researcher to get acquainted with the topic and the interviewees' roles in it. (Alastalo & Åkerman, 2010) The interviewer has an important role in steering the conversation towards the wanted direction if the interviewee gets sidetracked (Flick, 1998). The interviewer's familiarity with the topic also shows to the interviewees that they can go into more detail, which is more fruitful concerning the research (Alastalo & Åkerman, 2010).

The main strength of semi-structured interviews is the flexibility of the method, which can result in good quality data (Gillham, 2005). There are also limitations and challenges with semi-structured interviews. Even though the openness of semi-structured interviews offers great opportunities for interviewees to express themselves, it also requires the interviewer to be on top of the situation at all times and make decisions about the course of the interview, which can be challenging. The interviewer must make quick decisions about what to ask next and determine whether the topics have been covered sufficiently or if specifying questions are needed. It can also be difficult to balance between steering the conversation to the desired direction and being considerate towards the interviewee's way of talking. Especially in expert interviews it might be a challenge to keep the interviewee talking about relevant matters, since the research scope is usually quite narrow. (Flick, 1998) Another limitation in interviews is that the interview results do not necessarily represent the whole truth, because the results depend on the social conditions of the interview and the interpretation of the events in question from the perspective of the interview situation (Alastalo & Åkerman, 2010).

4.2.1 Focus group interviews

Focus group interviews are group interviews, where the discussion is centred around a specific topic and the participants are also carefully defined so that they have relevant experience considering the topic. (Gillham, 2005). The strength of focus group interviews is the interaction between the participants. As participants discuss together about the interview topics, they can cover things that would have not come up without the interaction. Compared to individual interviews, in focus groups it is not possible to go so deeply into one person's experiences, but on the other hand the social context of focus groups can bring new insights. (Morgan, 2019)

4.2.2 The implementation of the interviews

The interviews followed a semi-structured model. The questions were prepared to answer the research questions "What should be considered when organizing the introduction of a big collective transport project?" and "How can the ex-post evaluation of a big collective transport project introduction be done?". First part of the interviews concerned the project introductions and how they were carried out, and in the second part the focus was on ex-post evaluation of the introductions. The question base can be seen in Appendix A. The specific questions asked and their order varied between the interviews, since the interviews followed the semi-structured model. There were some minor differences in the question base between interviewees, since they represented different stakeholders in the projects. Still, the questions asked in the interviews were mostly the same.

The interviews were conducted between November 2023 and January 2024. The length of the interviews varied between 30 to 90 minutes. The variation in the length is explained by some interviews being individual and some being focus group interviews. A longer meeting was reserved for the focus group interviews than the individual ones. 7 of the interviews were held in Microsoft Teams and 2 face-to-face. One interview was held in English and the rest in Finnish, so some of the citations presented later in the results section are translations of the original interviews. All interviews were recorded with Microsoft Teams, which provided a transcript of the interviews. Since the transcripts contained some errors, they had to be gone through and corrected. Besides correcting the contents of the transcripts, they were also edited a bit. Repeated phrases and filler words were deleted to make the transcripts clearer. Detailed transcription is not necessary if the focus of the interviews is more on the content than on the interaction or the relationships between the interviewees (Ruusuvuori, 2010). Since the aim of the interviews was to collect expert knowledge, the main focus was on the content, so editing the unnecessary words did not damage the research material.

4.2.3 Interviewees

16 experts from different organizations related to collective transport projects were interviewed. These organizations included a collective transportation authority, collective transportation companies and an alliance. 7 of the interviewees were from the Helsinki Region Transport, 3 from Tampere Tramway Ltd, 3 from Metropolitan Area Transport, 2 from Aarhus Letbane and 1 from Jokeri Light Rail Alliance. Suitable interviewees were found with the help of the advisor of this thesis and suggestions were also asked from the interviewees. Interviewees often remain anonymous in research, but in expert interviews mentioning the names of the interviewees can be justified since it matters who the experts are considering the results (Platt, 1996, as cited in Alastalo & Åkerman, 2010). The interviewees were asked whether they wanted to stay anonymous or not. The list of interviewees and their roles is shown in table 1.

Table 1. Interviewees and their roles

Interviewee	**Role**	**Organisation**
Teuvo Syrjälä	Project manager	HSL
Tero Mertanen	Area manager	HSL
Lauri Räty	Area manager	HSL
Aleksi Manninen	Head of unit	HSL
Mikko Mukula	Collective transport planner	HSL
Juha Puolitaival	Collective transport planner	HSL
Markus Elfström	Collective transport planner	HSL
Mikail Kesenci	Project manager	Jokeri Light Rail Alliance
Artturi Lähdetie	Head of unit	Metropolitan Area Transport Ltd
Tero Hagberg	Head of transport production	Metropolitan Area Transport Ltd
Heidi Heikkilä	Head of fleet service	Metropolitan Area Transport Ltd
Martin Moth	Head of operations	Aarhus Letbane
Julian Barter	Manager for operations and projects	Aarhus Letbane
Antti Haukka	Head of operations	Tampere Tramway Ltd
Niina Uolamo	Head of electricity	Tampere Tramway Ltd
Markus Keisala	Project director	Tampere Tramway Ltd

The chosen interviewees had been responsible for introductions of different big collective transport projects. From the Helsinki region these projects included:

- Light rail line 15, opening 21.10.2023
- The second part of the Western Metro, opening 3.12.2022
- The reform of the tram network, opening in August 2017
- Ring Rail Line, opening 1.7.2015
- Kerava-Tuusula reform of the network, opening in 2019

In Tampere the project in question was the Tampere tramway, of which the first part opened 9.8.2021. In Aarhus the project in question was the Aarhus light rail, Aarhus Letbane, of which the first part opened 21.12.2017.

The group size of the interviews varied depending on the project in question. People who had been responsible for the same project introduction were interviewed together to avoid unnecessary overlaps in the interviews. 5 participants were interviewed individually and 4 focus group interviews were conducted. The groups had 2-3 members. In total 9 interviews were conducted.

Big collective transport introductions do not happen very often, which limits the number of possible interviewees. Also, some possible interviewees were not available for interview at the time of this study. These factors limited the sample of this study. However, it is often not possible or even desirable to interview every possible interviewee. This sample provided a good overview of the topic, and interviewing more people would have probably just confirmed the same results.

4.2.4 Coding of the interview material

The intention of analysing interview results is to organize and find patterns from the material (Saldana, Leavy, & Beretvas, 2011). It is not advisable to analyse the raw interview material immediately, it must be organized and classified first, and coding is a common method for doing that. In coding the researcher goes through the interview material from the perspective of the research questions and core themes of the research. The researcher chooses what kind of units are used in coding based on the research questions. There are many kinds of units that can be used, for example actions, ways of behaving, positive or negative attitudes or narratives. (Ruusuvuori, Nikander, & Hyvärinen, 2010) The codes are usually words or phrases that express an important part of the data. After the material has been gone through by coding, the codes can be clustered into categories. (Saldana, Leavy, & Beretvas, 2011)

When determining the codes and categories, it is useful to consider for example the research questions, theories and codes used by other researchers in

the field. Also, the research method can be used in categorizing, if the interview question base is already categorized in themes. (Hirsjärvi & Hurme, 2008) In expert interviews there usually is a question base for the interview, which has required the researcher to do some background work to compile. In that case, the analysis usually starts already when the interviews are prepared for, because the researcher is forming an idea of the topic already at that point and classifying the questions into categories. Therefore, in expert interviews the preparations help with coding and classifying the interview material. (Alastalo & Åkerman, 2010) After all the coding and classifying has been done, the material can be analysed further and theories can be developed (Hirsjärvi & Hurme, 2008).

In this research, when the interviews were transcribed, the transcripts were loaded into Atlas.ti, which was the chosen program to help with the coding. In Atlas.ti the transcripts were coded manually. The transcript material was gone through and words, sentences and paragraphs were marked with codes that matched their content. Since the interviews were conducted using mostly the interview question base, in which the questions were already categorized quite well into different themes, many codes could be formed based on them. During the first round of coding, more codes were created by going through the transcripts. There was a total of 24 codes after the first round of coding. A sentence or a paragraph was able to get more than one code.

After the first round of coding, some of the codes were overlapping and some were too broad or too narrow, so the codes were refined. Categories were formed to help with classifying the data. Some of the initial codes became categories to enable a deeper understanding of the themes. For example, during the first round of coding, all the risks were coded with “risks”, but during the second round, “risks” became a category. That way different risks could be classified and coded, such as “risks with the schedules” and “risks with the project organization”. 8 categories were formed and they all contained 2-8 codes.

A third round of coding was still needed, since there was still overlapping and some inconsistencies in the codes. The categories and codes were refined once again, and as a result there were 7 categories and in total 47 codes. The final categories were:

- Organization of introductions
- Factors to consider
- Goals for introductions
- Possible risks
- Success factors
- Conducting ex-post evaluation

- Developing ex-post evaluation

The categories and the codes included in them are presented in figure 5.

Figure 5. Categories and codes used for the analysis of the interview material.

4.3 Customer survey

Surveying is a common quantitative research method used to collect information with standardised questions (Vilkka, 2007). There are different ways for conducting surveys, for example by mail, by phone, by e-mail, in person or on the internet. Surveys collect mostly numerical data by asking closed questions, but there can also be open questions that produce written answers. Open questions can provide more insight into the respondents' opinions, but their classification and analysis is quite time-consuming (Valli, 2010).

An important factor to consider in surveying is the sample of the survey. Usually, it is not possible or feasible to study the whole population that is of interest, so the participants of the study must be chosen somehow. The sample

is a group of people from the population of interest, that have been chosen to participate in the survey. The results from the sample can be generalized to represent the whole population. To represent the population well, the sample must be chosen randomly, so that everyone in the population has the same probability to be chosen. That way the sample can be a representation of the same characteristics in the same proportion as in the whole population. The most commonly used sampling methods include simple random sampling, systematic sampling, stratified sampling, and cluster sampling. The sample can also be chosen with a non-probability method, in which case the sample is not random and thus does not provide generalizable results. (Nummenmaa, Holopainen, & Pulkkinen, 2014)

Besides the sampling method, also the sample size affects how accurately the survey results represent the whole population. If the sample size is too small, it cannot represent the characteristics of the population. When determining the sample size, it must be noted that not everyone will answer the survey, so the sample size should be big enough to produce the desired number of responses even though some participants would not answer. The reliability of the survey results is also affected by how the chosen sample answers the survey questions. If the questions are unclear, they can be misunderstood, or people can also give untruthful answers either intentionally or unintentionally. To get as good results as possible, the researcher must design the survey carefully, use a suitable sampling method and also analyse the results well. (Nummenmaa, Holopainen, & Pulkkinen, 2014) The timing of the survey is also critical to ensure the quality of the results (Vilkka, 2007).

Surveys are widely used in the collective transport sector. Surveys have been used to study for example travel satisfaction, service quality attributes (Abenoza, Cats, & Susilo, 2017), as well as the connection between the two of them and how important the individual service quality attributes are in determining the overall travel satisfaction (Sukhov et al., 2021). Also travel attitudes and behaviours have been surveyed (McCarthy et al., 2023). HSL conducts a lot of surveys, such as customer satisfaction surveys, ticket surveys, customer surveys, travel surveys and surveys about perceived safety on commuter trains (HSL, n.d.-c).

4.3.1 Implementation of the survey

The travel survey was designed and conducted in cooperation with the research department of HSL, since they also wanted to conduct a similar survey after the opening of the new light rail line. It was reasonable to combine the surveys as conducting two surveys around the same time about nearly the same topic could have affected the response rate and the quality of the

responses negatively. Webropol was used as the survey platform as that is what HSL usually uses. The target group was the users of the light rail line 15.

The survey was conducted in the end of February 2024, about four months after the opening of the line. As the survey was made in cooperation with other stakeholders, it set some limitations for the schedule. The schedule was postponed due to reasons not related to this study. Political strikes, school holidays and limited resources had an impact on when it was reasonable to conduct the survey. During 26.-28.2.2024 a total of 3200 invitations to answer the survey were handed out in the light rail. Survey assistants handed out cards that included a link to the web-based survey. The survey was open until 3.3.2024. The survey got 1 269 responses, which means that the response rate was 39,7 %.

The survey started with basic questions about the trip where the participant got an invitation to answer the survey, which was followed by questions about overall usage of the light rail line and its forerunner, the trunk bus line 550. Then there were questions about travel mode shifts and changes in the smoothness of the trip due to the new light rail line. After that the survey included statements about the service of the light rail that had to be evaluated. The survey ended with background questions about age, gender, occupation, usage of different travel modes and tickets used when travelling with HSL. All except two of the questions were closed, there were spots for writing about examples of how the light rail has affected the respondent's journeys and for general thoughts on the line. The survey focused on general image of the line, not on a specific trip, except the first questions that asked about the trip where the survey invitation was received.

The statements in the survey were based on the service promises of light rail by HSL. Some of the statements were taken straight from the service promises, some were rephrased a bit to combine two promises into one question. Most of the statements were evaluated on a scale from 0 to 5, where 0 was "I don't know", 1 was "Strongly disagree" and 5 was "Strongly agree". The statements about modal shift were also evaluated on a scale from 0 to 5, but the answer options were 0 as "I don't know", 5 as "Increased a lot", 1 as "Decreased a lot". The survey form is presented in Appendix B.

4.3.2 Analysis of the survey results

The research department delivered the survey results for analysis as an Excel file. All the 1 269 responses that were got could be used in the analysis as the survey platform does not save incomplete responses. The analysis was based on examining distributions and doing cross tabulation. Distributions express

how many of the respondents have answered a certain option in a question, so distributions show how the responses are distributed within a variable (Vehkalahti, 2008). Cross tabulation is a helpful tool in analysing how two variables are connected and whether they have an impact on each other (Heikkilä, 2008). Cross tabulation was used in the analysis of the survey results to see whether background factors such as home location and frequency of use of the light rail line have impacts on the responses. The open questions were analysed by categorizing the responses by coding them in Atlas.ti.

The results of the background questions in the survey tell something about how representative the sample is. In a representative sample the characteristics of the sample correspond to the characteristics of the population (Nummenmaa, Holopainen, & Pulkkinen, 2014). The main background variables will be presented here before analysing the results of the research questions in chapter 6.

Almost two out of three (61 %) respondents lived in Helsinki, which corresponds quite well to the fact that about two thirds of the light rail line are located in Helsinki (Raide-Jokeri, n.d.). 31 % of respondents lived in Espoo, where the rest of the line is located. 4 % lived in Vantaa and 2 % in other surrounding towns around the capital region. 2 % of respondents gave incomplete answers to the question related to home location. The distribution of the respondents' home locations is shown in figure 6.

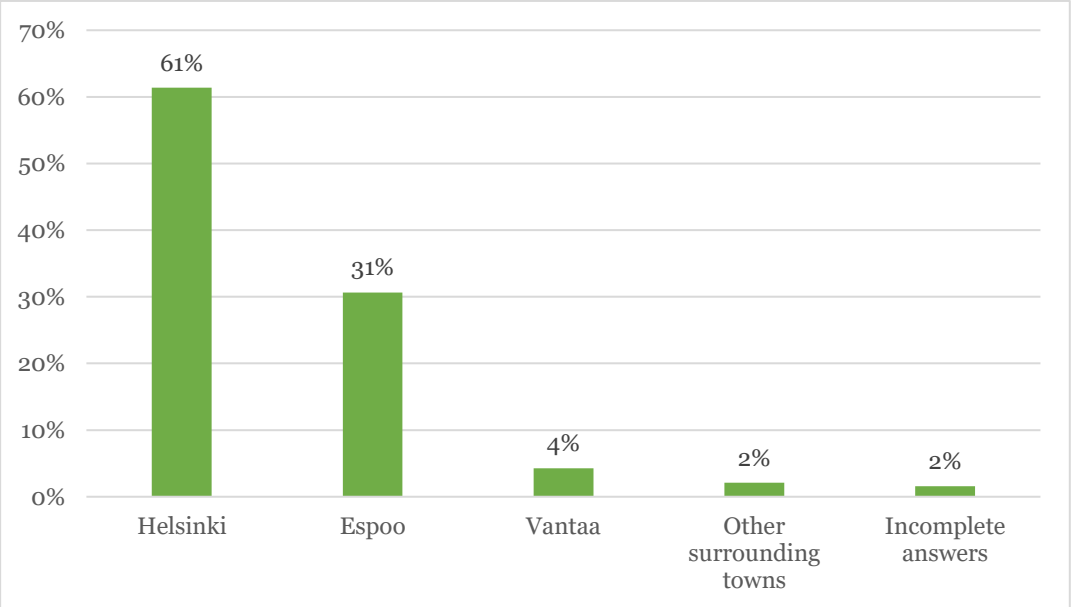

Figure 6. The distribution of respondents by home location (n=1269).

Women are somewhat overrepresented in the sample, as 54 % of respondents were female and 42 % male (figure 7). According to Aluesarjat statistical

database, the distribution by gender is quite even in the Helsinki region with a slight majority of women (Tilastokeskus, 2023), so the sample does not fully represent the population structure.

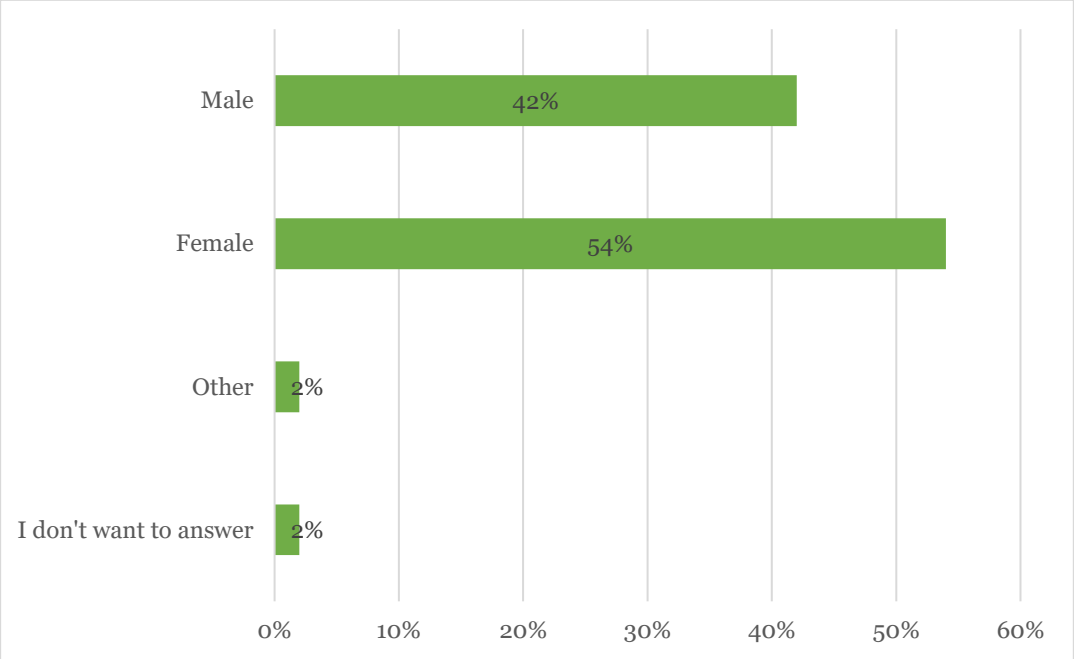

Figure 7. The distribution by gender in the sample (n=1260).

The age distribution of the respondents is shown in figure 8. The biggest age group among the respondents is 25-34-year-olds (29 %) and there was also many 18-24-year-olds (28 %) and 35-44-year-olds (20 %). Thus, the most part of the respondents were 18-44-year-olds. 7 % of respondents were under 18 years old and also the middle-aged age groups (45-54- and 55–64-year-olds) were smaller with 11 % and 9 % of respondents belonging to those groups. The smallest age group was the oldest group, over 65-year-olds (6 %). One response was excluded as the response was left blank. Compared to the age distribution in the Helsinki region (Tilastokeskus, 2023), the 18-44-year-olds are overrepresented in the sample. The proportion of 12-17-year-olds is in line with the actual age distribution of the region. Underrepresented in the sample are the oldest age groups, for example over 65-year-olds represent almost 20 % of the regions over 12-year-old population, whereas in the sample only 6 % of respondents were from this age group. 45-64-year-olds are also underrepresented but not as significantly as the over 65-year-olds. The method of the survey could have had an impact on the representativeness of the sample, as the survey was conducted as a web-based survey.

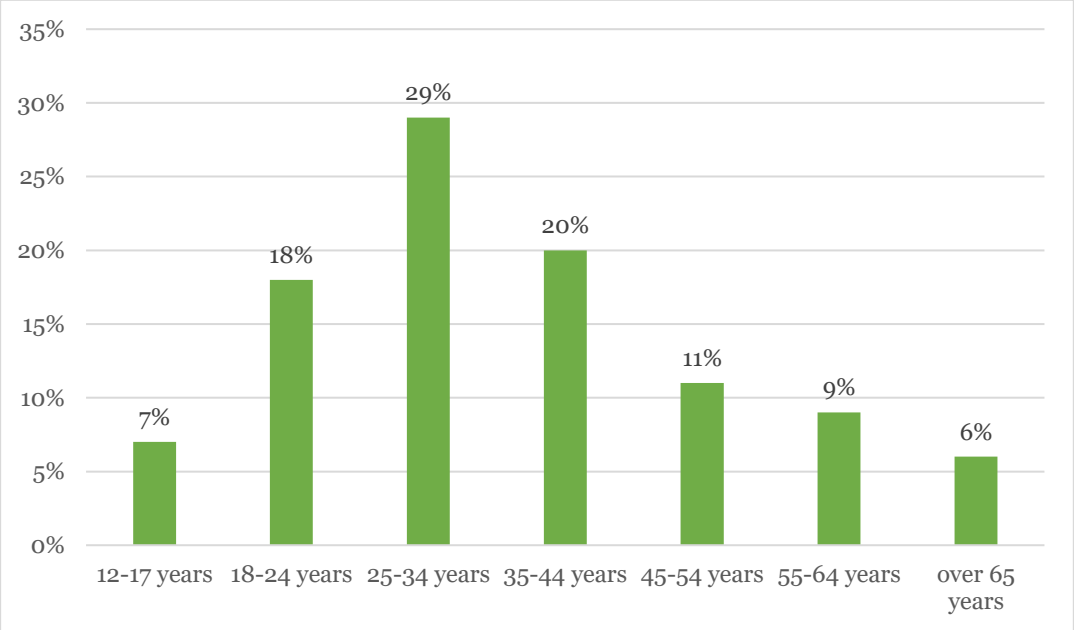

Figure 8. Age distribution of the respondents (n=1268).

As can be seen in figure 9, most part of the respondents (58 %) were employed, and the second biggest occupational group in the sample was students or schoolchildren with 29 % of the respondents. 7 % of respondents were retired and 4 % unemployed. Compared to occupational data from the Helsinki region (Tilastokeskus, 2024), employees, students and schoolchildren were overrepresented in the sample whereas retirees were underrepresented in the sample.

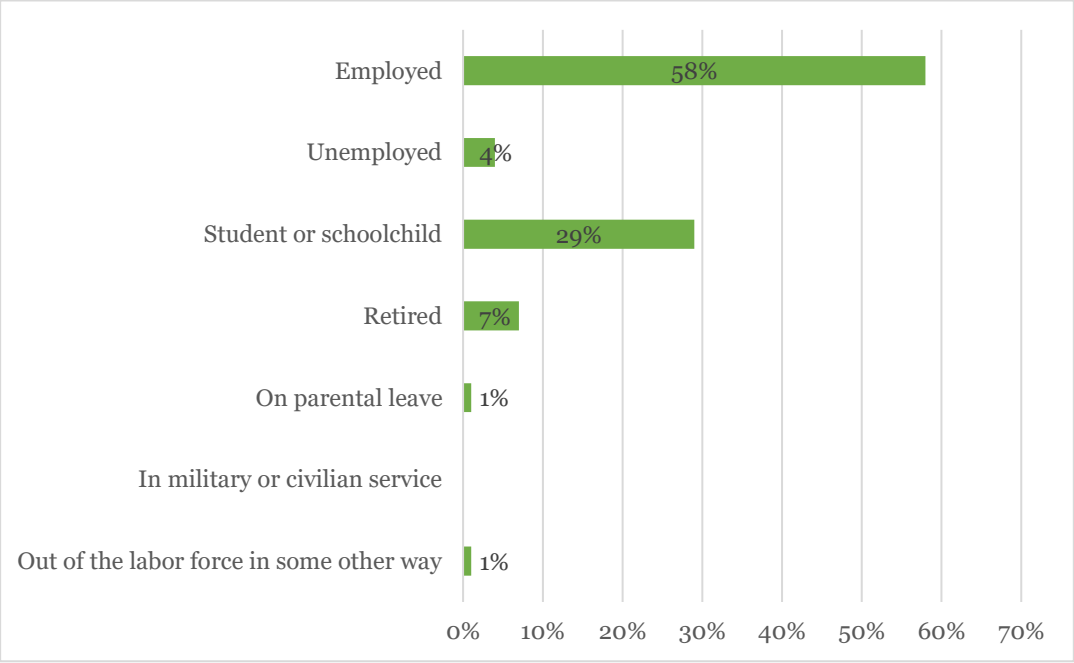

Figure 9. Distribution by occupation among the respondents (n=1269).

The respondents were quite frequent users of HSL's collective transport services, as 96 % of them used collective transport at least once a week. 61 % of respondents used collective transport daily or almost daily, 29 % several times a week and 6 % once a week. Only a small proportion of respondents were quite infrequent collective transport users, as 3 % used it 2-3 times a month and 1 % once a month or less often. Figure 10 shows the distribution by frequency of use.

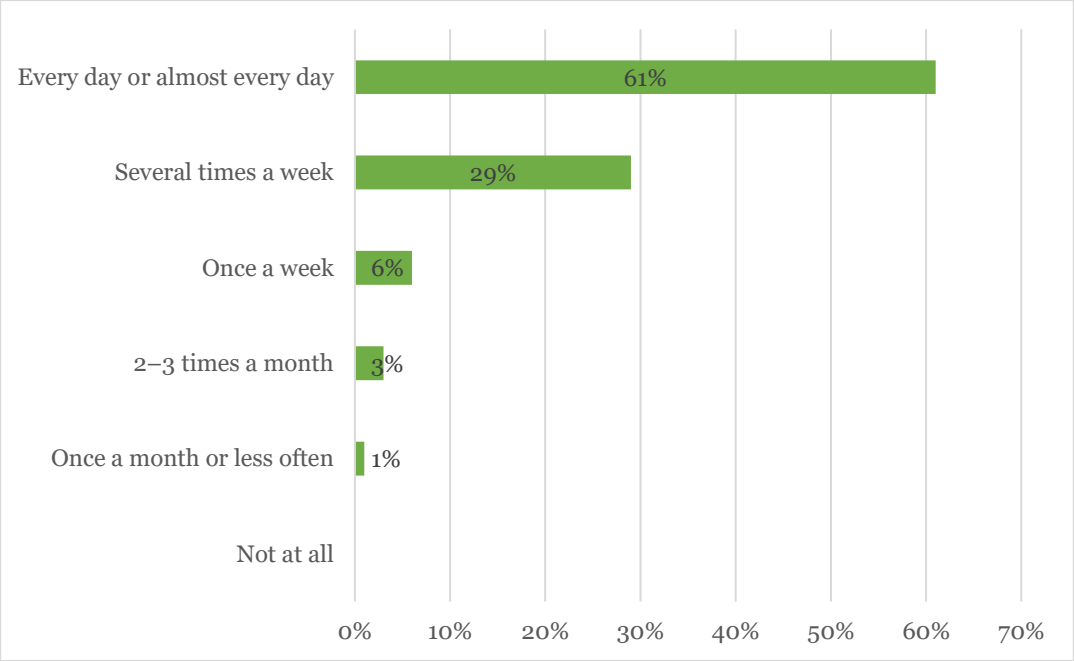

Figure 10. Distribution by how often the respondents have used collective transport in the HSL area over the past six months (n=1269).

Based on the distributions of how often respondents use the light rail line 15 and used the trunk bus line 550, it can be seen that the respondents generally use the light rail more than the preceding bus line. 38 % of respondents use the light rail every day or almost every day, whereas it was 26 % for the trunk bus line. 16 % of respondents did not use the bus line at all before the light rail started operating. The trunk bus line had more infrequent users among the respondents than the light rail, as 16 % used it once a month or less often, whereas for light rail only 6 % of respondents use it once a month or less often. Therefore, the light rail is used more frequently than the trunk bus line was among the respondents. Figures 11 and 12 illustrate the frequency of usage of the light rail line 15 and the trunk bus line 550.

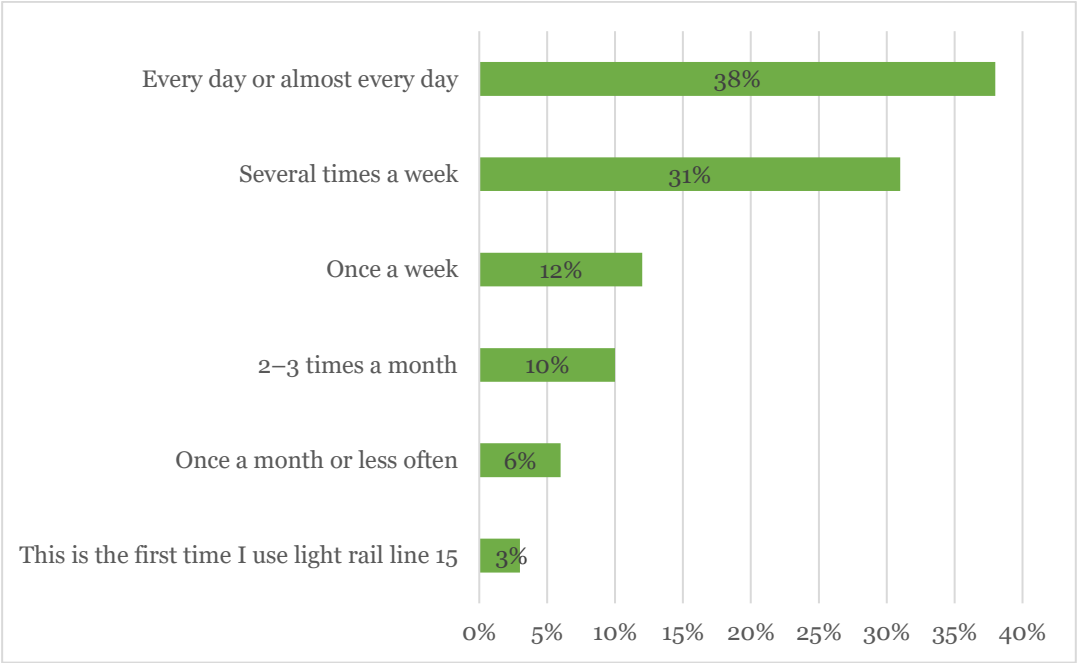

Figure 11. The distribution by how often respondents use the light rail line 15 (n=1269)

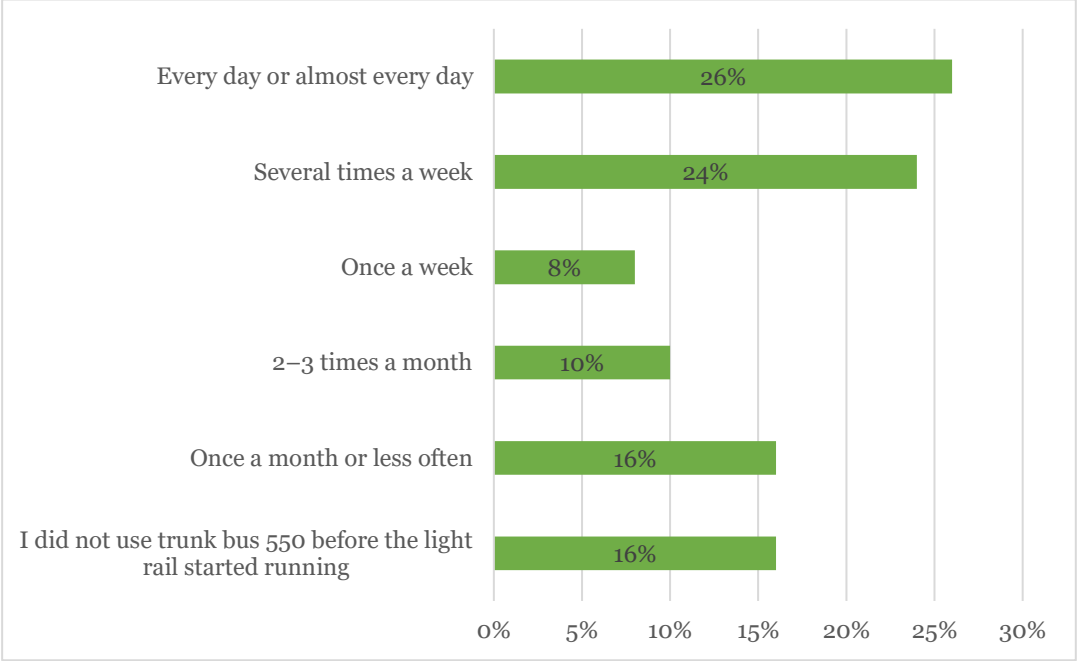

Figure 12. The distribution by how often respondents used the trunk bus line 550 before the light rail started operating (n=1269).

The respondents were also asked about which kind of a ticket they use when using HSL's services. As can be seen in figure 13, seasonal tickets were the most popular option, as 37 % of respondents used a season ticket in the HSL app and 37 % a season ticket in the HSL card. The use of seasonal tickets is

connected to the fact that most part of the respondents were frequent users of HSL's services. In total 18 % of respondents used single tickets, 5 % with the HSL card and 13 % with the HSL app. 5 % of respondents used multi-journey tickets in the HSL app. Only a small proportion of respondents (1 %) purchased single tickets from ticket machines.

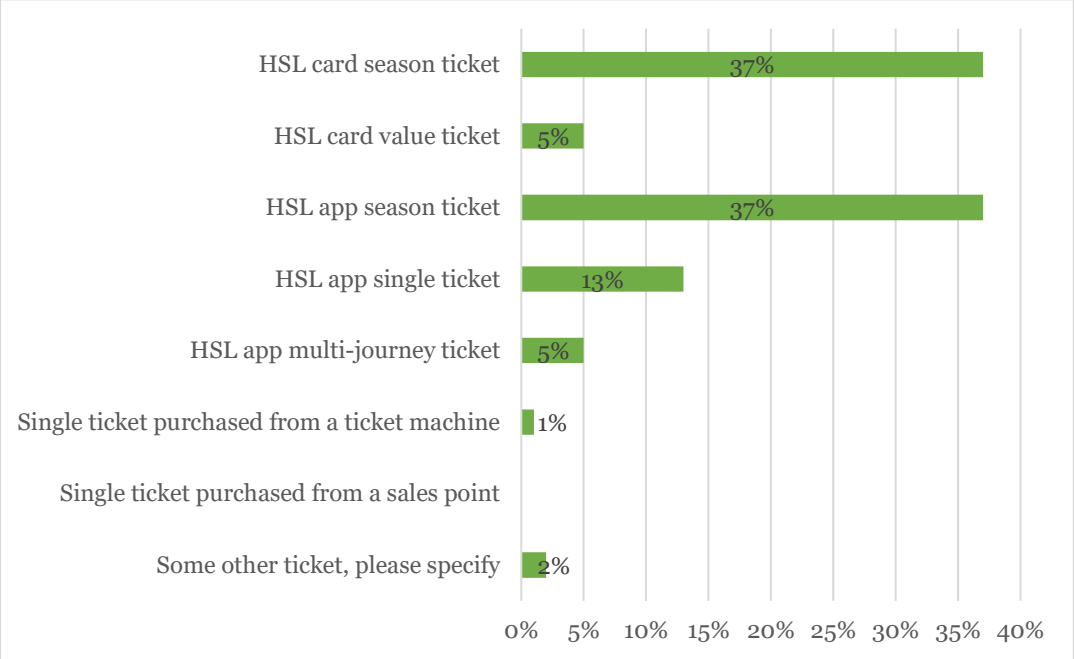

Figure 13. Distribution by ticket type used in HSL services (n=1269).

5 Interview results

This chapter aims to answer the first two research questions; “What should be considered when organizing the introduction of a big collective transport project?” and “How can the ex-post evaluation of a big collective transport project introduction be done?” and their subordinate questions with the help of the interview material. The first research question will be answered by focusing on how introductions have been organized, what factors should be considered when planning for introductions and what kind of goals have been set for them. The goal setting is also closely related to the second research question about ex-post evaluation. Additionally, concerning introductions, risks that should be taken into account in introductions will be examined as well as how to perform as successful introductions as possible. The second research question will be answered by examining the interview material concerning different ways of doing ex-post evaluation of introductions and ideas about developing the process.

5.1 Organizing introductions of big collective transport projects

5.1.1 Organization of introductions

The interviewees identified many stakeholders that are involved in project introductions. The stakeholders naturally vary between project type. The projects that were discussed in the interviews varied from big rail projects involving construction of new infrastructure to smaller scale projects concerning rerouting of bus lines. Stakeholders of collective transport projects can include a client, who has commissioned the project, a transport authority, a constructor, and an operator. Besides them, there can also be the owner of the infrastructure, traffic control, the owner of the fleet and maintenance of the fleet and infrastructure. Cities are also involved in project introductions, often in the role of a client. Depending on the project, some of these stakeholders might be under the same organisation. There are different models for carrying out these projects.

In the Helsinki region, the organization of big project introductions has developed into the current model after the challenges with the introduction of the first part of the Western Metro. The current model includes a steering group, an external task force involving all the stakeholder organizations and internal task forces inside all stakeholder organizations. The steering group includes management from the stakeholder organizations, and they supervise the whole project and make decisions. The internal task forces report to the external task force, which reports to the steering group. In the Tampere

tramway project, the way of organizing stakeholders was quite similar, they had a steering group and an external process group, but there were not as many task forces inside stakeholder organizations as in the Helsinki region's projects. In smaller scale projects there are not that many stakeholders and thus the introduction does not require as much organization of the stakeholders. In the introduction of the light rail line 15, the stakeholders were the cities of Helsinki and Espoo as clients, Jokeri Light Rail Alliance as the constructor, Metropolitan Area Transport as the operator and responsible for the maintenance of the infrastructure and fleet, Skoda Transtech as the deliverer of the fleet and HSL as the transport authority.

Based on the interviews, there is no clear and unambiguous line between the introduction phase and operation phase. Some interviewees emphasized that the introduction of the light rail line 15 is still ongoing even though the line is already operating, because the system is not yet completely finished. The operating started with longer headways than the goal was, and at the time of the interviews the goal of 6-minute headways had not yet been reached. However, the interviewees were not able to identify a clear point of time, when the commissioning phase could be defined to end.

5.1.2 Factors to consider in introductions

When organizing the introduction of a new collective transport project, information is needed about many factors that affect the introduction. As one of the interviewees stated, there is a lot of information to handle, but it is all needed.

"It is a bit hard to identify what kind of information there exactly should be, because in my opinion in the introduction there should be completely all the information."

The interviewees were however able to identify the main factors about which information is essential. The main factors were the construction of the infrastructure, recruitment and training of drivers and delivery time of the fleet. Planning the schedule of the introduction would be impossible without having information about the schedules of all these three factors that are critical for operations.

"And to have a kind of continuous follow-up, that we have an objective schedule for things and the follow-up of the realization and it concerns construction, fleet delivery, driver training and other different actions, so there's everything else; schedule planning of the traffic, schedule of implementing marketing and things like that."

Besides the main factors, recognized were also more detailed factors that are included in the main factors, such as safety systems and tendering schedules and delivery times of smaller components of the whole. Information about the desired service level and passenger forecasts is also needed. Passenger forecasts have an impact on for example how much stopping time should be reserved for different stations and whether there is a need for overlapping bus transit when opening a new rail line, but passenger forecasts still have more impact in the planning phase than the introduction phase of a project.

"We didn't take them [passenger forecasts] into account very much, it's more the case that they are taken strongly into account in the planning phase and of course here in the introduction phase when we have the situation that there is not enough fleet for the attempted 6-minute headway and then as the bus line is being run down based on contractual reasons, so we did calculate based on passenger counts and forecasts that which headway can we start with and when can we run down the bus traffic."

5.1.3 Setting goals for introductions

The goal for introductions that was mentioned the most in the interviews was to keep the schedule and start operating in time. Keeping the schedule is a common goal that steers the work of all stakeholders involved in project. It is also easy to evaluate whether the goal with the schedule is achieved. Keeping the schedule had been the main goal in most of the project introductions discussed, and for some projects it was the only goal that the interviewees recalled.

"Probably nothing besides the schedule, that we would keep the schedule."

As project stakeholders are responsible for different parts of the project, their goals for the introduction of the project vary too. The contractors usually have goals about the quality as well as the safety of the system. The contractor of the light rail line 15 also had a goal concerning the desired speed. For the operator of the light rail line 15 the primary task was to meet the needs of operating the traffic, and besides they were striving for reliability and a positive image of the light rail.

As the transport authority, HSL has had goals about the service, number of passengers and informing passengers. At HSL, the goal for project introductions is often to have "a successful introduction", which is quite a broad expression. It is not defined precisely, but it refers to the schedule and how the introduction looks like on the outside.

"Well, in a way the goal in our house often is that we get a successful introduction and that things are ready by then and operations start successfully, and that is already a lot. And then also, that residents would be informed. … But yeah, the goals often tend to be that we get things done in time and so that is looks elegant outwards."

Most of the goals that the interviewees mentioned were external as they were related to how the introduction is seen by customers, but few interviewees brought up also internal goals for the introduction, such as having good communication and ensuring flow of information and a common situation picture between the stakeholders. For some introductions, there have been no goals at all. There can also be goals for the whole project, but not for the introduction phase alone.

5.1.4 Possible risks to take into account

The interviewees identified many risks that are related to how the introduction is carried out in terms of project organization. Having inexperienced people working with introductions can cause challenges as the introductions are such complex systems involving many stakeholders and perspectives, and thus many things should be considered. Without prior knowledge and experience it can be difficult to handle the big picture.

"Maybe in all [introductions] the biggest challenge is to get such people involved who understand all the perspectives that are related to the introduction of a collective transport system, and in the end there are not that many of them in different organisations. … It is not necessarily people's fault or organisations' fault, I do not think that, but it is a challenge that is particularly related to this action, where you must be able to work in a very multisectoral way and understand the collective transport system as a whole."

Another risk related to the people who are working with the introduction concerns the motivation of employees. Motivation levels can decline, if a similar introduction has been carried out in the past and work with the introduction is not that new and fascinating anymore. Motivation is also related to contractual terms, since the contract determines the constructor's responsibilities after the construction is completed.

Considering the organization of introductions there are also risks related to how the work is organized. Too few key people can be a risk, but also it can be challenging to have too big working groups with too many responsible people. Considering bit smaller introductions, the risk of not having enough resources can be realized, if the project is not given much importance. In

bigger introductions, too many leaders or forums where things are discussed can lead to unclarity and frustration.

"I want to say about the management of the situation picture, that there were quite many of those situation picture managers. … In the end we didn't know anymore, which [meeting] is which and we always put the same material in all of them … and in Thursday's meeting, which was the third situation picture meeting that week, we got it right."

Resources can cause other risks as well. If there is a lack of resources or unwillingness to use them, the testing phase of the fleet and the training phase of the drivers can remain quite short, which can lead to inexperienced drivers and unreliability of the fleet. If the schedule is tight and the track is being fixed at the same time as drivers are supposed to be training there, it can harm the training phase of the drivers. For example, in the introduction of the Tampere tramway there was a commercial test-driving phase where they tested the system by driving occasionally and taking passengers aboard, and then fixed the tracks and fleet accordingly. That approach decreased the risks related to inexperienced drivers and unreliable fleet. Getting the operators and drivers ready for the introduction requires coordination between the stakeholders. Not familiarizing a new operator well to the system can cause challenges.

"So, the risk or challenge that is here, when there is a completely new thing and new drivers, the know-how doesn't come right away, and not necessarily at once."

"Yeah, that's something I think you should focus on, understanding the system quite early in the phase and making the rules also quite early because you need to train 100 people to use it. It doesn't help getting all the technical documents handed over the day before the opening."

Risks related to schedules came up many times in the interviews. It was pointed out that if the schedule is too slack, it is not motivating for the employees. However, there are more risks with a schedule that is too tight. Keeping the schedule is usually the main goal of introductions, and there are factors that can risk staying on schedule. Delivery time of the fleet, schedule of construction, training time of the drivers and schedule of different tendering processes were mentioned as schedule risks. Different legal proceedings can also risk staying in the schedule, as well as safety approvals.

"And another is then that do these municipalities understand, do things go into implementation for real, because some things happen slowly and they have to get done in time in the municipality. … If I'm being real there's a risk

that all these things will get buried under everything else and then some changes happen very late for example in the stops or at worst we do not get some street connection open, which has been agreed on ages ago and traffic has been tendered there."

The stakes with schedule risks are quite high. A few of the discussed projects had been delayed and the delay had remarkable impacts on the public opinion of the project. A bad impression as a result of a delayed opening or other challenges in the beginning of operations can have long-term impacts on how the project is seen.

"Then we announced the opening in September and a few hours or maybe a day before the opening, the opening was delayed, and overnight everybody shifted from being supporters to being the opposite. And we have struggled with that in my opinion since then."

"And we still hear that the metro doesn't work very well and it was a waste of money and so on, even though there's this new extension which was very well received and it was opened in time and everything went well with that. But still people think that well, it's not good because it went very wrong when the first extension was opened."

5.1.5 Performing successful introductions

The interviewees were able to identify multiple factors that successful introductions are comprised of. Close cooperation was the factor that was mentioned the most, so it is a key factor in ensuring successful introductions. Other success factors that are closely related to close cooperation are communication, situation picture, leadership, and decision-making. All of these are connected with functional working groups, where all essential stakeholders are represented, flow of information is good and decision-making is clear.

"So, what I consider to be the most important, is that we integrate all the stakeholders together and look at the big picture in order for operations to start."

Examples of stakeholders that are important to remember to involve are different parts of the city organization and end users, such as maintenance and traffic control. Inside one organization there can be multiple parties that need to be involved. HSL as the collective transport authority should also be involved early on in the planning and implementation phase representing the passenger perspective, as it is too late to affect many things in the introduction phase. As many stakeholders work together in these big project introductions, leaders and decision-making processes must be defined clearly.

"Even though we are highlighting that it was done with a small group, it was our bliss, but even though there would be more people, then the decision-making power must be given to the right people to do it. So, they have everyone's support and they make the best decisions in that moment."

Communication internally between project stakeholders as well as externally is very important in ensuring a successful introduction. The project stakeholders must communicate with each other to keep an updated situation picture, which is essential in project management in general, and more precisely also in risk management. The risks and possible scenarios related to them must be communicated openly and followed to be able to prepare for different scenarios. External communication to residents is also very important, so they are up to date and prepared for the changes.

"My experience is that if people just know and understand why something is happening, they accept it. But if it is just happening to them without them knowing it, they will complain and complain and complain."

The importance of having a common agenda and clear goals guiding the work came up in many interviews. When the stakeholders work towards the same goal, everyone can organize their work accordingly. Setting clear goals also helps when evaluating how the introduction succeeded ex-post. The main goal of collective transport project introductions is often to keep the schedule, and having a clear and common schedule was also mentioned multiple times by the interviewees as a success factor. However, there were differing opinions about when is the optimal time to announce the opening date to the public. Depending on the interviewees previous experiences, some see it as a good thing to announce the opening date early on, so that it guides everyone's work and puts a little positive pressure, whereas some think it should be announced as late as possible to avoid the negative impacts that come with failing to achieve the schedule.

"Do not announce a date for opening until you are very, very, very sure."

"Everyone must work together towards the optimal date and then just boldly announce the date and then you go with that."

It would be useful to be able to be open about the opening date, but it is challenging to develop the system as media and residents are so closely involved in it and developing the system would also require a change of perspective from them.

"Some way the thing I would've hoped for that we could've handled better is that we could've been open about the opening date with a larger group of people… if that could somehow [be developed], either by formulating things openly like with a "we are aiming for that, but it can be that it goes there" - kind of a solution, so there wouldn't be the public pressure that we have to succeed in a certain schedule or if we do not get the metro operating on a certain day, then we have failed."

The main success factors according to the interviews were close cooperation, clear schedule, communication and situation picture, clear goals and leadership and decision-making. Besides those, some success factors were mentioned a couple times in the interviews, such as keeping up the motivation of employees, having enough resources, cooperation between similar actors in different cities, learning from previous challenges, acknowledging the customer perspective, and having overlapping bus transit when introducing a new rail line.

"I have to thank the first part of the Western metro, because I feel like without the situation with it and the lessons learned, the introduction would have not been given such a big role and a lot of time. The first part of the Western metro maybe caused that the introduction must be given the needed time and it has to be planned in time."

5.2 Ex-post evaluation of introductions

5.2.1 Conducting ex-post evaluation

Based on the interviews, there is no standardized way of ex-post evaluating big collective transport project introductions and there is no clear and common conception of what ex-post evaluation can include. Some interviewees identified multiple ways of conducting ex-post evaluation, while some others came up with only one.

"It depends on who is doing, how it is done, what it has been about, so there is no standardized model at HSL, where everything would be taken into account. There are some things, like the before-after-survey, that we get something out of it and some customer satisfaction surveys or others, but there is no clear model, that would have gathered everything together and would focus on the introduction, its success, and the impacts, like how it has realized."

Three distinct ways of conducting ex-post evaluation at HSL were identified in the interviews. The three methods that stood out were customer surveys, internal evaluation, and validation through data. As stakeholders are

responsible for different parts of the introduction, their needs and ways for doing ex-post evaluation also differ. Among other interviewees internal evaluation also came up and besides that some other ways that did not fit into the three categories, such as producing different kinds of reports and documents.

HSL usually conducts quite standardized customer surveys before and after changes in the collective transport system to find out what the change has been like from the customers' perspective. The purpose of the surveys is to gather information about whether the desired change in the service was realized, so the survey questions vary a bit depending on what the change has been about. Especially, if there have been some goals for the introduction, questions related to them should be asked.

"[The surveys] should ask about customer satisfaction, but it should be about whether the customer feels like the service is similar to what was planned. Because it should be discovered already in the planning phase, what kind of needs the customers have and what is the service level that comes from the customer needs. …Because everyone of course has different expectations, but how well it works for you, whether the change … has been an improvement or a decline, should at least be asked."

Asking customers about their experiences was considered very important in ex-post evaluating project introductions, but it has its limitations. Customer surveys can give valuable insights, but the subjective impressions of customers might not tell the whole truth. Therefore, it can be useful to use other evaluation methods as well.

"It's actually very difficult to ask people questions, because they're very affected by this one trip, how it went. …You have to be careful with the questions and who you ask and how."

The second method for ex-post evaluation of introductions that HSL and also other stakeholder organizations use is internal evaluations. Internal evaluations can be about assessing whether goals set for the organization of the introduction have been accomplished or just discussing how the introduction went and what could be done differently. Internal evaluations have been done both for all project stakeholders and inside stakeholder organizations. The project manager conducted an internal ex-post evaluation also for HSL's internal task force working with the introduction of the light rail line 15. There is no standardized way for conducting the internal evaluation, but many subjects, such as project management, resourcing and scheduling are common for all projects and can be evaluated.

Some goals that have been set for introductions can be evaluated by analysing data. For example, punctuality, reliability, passenger numbers and speed can be measured and evaluated objectively. Data analysis can thus complement findings from customer surveys.

"But then I think that is very important as well, a third one, that we have the customers' subjective experience and viewpoint and feelings, then we have our own goals for the introduction and their evaluation, and then overall whether the thing works, and then there is still this validation through data, so if we notice that nobody is traveling anymore with any mode so what use is it that our customers said that this is very nice."

It is not unusual not to do any ex-post evaluation. It is not seen as that important, if the introduction has gone well, and therefore it is easy to forget about it and move on to next projects. Ex-post evaluation can also seem unnecessary, if there are no similar projects in sight. There seems to always be other projects to work on, so extra work that feels unnecessary is not very attractive.

"There was the fact that when it went well and on the other hand there was not in sight whether there would be a next project, since metro introductions are not coming anymore like that, so [ex-post evaluation] was not organized for that."

Sometimes it can be the case that there is willingness to do ex-post evaluation, but scarce resources limit the chances. After a long project, motivation levels can be quite low and as time and resources are limited, ex-post evaluation can be left undone.

"We were just happy that we finally got the project going or traffic operating. There was quite enough work with running the traffic and of course there were many new projects then replacing it."

5.2.2 Developing ex-post evaluation

Many development ideas for ex-post evaluation were brought up in the interviews. The most common development idea was to do ex-post evaluation more systematically. The evaluation process should not be too complex or heavy, but there should be some kind of a model that would help gathering all the necessary information. To make ex-post evaluation as useful as possible, it should be considered thoroughly what is wanted from it, what is the needed information and how different stakeholders should follow and document their work. How the evaluation results will be used should guide the development of the evaluation process, so the results would actually be useful

in future work. The usefulness of the evaluation results is one open question in developing ex-post evaluation, since all introductions are unique and big project introductions occur quite rarely.

"I was left wondering that ... gathering this information afterwards is always more challenging, so it's good that it's done now. But maybe the format should be thought out more systematically, so what information we want to gather. It should be recognized what is related to introduction and what we want to observe."

In order to be able to conduct ex-post evaluation better, there should also be clear goals set for the introduction, so that their achievement could be evaluated. So, developing ex-post evaluation also requires developing the introduction phase itself. To some extent, the evaluation could start already during the introduction process, as for internal evaluation more continuous evaluation throughout the whole process cloud be useful. Internal evaluation after the project could also include an opportunity for mental recovery, some kind of a meeting for offloading stress and tension. All in all, more time could be spent for the internal evaluation, but it would require a bigger change in the working culture to ensure that everyone would not have to rush to next projects immediately after one is finished. Besides time, reserving more resources for ex-post evaluation could improve the results.

One open question that remains is when the right time would be to conduct the ex-post evaluation. There is no clear definition of when the introduction phase ends and no common model for the timing of ex-post evaluation. According to some of the interviewees, it should not be done right away after the introduction, so that it is easier to see the bigger picture. Some say that there is no right or wrong time. However, some kind of a line between the introduction phase and normal operations should be defined to be able to separate ex-post evaluation of the introduction and the normal follow-up that is done for collective transport.

"It depends on the goal and how it's formulated and how its measurement has been determined. It is good to follow the situation even before the introduction, but also after the start of operations it is good to follow the outcome right away. And then of course, depending on what kind of goals there are, continuing the follow-up as long as needed related to the introduction. Then of course at some point we move to the normal follow-up of the traffic's functioning and outcome."

6 Customer survey results

In this chapter, the third research question "Does the realized service of the light rail line 15 correlate to what was planned?" will be answered based on the customer survey results. The customer survey included statements related to the service promises that the respondents were asked to evaluate and there was also space for open comments. Average scores will be presented for each statement. The survey results are divided into four subchapters based on the four main service promises.

6.1 Smoothness of travelling

Half (50 %) of the respondents strongly agreed that travelling on light rail feels fast and easy, and 38 % agreed somewhat (figure 14). The average score on this statement was 4,3, which indicates that the light rail has succeeded in providing a fast and easy service. 6 % of respondents disagree with the statement, and in the open comments of the survey, speed and trip time was the topic that was mentioned the most. The comments are twofold, some say that it does feel fast to travel by light rail, but many respondents criticize that it does not feel fast and that in fact the light rail has increased their travel time. Based on cross tabulation between the statement and respondents' age the most unsatisfied age groups are 18–24-year-olds, 25–34-year-olds and over 55-year-olds. Under 18-year-olds and 45-54-year-olds are the most satisfied. One possible explanation for the unsatisfaction of people between the ages of 18 and 34 could be that they usually have busy lives with studies, work and young children, which can limit their daily travel time budget.

How fast the trip feels depends on other factors as well besides the speed of the light rail. As stop locations have changed, the total trip time has changed for many people when the closest stops are closer or further away than before. In some places transfer distances between light rail and bus are longer than they used to be with the trunk bus line. Due to the longer headway, waiting times at transfers have also become longer for some people. These factors can have an impact on how people feel about the speed and smoothness of their trips, which will be examined next.

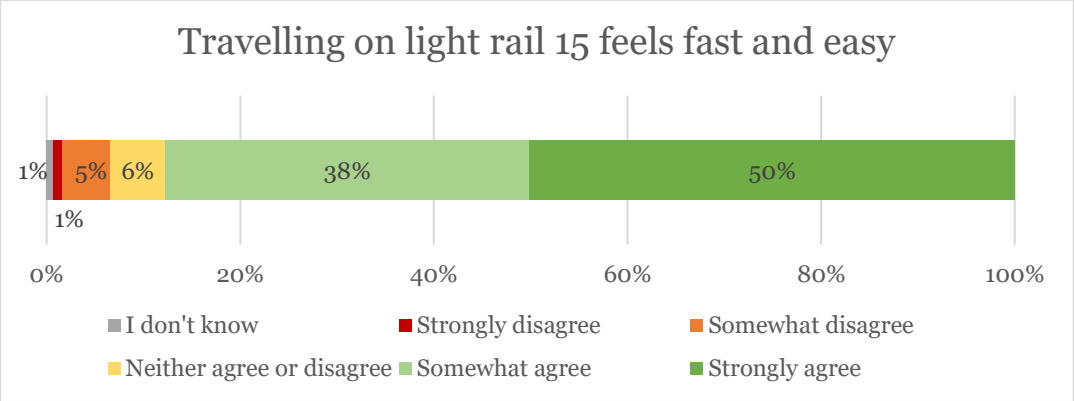

Figure 14. The respondents' experience on how fast and easy it is to travel by light rail line 15 (n=1269).

The service promise "Traveling by light rail doesn't need to be planned beforehand" was not directly asked in the survey, instead different parts of the survey answer it. Besides the questions about how fast and easy it feels to travel by light rail and how the light rail has affected the smoothness of journeys, also the open comments about headway, schedule and smoothness tell a lot about the realization of the service promise. As can be seen in figure 15, the smoothness of journeys has improved because of the light rail. 34 % of respondents consider that it has improved considerably and 39 % that it has improved a little. In total 13 % of respondents feel like the smoothness of journeys has decreased due to the light rail line. The average score on this statement was 2,1, on a scale from 1 to 6, where 1 was "Improved considerably", 5 was "Decreased considerably" and 6 was "I don't know".

Based on cross tabulation comparing the home locations of respondents with their experience on the smoothness of journeys, it can be noticed that the negative experiences with the smoothness of journeys are somewhat centred in certain areas. For example, in Northern Leppävaara 36 % of respondents (n=28), in Reimarla 47 % of respondents (n=19) and in Lintuvaara 60 % of respondents (n=15) considered that the smoothness of their journeys had decreased a little or considerably. Other areas that stood out as having a negative experience on the smoothness included for example Koskela, Puotinharju and Northern Tapiola. In many of these areas, the closest light rail stop is further away than the closest trunk bus line stop used to be, which has affected the smoothness of journeys negatively.

The open comments support the results from the cross tabulation. Headway, stop locations and schedules can affect the experience on smoothness. Many respondents commented that the headway is too long compared to what they were used to with the trunk bus line 550. The longer headway makes transfers also longer if the schedules do not match well with other modes. Respondents

commented that as the headway shortens, travelling won't be needed to be planned beforehand but at the time of the survey it requires some planning.

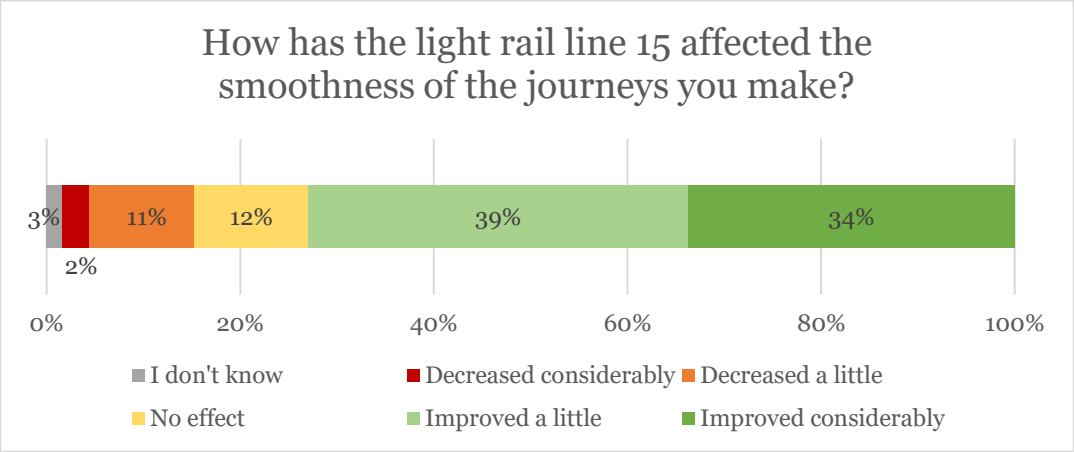

Figure 15. The respondents' experience on the effect the light rail had on smoothness of journeys (n=1269).

The service promise of "The light rail stops are easily accessible" was not asked directly in the survey either, but the open comments provided some insights of people's experiences. In the open comments there was quite a lot of feedback on stop locations that had changed. For some the change was positive, but for many the stops have moved further away making the light rail not accessible by foot. Especially areas around Northern Leppävaara came up often in the responses, which corresponds to the results of the cross tabulation between home locations and smoothness of journeys. Many comments praised the light rail for having stops in central places close to services, but on the other hand transfers to bus stops seem to have worsened in many places.

6.2 Reliability of travelling

Of all the statements in the survey, the statement about punctuality and reliability of the light rail line 15 got the lowest score, as the average score of the statement was 3,8. 29 % of respondents agreed strongly that the light rail line 15 offers a punctual and reliable service and 42 % agreed somewhat. Quite a big portion of respondents, 18 %, answered that they do not agree with the statement (figure 16). Cross tabulation between the experienced punctuality and reliability and frequency of use of the light rail showed that there are differences between different user groups. The more a respondent used the light rail, the more unsatisfied they were with its punctuality and reliability. Of the respondents that used the light rail daily or almost daily (n=482) 6 % disagreed strongly with the statement and 16 % disagreed somewhat. The proportion of disagreeing respondents was smaller in user groups that used

the light rail less frequently. 23 % of respondents that used the light rail daily or almost daily agreed strongly with the statement, whereas the corresponding proportion of users that used the light rail once a week was 36 %. Frequent users have probably faced more disturbances which has affected their experience of punctuality and reliability.

Punctuality and reliability were also mentioned in many of the open comments. Many comments brought up that when the light rail operates normally, it stays in schedule and is reliable, but several disruptions have weakened its punctuality and reliability during the first winter. During the first winter of operations there have been many disruptions and cancellations caused by cars stuck in the light rail tracks, weather conditions and technical problems. Political strikes have also stopped the traffic for several days. Many respondents have been unhappy with how unpunctual and unreliable the light rail has been and hope solutions will be found before next winter. In disruption situations it has been hard to find replacing connections in many places and many respondents wish that the bus line would still operate besides the light rail.

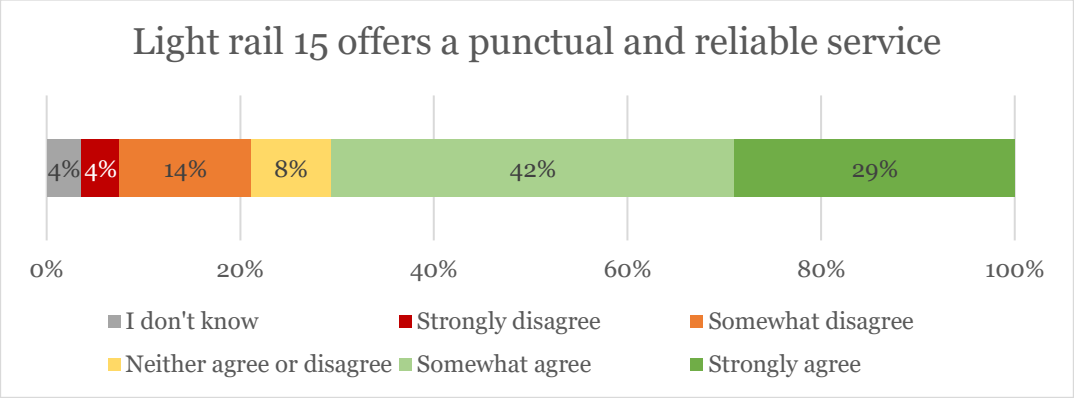

Figure 16. The respondents' experience on how punctual and reliable the service of the light rail 15 is (n=1269).

There seems to be room on board the light rail quite well, as figure 17 shows. 48 % of respondents strongly agreed that there is always room on board, and 34 % agreed somewhat. In total 9 % disagreed with the statement. The average score for the statement was 4,3. In the open comments some respondents complained about the light rail being too congested during rush hours with 10-minute-headways. As the headway shortens, that problem should be fixed.

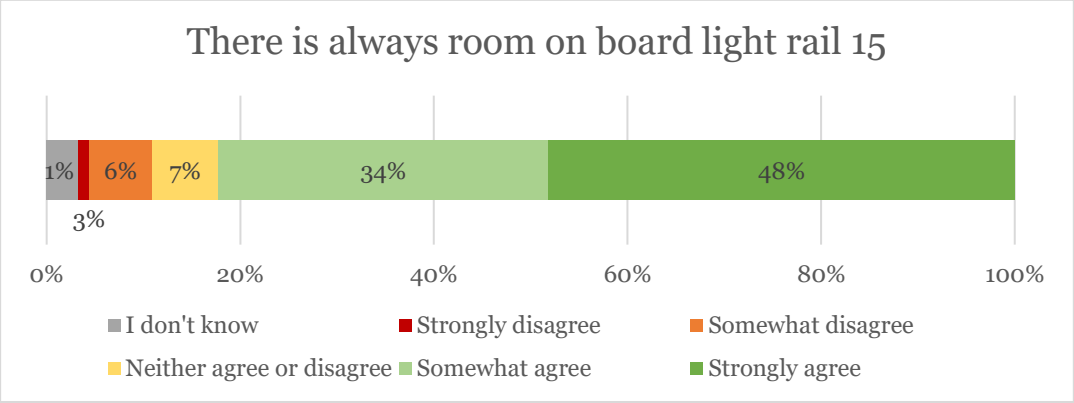

Figure 17. The respondents' experience on how well there is room on board the light rail 15 (n=1269).

Passenger information was not directly considered in the survey, but there were some open comments about it related to disruption situations. The respondents want more real-time information in disruption situations in order to be able to plan their travelling. Some respondents were very unsatisfied with the inaccuracy of the passenger information.

6.3 Safety

The respondents see travelling on the light rail quite safe. 70 % of respondents strongly agreed that it feels safe to travel on light rail and 26 % agreed somewhat. The distribution of responses can be seen in figure 18. The average score was 4,6, which was the highest average score among all the statements in the survey. In the open comments there were only a few comments about safety on board, a couple complaints about not feeling safe and needing more guards, but there were also contrary comments saying that it does feel safe on board.

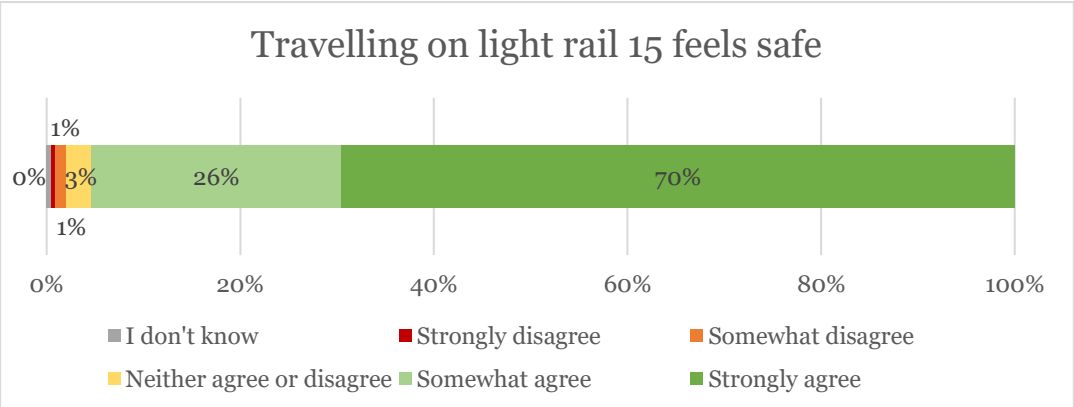

Figure 18. The respondents' experience on the safety on light rail 15 (n=1269).

The experienced safety when moving near the light rail line with other modes is alright based on the responses, but not as good as safety on board, which can be seen clearly when comparing the distributions of responses in figures 18 and 19. Still, most people (83 %) feel like it is safe to move near the light rail, the proportion of people who agree strongly is just smaller than in the previous statement about safety on board. More people have also responded that they do not know (3 %) or they neither agree nor disagree (8 %) compared to the previous statement. The average score for safety when moving near the light rail line with other modes was 4,3.

The open comments included some comments about safety risks when moving near the light rail line. The comments concerned crossing points, where pedestrians and cyclists have to give way to the light rail, which feels unsafe especially for vulnerable groups such as children, elderly and blind people. However, compared to how concerned people seemed to be about the safety of pedestrians during the introduction phase of the project, the number of comments about the topic is surprisingly low.

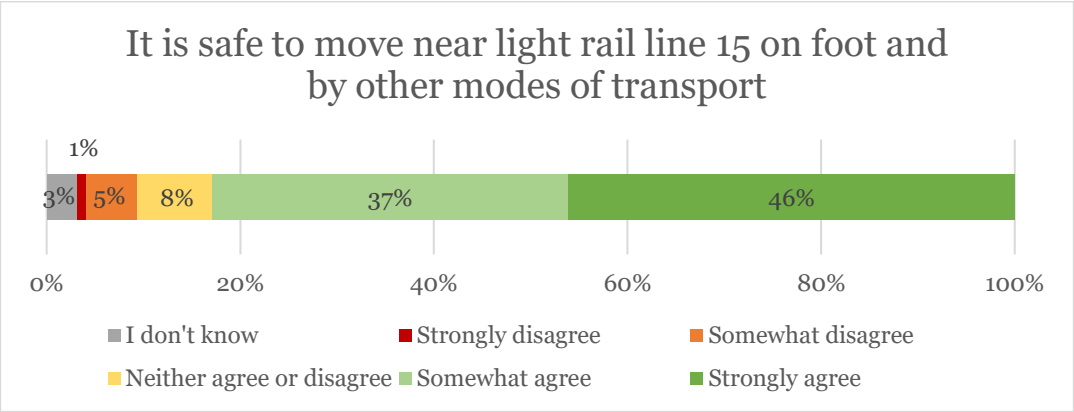

Figure 19. The respondents' experience on safety when moving near the light rail line 15 (n=1269).

6.4 Impacts on everyday life

One of the service promises of light rail was to reduce the need for using a private car and the survey question about modal shift examined that. 6 % of respondents evaluated that the light rail has decreased their car usage a lot, and 8 % evaluated that it had decreased a little. Thus, a small modal shift can be seen, but for most of the respondents (75 %) there has been no change in car usage. However, it is not known how much the respondents used a car before the light rail line. For a small number of people, the light rail has increased their car usage, 1 % said that their car usage has increased a lot and 3 % that it has increased a little. The modal shift from cars as well as other modes of transportation can be seen in figure 20. Concerning the modal shift

from driving, the average score was 2,9. The scale was from 0-5, where 5 was "Increased a lot", 1 was "Decreased a lot" and 0 was "I don't know". Therefore, the lower the score, the more modal shift from driving had happened.

The responses for changes in car usage were compared to respondents' home locations with cross tabulation to see whether changes in car usage differ between areas. With cross tabulation, some areas stood out as places where car usage had decreased whereas in some other areas car usage had increased because of the light rail. Still, in the most areas the main part of respondents answered that the light rail has had no change in the frequency they use a car.

The areas where the light rail has had a positive impact on the modal shift from cars include areas of which the light rail line goes through, such as Haaga, Pajamäki, Pitäjänmäki, Veräjämäki, Viikki and Laajalahti-Friisinmäki. For example, in the Laajalahti-Friisinmäki area 17 % of the respondents (n=76) answered that the light rail had decreased their car usage. A positive impact on modal shift can also be seen in some areas that are close to the light rail line, but through which the line does not go, such as Toukola-Vanhakaupunki, Niittykumpu and Matinkylä.

The areas that stood out the most as places where car usage had increased were Northern Leppävaara, Lintuvaara, Tapiola, Reimarla, Konala and Puotinharju. For example, in Northern Leppävaara 30 % of respondents (n=83) answered that their car usage had increased because of the light rail. Northern Leppävaara, Reimarla and Tapiola are areas where the light rail line follows a different route than the preceding trunk bus line 550 and does not go as close by as the bus line, which can explain the results. Lintuvaara and Konala were also quite near the route of the trunk bus line 550. Respondents from different areas in Vantaa also experienced that their car usage had increased. The results were similar as in the cross tabulation made for smoothness of journeys and home locations, and also the open comments about stop locations were mostly in line with the results. One exception was Pitäjänmäki, which was mentioned in the open comments as a place where the collective transport connections worsened due to the light rail, as the trunk bus line used to go to Pitäjänmäki train station, where the light rail does not go. However, none of the respondents from Pitäjänmäki (n=101) had increased their car usage, 14 % had decreased it and for the rest it had stayed the same after the introduction of the light rail line.

An interesting finding is that in some areas that are further away from the light rail line car usage has decreased more than in some areas that are actually closer to the light rail line. For example, in Niittykumpu 23 % of respondents (n=31) have experienced that the light rail has decreased their car usage and for the rest it has had no change. On the other hand, in Tapiola 24 % of

respondents (n=21) and Northern Tapiola 17 % of respondents (n=24) had increased their car usage and only a couple respondents in those areas had decreased their car usage. The light rail line is located closer to Tapiola than Niittykumpu, but the results could be explained by the fact that the trunk bus line 550 used to go through Tapiola whereas the light rail line does not, so the area has experienced changes in the collective transportation system. The trunk bus line 550 did not go through Niittykumpu, so nothing has changed that dramatically in the area's connections, only a new mode of transportation, which might be more attractive than a bus, has appeared nearby.

The biggest modal shift has happened from buses to light rail, as more than half of the respondents (58 %) have evaluated that their bus usage has decreased a lot or a little. That is not a surprising result, as the light rail line replaced a popular trunk bus line. At the time of the survey, the light rail had operated for about four months, from October to March, which probably affected the results as people do not have experience on the service during summer months.

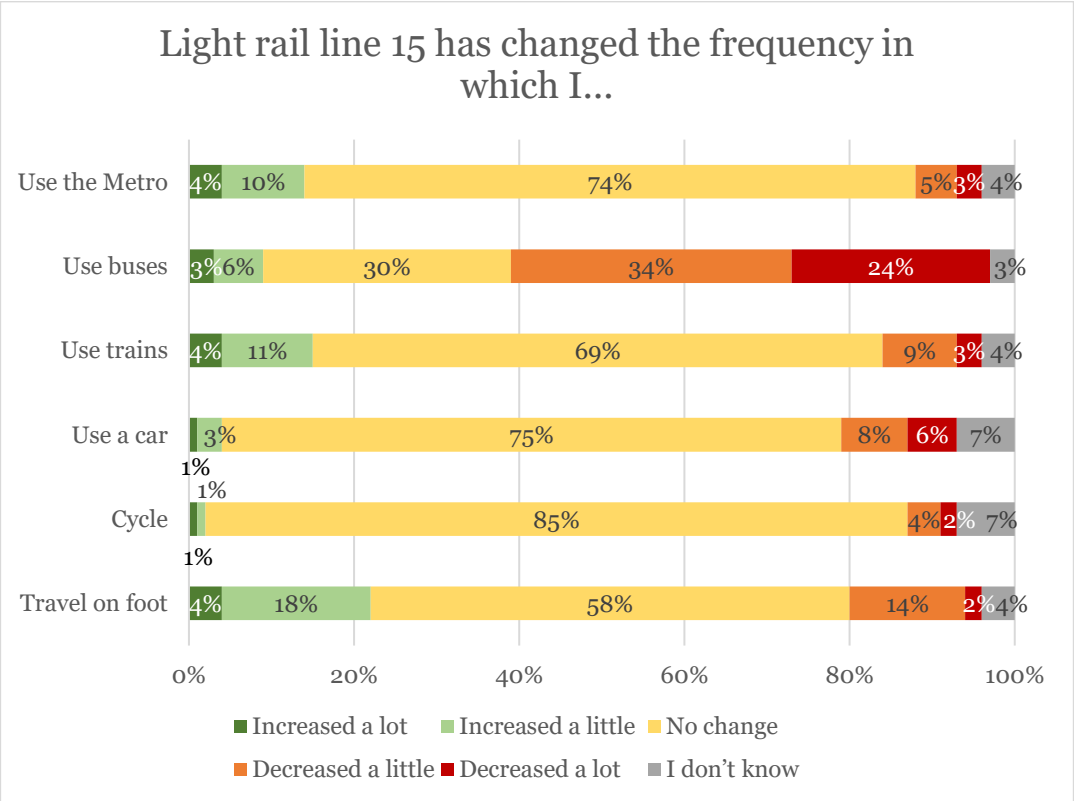

Figure 20. Modal shift caused by the light rail line 15 (n=1269).

According to the respondents, travelling on the light rail is quite nice and pleasant. 64 % of respondents answered that they strongly agree that it feels nice and pleasant and 28 % agreed somewhat. Only 3 % of respondents

answered that they disagree with the statement (figure 21). As the average score of the statement was 4,5, the light rail seems to be a success in terms of travel comfort. The open comments support this finding, as there were many comments saying that it is nicer to travel by light rail than bus, as it is smoother and causes less motion sickness. The smoothness has made it possible for people to read or work during the trip. The respondents also like the big windows and nice views from the light rail, which is related to the last service promise "Travelling by light rail offers experiences".

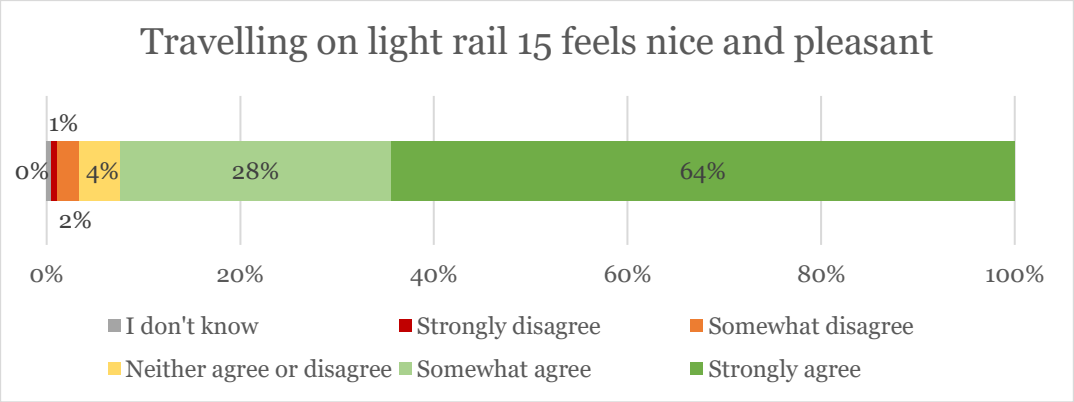

Figure 21. The respondents' experience on how nice and pleasant it is to travel with the light rail line 15 (n=1269).

7 Discussion and conclusions

7.1 Discussion of findings

7.1.1 Findings from the expert interviews

The expert interviews were supposed to answer the first two research questions, “What should be considered when organizing the introduction of a big collective transport project?” and “How can the ex-post evaluation of a big collective transport project introduction be done?” and their subordinate questions. The main points to answer these questions are listed in figures 23 and 24. Here are presented some interesting findings more in depth.

There is no standardized way of doing ex-post evaluation for whole projects (Nicolaisen & Driscoll, 2016) and based on the interviews not for evaluating the introduction phase either. The interviewees had no common conception of what to include in the ex-post evaluation of a project introduction and also their attitudes towards the necessity of it varied. However, there was still a mutual understanding that some kind of an ex-post evaluation would be useful and there should be a simple system for doing it. What information is actually useful considering future projects should be considered carefully to develop a system for ex-post evaluating introductions that is functional, useful and easy to use.

Based on the literature review there are differing views on what to use as reference points in ex-post evaluations, some offer no recommendations (Nicolaisen & Driscoll, 2016), other perspectives vary from one year after opening (Flyvbjerg, 2005) to two years after opening (Andersen et al., 2007), but these recommendations are for ex-post evaluation of whole projects. The expert interviews did not offer an unambiguous answer to when ex-post evaluation for the introduction phase should be done either, in other words what should be the reference point for that. To determine a good reference point for the ex-post evaluation of a project introduction, the line between the introduction phase and normal operations should be defined more clearly, as it came up in the interviews that there is no clear line. The choice of the reference point is crucial, as the choice can affect how successful the project is seen (Olsson et al., 2010). The optimal reference point for ex-post evaluation might also depend on what type of evaluation is done, is it internal evaluation, customer survey or validation through data. Internal evaluations can be done soon after the introduction if the focus is on how the organization of the introduction succeeded. For customer surveys and validation through data more time is needed after the introduction to gather operational data and for customers to gather experience to be able to evaluate the service.

The point of ex-post evaluation is to assess whether the goals that were set for the project were met (Meunier & Welde, 2017). If the introduction phase is to be evaluated ex-post, there should thus be some goals that could be used in the evaluation. Based on the expert interviews, the goals for introductions tend to be mostly about keeping the schedule and for HSL the goal is usually formulated as having "a successful introduction", which also refers to the schedule and keeping a good image outward. The success of the schedule goal is easy to determine, but evaluating only the schedule does not offer a very profound description of how the introduction succeeded otherwise. If a more thorough ex-post evaluation is to be done, more goals that are defined well are needed for the introduction phase. Having clear goals also helps in organizing the introduction, when everyone knows what they are working towards and can prioritize their work, which makes it easier to work with common project introductions.

7.1.2 Findings from the customer survey

The customer survey was conducted for light rail passengers as a web-based survey in February 2024. The response rate of the survey was 39,7 % and the results give a good overview of how the customers have experienced the service of the new light rail, providing an answer to the third research question "Does the realized service of the light rail line 15 correlate to what was planned?". Based on the average scores of the survey statements, the realized service of the light rail 15 correlates to the service promises quite well. On a scale of 0-5, where 5 is the best score, the statements' average scores were between 3,8-4,6. The punctuality and reliability of the service got an average score of 3,8, whereas all the others got a 4,3 or higher.

During the first winter of operations, there have been many factors causing disruptions and thus challenges for the punctuality and reliability of the light rail service. Cars have got stuck in the tracks, and weather conditions and technical problems have caused problems for operating, which can explain the low score of the statement. However, according to operations data the light rail traffic has been punctual if there have been no external disturbances on the tracks (J. Stenmans, personal communication, 16.2.2024). Frequent users were the least satisfied with the punctuality and reliability of the service, which can be explained by the fact that they have suffered from the disturbances most often. Infrequent users might not be as dependent on the light rail and can choose other modes to replace it, so they have probably faced less disturbances than more frequent users.

Based on literature, punctuality is the most important service quality attribute to collective transport users besides travel speed and service frequency, meaning that these three attributes affect the overall satisfaction with

collective transport the most (Mouwen, 2015). It is therefore no wonder that these themes were among the most frequently mentioned in the survey's open comments as they are so essential for overall satisfaction with the service. To keep especially the frequent users satisfied with the service and keep them using it regularly requires minimizing disturbances and improving the punctuality and reliability of the light rail. Improvements in this area could also help with the modal shift, if the light rail got a more positive image in terms of its reliability.

The modal shift was evaluated on a different scale than the other statements, and for it the score was the better the lower it was. The scale was from 0 to 5, and the average score for the change in car usage was 2,8. A small modal shift from cars to light rail had thus happened, even though most of the respondents experienced that the light rail did not have any impact on their car usage, still more people had decreased their car usage than increased. One disadvantage of the sample was that it only included light rail users, so if someone had increased their car usage because of the light rail and did not use it at all, they were not included in the sample. Therefore, the whole impact on modal shift cannot be examined.

Based on the literature review, there have been different results in different cities and projects in terms of modal shift. Often the modal shift to rail traffic comes from buses, but for example in Manchester there was also modal shift from cars to light rail, but the modal shift from driving concerned mostly infrequent leisure trips and not frequent commuting (Senior, 2009). For the light rail line 15, the biggest modal shift also happened from buses, which is natural as it replaced a bus line. Concerning the modal shift from cars, it was dependent on the area. As Ingvardson & Nielsen (2018) stated, how the project improves the local transportation system affects the impacts it can have. In some areas the collective transportation connections declined when the light rail line 15 was introduced as the closest stops moved further away and in these areas the modal shift was opposite than hoped for, meaning an increase in car usage. Examples of these areas are Northern Leppävaara and Tapiola. On the other hand, for example in Laajalahti-Friisinmäki the transport connections improved significantly, which had a positive impact on the modal shift from cars.

Modal shift is not only dependent on the service of the new line as for example land-use (Lee & Miller, 2022) and service on other collective transport lines affect mode choices (Lee et al., 2017). The areal differences could be analysed even further to find out other factors that explain the differences in modal shifts. For example, it would be interesting to analyse what could explain that car usage has decreased more in some areas that are further away from the light rail than areas that are closer to it. Possible explanations could

be other transport connections, customers' expectations, demographic differences or something else. The importance of the collective transport network as a whole was emphasized in the open comments of the survey as many respondents commented how the introduction of the light rail and changes in bus lines had affected their travelling. For instance, schedule, route and stop location changes can easily affect the length and smoothness of the trip positively or negatively, which affects mode choice and can lead to modal shift.

The results of the survey illustrate well the difficult choices that have to be made when planning collective transport. On the other hand, the respondents were unsatisfied with stop locations that had changed and thus made their journeys longer or less smooth, but at the same time there were many comments about how the light rail is not fast enough. To be faster there would have to be even less stops and they would probably be even further away from the users. If the customers experience some kind of a decline in their service, it can be hard for them to see the big picture and understand the overall benefits and the compromises that must be made in collective transport planning.

Besides place of residence, also other characteristics can have an impact on how satisfied the users are with different parts of the service. Market segmentation can help with understanding the different user groups and what they value, which can be useful when developing the services (dell'Olio, Ibeas, & Cecin, 2011). Based on the survey results, the customers' experience on the speed and easiness of the light rail service varied between age groups. The most unsatisfied age groups were 18-34-year-olds and over 55-year-olds. As the question asked about two things, speed and easiness, it is possible that different age groups are unsatisfied with different parts of the question. 18-34-year-olds tend to have busy lives and the travelling might not feel fast enough for them, but for the over 55-year-olds the reasons for unsatisfaction might be different. It can be that they are also unsatisfied with the speed of light rail for example compared to driving, but the easiness of travelling might also be a problem for older people. Also, in Mouwen's (2015) study, the elderly were less satisfied with the ease of boarding and alighting than younger people.

All the service promises of light rail and the answers to whether their realized service corresponds to what was planned are collected together in figure 22. The more detailed criteria descriptions for the service promises can be seen in figure 2 in the background information chapter (3.2.1.). The blue rows indicate precise numeral goals from the service promises and the project plan, which could be evaluated with operational data. They are placed under the service promises that they are related to. All in all, based on the results in

figure 22, the light rail line 15 has been able to achieve the planned service quite well. Punctuality and modal shift were not as successful as other service promises.

Service promises of light rail	Planned service	Realized service
Light rail traffic helps me get to my destination easily and fast	It feels fast to travel by light rail	4,3*
	Average speed is 20-25 km/h, in the project plan 25 km/h	23,08 km/h
	Traveling by light rail doesn't need to be planned beforehand	4,3* on speed and easiness of travelling 2,9** on smoothness of journeys
	Traffic starts early and continues past midnight every day	Service hours are 4:30-1:15 on weekdays and 5:30-1:15 on weekends
	Headway is 5-10 minutes on weekdays, 3-5 minutes at most frequent traffic	The headway was 12 minutes at the start of operations, the goal is to achieve a 6 -minute-headway in summer 2024
	The light rail stops are easily accessible	Yes
Light rail traffic is always reliable	Light rail traffic is punctual	3,8*
	One can always fit onboard	4,3*
	The passenger information is accurate	Not measured, but customer satisfaction with passenger information is good
Light rail traffic is safe and accessible	Light rail traffic is safe to pedestrians and other traffic	4,3*
	It is safe to use light rail traffic	4,6*
	The light rail cars, stops and routes are accessible	Yes
	The passenger information of light rail is accessible to all passengers	Yes

Light rail traffic makes everyday life easier and uplifts one's mood	Light rail traffic reduces the need for using a private car	2,9***
	Light rail cars are comfortable and in good condition	4,5*
	Traveling by light rail feels pleasant	4,5*
	Traveling by light rail offers experiences	Not measured, but based on open comments it is fulfilled

Figure 22. The service promises of light rail by HSL and their realization for the light rail line 15.
*On a scale from 0 to 5, where 0 was "I don't know", 1 was "Strongly disagree" and 5 was "Strongly agree".
** on a scale from 1 to 6, where 1 was "Improved considerably", 5 was "Decreased considerably" and 6 was "I don't know".
***On a scale from 0 to 5, where 0 was "I don't know", 1 was "Decreased a lot" and 5 was "Increased a lot".

7.1.3 Combined findings from the interviews and survey

Ex-post evaluation is based on evaluating whether the goals that were set for the project were met (Meunier & Welde, 2017). For the light rail 15 there were many goals set in different documents, and some of them were for the whole project and some more specifically for the introduction phase. For example, the service promises of light rail are not targeted for the introduction phase in particular, they are guidelines for the whole project, but still they were used in this study to evaluate the success of the introduction phase. The realization of the service promises is not dependent only on the introduction phase, which provokes questions about whether they can be used to evaluate the success of the introduction. Therefore, evaluating the success of the introduction phase based on the realization of the service promises is not able to cover the whole truth about the success. The service promises were good goals, but limiting the examination only to the introduction phase is too restrictive. What comes to evaluating the success of the internal organization of introductions it is reasonable to conduct an ex-post evaluation, but for the realization of the service the limitation to evaluate only the introduction phase might not be justified. It can still be discussed whether there were some factors in the introduction of the light rail line 15 that can provide explanations to the survey results.

What comes to the biggest challenge the light rail line 15 has had during its first winter, the many disruptions and their impacts to punctuality and reliability, it should be considered what could have been done differently in the

introduction phase of the project to prevent it. Risk management came up in the expert interviews as a success factor in introductions. For the light rail 15, possible risks should have been surveyed more thoroughly. Maybe it did not seem likely that so many drivers would accidentally end up driving on the tracks and getting stuck, since trams have operated nearby for so long that it is easy to think that drivers would be used to them. These risks could have been considered already in the planning phase of the project, but in the introduction phase at the latest. As the light rail line 15 is a long line, it is vulnerable to disruptions and possible causes of disruptions could have been taken into account better.

Many of the survey respondents were unsatisfied with the long headway the light rail started to operate with and that is something that was decided in the introduction phase. A decision had to made whether to start operations earlier but with longer headways or to start later with shorter headways. Based on passenger forecasts and contractual reasons the first option was chosen. Based on the survey responses, there has been quite enough room on board the light rail, so the capacity has been enough with the longer headways. Still, it is not known if a shorter headway right from the beginning of operations could have for example attracted more passengers and strengthen the modal shift. On the other hand, postponing the start of operating in order to have more light rail cars and thus being able to start operations with shorter headways could have annoyed customers as well if everything else was ready for operations to start.

As the route and stop locations are determined long before the introduction phase of a project, there is not much that can be done for things such as modal shift any more in the introduction, except maybe share information and market the service to attract users. The speed of the light rail is also heavily dependent on the planning and construction of the system, but during the introduction phase it is still possible to affect the training of drivers so that they can operate the system as well as possible. What comes to accessibility, it is also mostly determined during the planning and construction phases, only small modifications can be made in the introduction. There are thus some things that can be affected during the introduction phase, but it should be kept in mind how significant the previous phases are in terms of realized service.

7.2 Checklist for opening

Figure 23 presents the most important things that should be considered when organizing introductions, including the main factors that affect the introduction phase, possible risks and success factors.

Main factors to consider	Possible risks	Success factors

• Recruitment and training of drivers
• Delivery time of fleet
  ○ Tendering schedules
  ○ Delivery times of smaller components
• Infrastructure construction schedule
  ○ Safety system
• Desired service level
• Passenger forecasts
	• Project organization
	  ○ Too big or too small working group
	  ○ Inexperienced employees
	  ○ Lack of motivation
	• New drivers or operators
	  ○ Lack of resources for training
	• Unreliable fleet
	  ○ Lack of time for testing
	• Too slack or too tight schedule
	• Schedule risks and a negative public opinion
	  ○ Delivery times, schedules of construction, training, tendering, legal proceedings
		• Close cooperation
		• Communication and up-to-date situation picture
		• Clear schedule
		• Clear and common goals
		• Leadership and decision-making
		• Risk management
		• Learning from previous challenges
		• Considering the customer perspective
		• Enough resources
		• Keeping up motivation
		• Overlapping bus transit

Figure 23. Checklist for organizing collective transport project introductions.

7.3 Checklist for ex-post evaluation

Figure 24 presents a checklist for conducting ex-post evaluation for project introductions, containing first general things that should be considered in ex-post evaluations and then more specifically about the three ways of conducting ex-post evaluations for HSL that were recognized in the interviews.

General about ex-post evaluations of project introductions
- Set clear and measurable goals for the introduction phase   ○ Make sure the goals are about things that are related to the introduction phase - Define when the introduction phase ends and what is the reference point used in the ex-post evaluation

- Ex-post evaluation can be useful even though the introduction has gone well or there does not seem to be any similar projects in sight o For example, it can be good for the employees to have a place to let out everything and discuss possible challenges together to clear the air - Define what is wanted from the ex-post evaluation to keep it compact and well suited to its purpose	
Ways of conducting ex-post evaluation	Things to consider
Internal evaluation	- Evaluating goals set for the organization of introduction - People are often in hurry to move on to next projects, so try to reserve time for ex-post evaluation and help people understand what the benefits from it are, so that it does not feel like unnecessary extra work - Can be organized as a survey or a discussion o Surveys might not get that many answers, as they are easy to skip if you are busy, conversations can be more fruitful but need more time – Internal evaluation can also be continuous during the introduction phase
Customer survey	- Reserve enough resources in time - Form the questions so that they examine the desired change, the realization of goals and whether customers' expectations have been met - The subjective experiences of customers are valuable, but can be complemented by validation through data
Validation through data	- Things such as punctuality, reliability, speed and passenger numbers can be measured objectively - At some point it will shift to normal follow-up from ex-post evaluation of introduction, so determine the time for that

Figure 24. Checklist for conducting ex-post evaluation for project introductions.

7.4 Limitations of this study

The research design posed some limitations and challenges for the study. As the topic of this thesis was very specific, there was no directly related previous research to base the thesis on. Other studies have not focused only on the introduction phase of project, which restricted the possibilities for comparing the results with previous ones. That can limit the reliability of the results. Limiting the examination on the introduction phase was problematic also

because knowledge about the introduction phase is limited. There is no common conception about when the phase starts and ends and what things can actually be affected during the phase, which questions the focus of the study. That has posed some challenges for this study, as the unclarities came up during the process when it was hard to shift the focus of the study anymore.

Considering the expert interviews, the relatively small size of the field limited the number of possible interviewees. As the focus was on HSL and how HSL should conduct ex-post evaluation, HSL experts represented the biggest group of interviewees. Representatives of other organizations were also interviewed to get a broader understanding of organizing and ex-post evaluating project introductions. A diverse group of interviewees offered versatile results, but their relevance for HSL is limited as the roles and responsibilities of different stakeholders vary in different cities and projects.

As there was no relevant literature about collective transport project introductions, the interviews were the only source of information. It meant that the interviews were planned before having that much information about the topic, so the interview questions might have not been as relevant as they could have been. After the interviews the topic and its challenges got clearer and with that knowledge some other questions could have been asked from the interviewees but it was not possible in the schedule of this study.

What comes to the customer survey, the fact that it was done in cooperation with the research department of HSL set some limitations. It restricted the timing of the survey as well as the structure. It would have been interesting to examine for example the impact of expectations of the new line on the experienced satisfaction, but it would have required room for more detailed questions in the survey. The survey was postponed a few times, and the timing was as late as it could be in terms of the schedule of this study. As there is no framework for ex-post evaluating project introductions, it is hard to know what a good time would be for conducting the ex-post evaluation. At the time of the survey, customers had had about four months to get used to the light rail and form their opinions and habits. However, how well the results represent the success of the introduction phase depends on how the introduction phase is defined. It can be discussed whether the introduction phase has already ended or whether it ends when the 6-minute headway has been reached.

During the first four months of operations there have been challenges with cars driving on the tracks of the light rail line, which has caused disturbances that have had a negative impact on people's images of the line. During the first months of operating there were also days without any traffic on the light rail line due to political strikes, which can also affect the opinions of the

survey respondents. There was a two-day strike just two weeks before the survey was conducted. These factors have to be considered when examining the survey results. The sample of the survey also poses one limitation to the study, as only light rail travellers were included in the sample. Therefore, the light rail's impact on the modal shift cannot be fully examined as some people might have shifted to other modes because of the light rail and thus they are not included in the sample.

7.5 Further research and development

During this study it has come up that it is somewhat unclear what the introduction phase of a collective transport project includes and when it ends. Future research on the topic could thus focus on determining more clearly when the introduction phase can be seen to end and which parts of the service can be affected in the introduction phase and how.

However, it could be more useful to conduct ex-post evaluations without limiting the examination only in the introduction phase. The realization of many of the service promises that were evaluated here are not dependent on the introduction phase alone. Therefore, the service promises might not be the right goals to assess if ex-post evaluation is done for the introduction phase only. If things such as service promises are to be evaluated, it should be considered that also the phases before introduction have a remarkable impact on how the service is realized. Whether ex-post evaluations are done for the introduction phase or the whole project in the future, it should be clarified what is wanted from the ex-post evaluation and a model could be developed for it. The model should make sure that all the necessary information is gathered effectively.

References

Abenoza, R. F., Cats, O., & Susilo, Y. O. (2017). Travel satisfaction with public transport: Determinants, user classes, regional disparities and their evolution. *Transportation Research Part A: Policy and Practice*, *95*, 64-84. https://doi.org/https://doi.org/10.1016/j.tra.2016.11.011

Alastalo, M., & Åkerman, M. (2010). Asiantuntijahaastattelun analyysi: faktojen jäljillä. In P. Nikander, M. Hyvärinen, & J. Ruusuvuori (Eds.), *Haastattelun analyysi*. Vastapaino.

Andersen, B., Bråthen, S., Fagerhaug, T., Nafstad, O., Næss, P., & Olsson, N. (2007). *Effektvurdering av store statlige investeringsprosjekter: Impact evaluation of large governmental investments*.

Brands, T., Dixit, M., & Oort, N. v. (2020). Impact of a New Metro Line in Amsterdam on Ridership, Travel Times, Reliability and Societal Costs and Benefits. *European Journal of Transport and Infrastructure Research*, *20*(4), 335-353. https://doi.org/10.18757/ejtir.2020.20.4.4084

Broersen, T. (2019). *Organisation of a test & commissioning phase in light rail projects* http://essay.utwente.nl/80017/

dell'Olio, L., Ibeas, A., & Cecin, P. (2011). The quality of service desired by public transport users. *Transport Policy*, *18*(1), 217-227. https://doi.org/https://doi.org/10.1016/j.tranpol.2010.08.005

Dent, N., Hawa, L., DeWeese, J., Wasfi, R., Kestens, Y., & El-Geneidy, A. (2021). Market-Segmentation Study of Future and Potential Users of the New Réseau Express Métropolitain Light Rail in Montreal, Canada. *Transportation Research Record*, *2675*(10), 1043-1054. https://doi.org/10.1177/03611981211014528

Eboli, L., & Mazzulla, G. (2007). Service Quality Attributes Affecting Customer Satisfaction for Bus Transit. *Journal of Public Transportation*, *10*(3), 21-34. https://doi.org/https://doi.org/10.5038/2375-0901.10.3.2

Edwards, M., & Mackett, R. L. (1996). Developing new urban public transport systems: An irrational decision-making process. *Transport Policy*, *3*(4), 225-239. https://doi.org/https://doi.org/10.1016/S0967-070X(96)00023-6

Flick, U. (1998). *An introduction to qualitative research*. Sage.

FLOU. (2019). *Raide-Jokerin Hankearviointi*.

Flyvbjerg, B. (2005). Measuring inaccuracy in travel demand forecasting: methodological considerations regarding ramp up and sampling. *Transportation Research Part A: Policy and Practice*, *39*(6), 522-530. https://doi.org/https://doi.org/10.1016/j.tra.2005.02.003

Flyvbjerg, B., Skamris Holm, M. K., & Buhl, S. L. (2005). How (In)accurate Are Demand Forecasts in Public Works Projects?: The Case of Transportation. *Journal of the American Planning Association*, *71*(2), 131-146. https://doi.org/10.1080/01944360508976688

Gillham, B. (2005). *Research Interviewing: the Range of Techniques*. McGraw-Hill Education.

http://ebookcentral.proquest.com/lib/aalto-ebooks/detail.action?docID=287863
Heikkilä, T. (2008). *Tilastollinen tutkimus* (7. uud. p. ed.). Edita.
Hirsjärvi, S., & Hurme, H. (2008). *Tutkimushaastattelu : teemahaastattelun teoria ja käytäntö*. Gaudeamus Helsinki University Press.
HSL. (2017). *Helsingin seudun pikaraitioliikenteen palvelukuvaus*.
HSL. (2022). *Kaupunki- ja pikaraitioliikenteen linjastosuunnitelma*.
HSL. (2023). Internal database.
HSL. (2023a). Internal document.
HSL. (2023b). Internal document.
HSL. (2023a). *HSL:n ensimmäisen pikaratikan linjanumero on 15*. https://www.hsl.fi/hsl/uutiset/uutinen/2023/05/hsln-ensimmaisen-pikaratikan-linjanumero-on-15
HSL. (2023b). *Liikenne pikaraitiolinjalla 15 alkaa 21.10*. Retrieved 8.11. from https://www.hsl.fi/hsl/uutiset/uutinen/2023/09/liikenne-pikaraitiolinjalla-15-alkaa
HSL. (n.d.-a). *Kysymyksiä ja vastauksia*. Retrieved 16.11. from https://www.hsl.fi/kampanjat/pikaratikka/kysymyksia-ja-vastauksia
HSL. (n.d.-b). *Reittiopas*. Retrieved 8.11. from https://reittiopas.hsl.fi/linjat/HSL:2015/aikataulu/HSL:2015:1:01?serviceDay=20231111
HSL. (n.d.-c). *Research and surveys*. Retrieved 23.11. from https://www.hsl.fi/en/hsl/research-and-surveys
HSL. (n.d.-d). *Tiheässä liikenteessä pääset kyytiin ilman pitkiä odotuksia*. Retrieved 8.11. from https://www.hsl.fi/kampanjat/pikaratikka/liikenne
Ingvardson, J. B., & Nielsen, O. A. (2018). Effects of new bus and rail rapid transit systems – an international review. *Transport Reviews*, *38*(1), 96-116. https://doi.org/10.1080/01441647.2017.1301594
Kovács, G., & Spens, K. M. (2005). Abductive reasoning in logistics research. *International Journal of Physical Distribution & Logistics Management*, *35*(2), 132-144. https://doi.org/10.1108/09600030510590318
Lee, J., Boarnet, M., Houston, D., Nixon, H., & Spears, S. (2017). Changes in Service and Associated Ridership Impacts near a New Light Rail Transit Line. *Sustainability*, *9*(10), 1827. https://www.mdpi.com/2071-1050/9/10/1827
Lee, J., & Miller, H. J. (2022). Simple pre-post analysis overestimates the impacts of new public transit services on ridership: Evidence from a quasi-experimental study of new bus rapid transit in Columbus, Ohio, USA. *Journal of Public Transportation*, *24*, 100035. https://doi.org/https://doi.org/10.1016/j.jpubtr.2022.100035
Mackett, R. L., & Edwards, M. (1998). The impact of new urban public transport systems: will the expectations be met? *Transportation Research Part A: Policy and Practice*, *32*(4), 231-245. https://doi.org/https://doi.org/10.1016/S0965-8564(97)00041-4

McCarthy, L., Delbosc, A., Kroesen, M., & de Haas, M. (2023). Travel attitudes or behaviours: Which one changes when they conflict? *Transportation*, *50*(1), 25-42. https://doi.org/10.1007/s11116-021-10236-x

Meunier, D., & Welde, M. (2017). Ex-post evaluations in Norway and France. *Transportation Research Procedia*, *26*, 144-155. https://doi.org/https://doi.org/10.1016/j.trpro.2017.07.015

Morgan, D. L. (2019). Basic and Advanced Focus Groups. In. SAGE Publications, Inc. https://doi.org/10.4135/9781071814307

Mouwen, A. (2015). Drivers of customer satisfaction with public transport services. *Transportation Research Part A: Policy and Practice*, *78*, 1-20. https://doi.org/https://doi.org/10.1016/j.tra.2015.05.005

Nicolaisen, M. S., & Driscoll, P. A. (2014). Ex-Post Evaluations of Demand Forecast Accuracy: A Literature Review. *Transport Reviews*, *34*(4), 540-557. https://doi.org/10.1080/01441647.2014.926428

Nicolaisen, M. S., & Driscoll, P. A. (2016). An International Review of Ex-Post Project Evaluation Schemes in the Transport Sector. *Journal of Environmental Assessment Policy and Management*, *18*(01), 1650008. https://doi.org/10.1142/s1464333216500083

Nummenmaa, L., Holopainen, M., & Pulkkinen, P. (2014). *Tilastollisten menetelmien perusteet*. Sanoma Pro.

Olesen, K. (2020). Infrastructure imaginaries: The politics of light rail projects in the age of neoliberalism. *Urban Studies*, *57*(9), 1811-1826. https://doi.org/10.1177/0042098019853502

Olesen, M. (2014). Framing light rail projects – Case studies from Bergen, Angers and Bern. *Case Studies on Transport Policy*, *2*(1), 10-19. https://doi.org/https://doi.org/10.1016/j.cstp.2013.12.002

Olsson, N. O. E., Krane, H. P., Rolstadås, A., & Veiseth, M. (2010). Influence of reference points in ex post evaluations of rail infrastructure projects. *Transport Policy*, *17*(4), 251-258. https://doi.org/https://doi.org/10.1016/j.tranpol.2010.01.008

Pickrell, D. H. (1992). A Desire Named Streetcar Fantasy and Fact in Rail Transit Planning. *Journal of the American Planning Association*, *58*(2), 158-176. https://doi.org/10.1080/01944369208975791

Raide-Jokeri. (n.d.). *Mikä Raide-Jokeri?* Retrieved 2.11.2023 from https://raidejokeri.info/mika-raide-jokeri/

Ruusuvuori, J. (2010). Litteroijan muistilista. In P. Nikander, M. Hyvärinen, & J. Ruusuvuori (Eds.), *Haastattelun analyysi*. Vastapaino.

Ruusuvuori, J., Nikander, P., & Hyvärinen, M. (2010). Haastattelun analyysin vaiheet. In J. Ruusuvuori, P. Nikander, & M. Hyvärinen (Eds.), *Haastattelun analyysi*. Vastapaino.

Saldana, J., Leavy, P., & Beretvas, N. (2011). *Fundamentals of Qualitative Research*. Oxford University Press, Incorporated. http://ebookcentral.proquest.com/lib/aalto-ebooks/detail.action?docID=665394

Senior, M. L. (2009). Impacts on travel behaviour of Greater Manchester's light rail investment (Metrolink Phase 1): evidence from household

surveys and Census data. *Journal of Transport Geography*, *17*(3), 187-197. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2008.11.004

Sukhov, A., Lättman, K., Olsson, L. E., Friman, M., & Fujii, S. (2021). Assessing travel satisfaction in public transport: A configurational approach. *Transportation Research Part D: Transport and Environment*, *93*, 102732. https://doi.org/https://doi.org/10.1016/j.trd.2021.102732

Tilastokeskus. (2023). *Väestö iän ja sukupuolen mukaan 31.12.* https://stat.hel.fi/pxweb/en/Aluesarjat/Aluesarjat__vrm__vaerak__umkun/Hginseutu_VA_VR01_Vakiluku_ika.px/table/tableViewLayout1/

Tilastokeskus. (2024). *Uudenmaan väestö pääasiallisen toiminnan, iän ja sukupuolen mukaan 31.12.2001-* https://stat.hel.fi/pxweb/fi/Aluesarjat/Aluesarjat__tyo__tyom__umkun/01UMS_Paa_as_toiminta.px/table/tableViewLayout1/

Valli, R. (2010). Kyselylomaketutkimus. In J. Aaltola & R. Valli (Eds.), *Ikkunoita tutkimusmetodeihin. 1, Metodin valinta ja aineiston keruu : virikkeitä aloittelevalle tutkijalle* (3. uud. ja täyd. p. ed.). PS-Kustannus.

Vehkalahti, K. (2008). *Kyselytutkimuksen mittarit ja menetelmät*. Tammi.

Vilkka, H. (2007). *Tutki ja mittaa : määrällisen tutkimuksen perusteet*. Tammi.

Wang, J., Lu, Y., Yang, Y., Peng, J., Liu, Y., & Yang, L. (2023). Influence of a new rail transit line on travel behavior: Evidence from repeated cross-sectional surveys in Hong Kong. *Journal of Transport Geography*, *106*, 103526. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2022.103526

WSP, & Ramboll. (2015). *Raide-Jokeri Hankesuunnitelma*. Espoon ja Helsingin kaupungit

Wu, W., & Hong, J. (2017). Does public transit improvement affect commuting behavior in Beijing, China? A spatial multilevel approach. *Transportation Research Part D: Transport and Environment*, *52*, 471-479. https://doi.org/https://doi.org/10.1016/j.trd.2016.08.032

Appendix A. Interview question base

Part 1. Introducing a collective transport project

1. Which collective transport project introductions have you worked with and what was your role?
2. How big have these projects been?
3. What different stakeholders have been involved in the introductions? What were their roles?
    a. How was the cooperation coordinated?
4. What was included in the introduction of the project?
5. What goals guided the introduction?
6. What kind of information should there be beforehand about the factors impacting the introduction of a project? (e.g., delivery time of the fleet, length of driver training, recruitment of drivers)
    a. How were passenger forecasts considered in the introduction?
7. What kind of risks or challenges should be considered in introductions?

Part 2. Ex-post evaluation

1. Have you evaluated the success of the introduction afterwards?
    a. If not, why?
2. How was the ex-post evaluation of the introduction carried out?
    a. Have you measured if the goals for the introduction were achieved?
    b. Is ex-post evaluation systematic or more feelings-based or case-dependent?
    c. If customer satisfaction surveys have been utilized in the ex-post evaluation, what has been asked in them?
    d. What do you think should be asked from the customers when evaluating the introduction?
3. Are there some other ways that could be used to evaluate introductions?
4. What was successful in the introduction?
5. What should have been considered, but wasn't?
6. What could be developed in introductions and their ex-post evaluation?
7. Have you had a chance to utilize the knowledge from the ex-post evaluation in other introductions?

At the end

1. Do you have something to add? Is there something relevant that we haven't discussed?

Appendix B. Survey form

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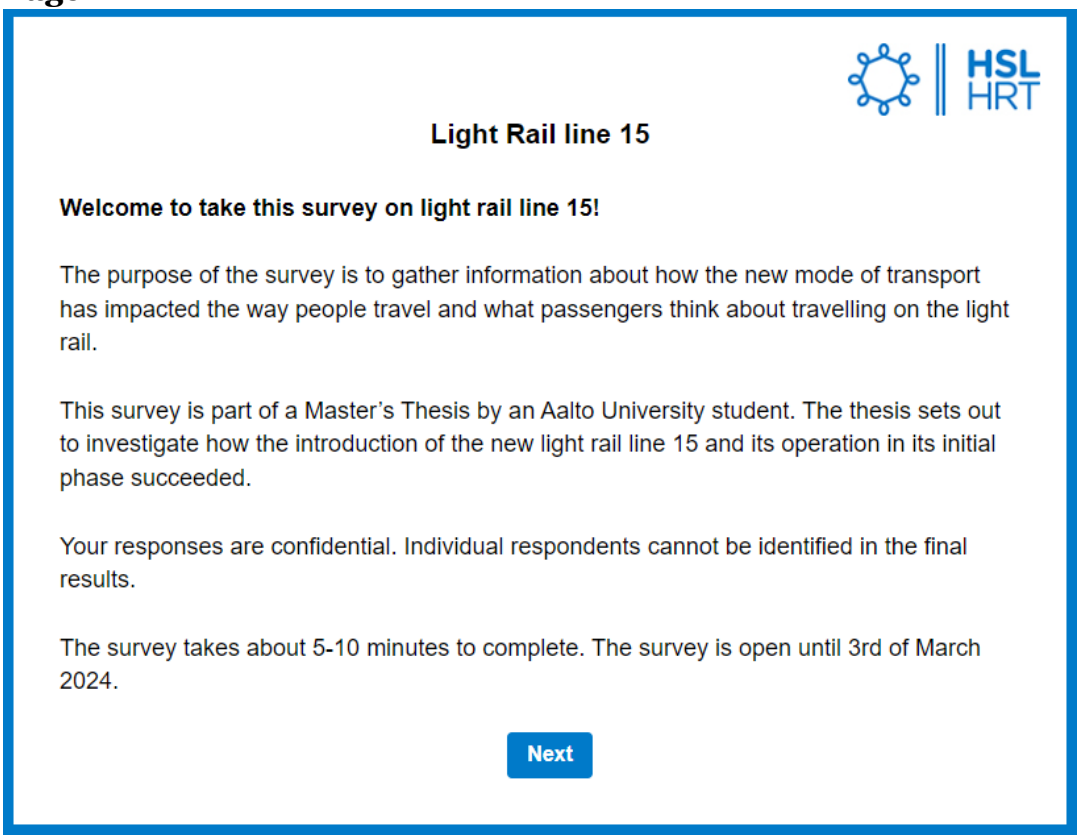

HSL HRT

Light Rail line 15

Welcome to take this survey on light rail line 15!

The purpose of the survey is to gather information about how the new mode of transport has impacted the way people travel and what passengers think about travelling on the light rail.

This survey is part of a Master's Thesis by an Aalto University student. The thesis sets out to investigate how the introduction of the new light rail line 15 and its operation in its initial phase succeeded.

Your responses are confidential. Individual respondents cannot be identified in the final results.

The survey takes about 5-10 minutes to complete. The survey is open until 3rd of March 2024.

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HSL HRT

Light Rail line 15

Questions about your journey

The following questions concern the journey during which you received an invitation to participate in this survey.

Where did you start this journey?

- ◯ My home or place of residence
- ◯ My workplace
- ◯ My school or place of study
- ◯ Child's daycare center, school or place for their hobby (I either picked up or dropped off a child)
- ◯ Shopping venue or location for errands (shop, post office, doctor's office etc.)
- ◯ Location for work-related errands
- ◯ Leisure location
- ◯ Other place

At which stop did you get on light rail 15?

- Type a key word or select from list -

Where did you arrive in or will arrive in?

- ◯ My home or place of residence
- ◯ My workplace
- ◯ My school or place of study
- ◯ Child's daycare center, school or place for their hobby (I either picked up or dropped off a child)
- ◯ Shopping venue or location for errands (shop, post office, doctor's office etc.)
- ◯ Location for work-related errands
- ◯ Leisure location
- ◯ Other place

At which stop did you get off or are going to get off light rail 15?

- Type a key word or select from list -

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Light Rail line 15

Light rail line 15

Light rail line 15 is a light rail that has been operating between Itäkeskus and Keilaniemi since October 2023.

How often do you use light rail line 15?

- ◯ Every day or almost every day
- ◯ Several times a week
- ◯ Once a week
- ◯ 2–3 times a month
- ◯ Once a month or less often
- ◯ This is the first time I use light rail line 15

Light rail line 15 replaced trunk bus route 550. After the light rail started running, trunk bus 550 began operating a reduced service in the fall of 2023. The bus route was withdrawn entirely at the turn of the year 2023/2024.

Did you use trunk bus 550 before the light rail started running?

- ◯ Every day or almost every day
- ◯ Several times a week
- ◯ Once a week
- ◯ 2–3 times a month
- ◯ Once a month or less often
- ◯ I did not use trunk bus 550 before the light rail started running

Did you use trunk bus 550 after the light rail had started running (between the end of October and New Year)?

- ◯ Every day or almost every day
- ◯ Several times a week
- ◯ Once a week
- ◯ 2–3 times a month
- ◯ Once a month or less often
- ◯ I did not use trunk bus 550 after the light rail had started running

Please evaluate the following statement in terms of different modes of travel

Light rail line 15 has changed the frequency in which I..

	Increased a lot	Increased a little	No change	Decreased a little	Decreased a lot	I don't know
Use the Metro	○	○	○	○	○	○
Use buses	○	○	○	○	○	○
Use trains	○	○	○	○	○	○
Use a car	○	○	○	○	○	○
Cycle	○	○	○	○	○	○
Travel on foot	○	○	○	○	○	○

How has light rail line 15 affected the smoothness of the journeys you make?

- ○ Improved considerably
- ○ Improved a little
- ○ No effect
- ○ Decreased a little
- ○ Decreased considerably
- ○ I don't know

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Light Rail line 15

Please evaluate the following statements concerning light rail line 15

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	I don't know
I have received enough information on the light rail to facilitate my travelling	○	○	○	○	○	○
Travelling on light rail 15 feels fast and easy	○	○	○	○	○	○
Travelling on light rail 15 feels safe	○	○	○	○	○	○
It is safe to move near light rail line 15 on foot and by other modes of transport	○	○	○	○	○	○
Travelling on light rail 15 feels nice and pleasant	○	○	○	○	○	○
There is always room on board light rail 15	○	○	○	○	○	○
Light rail 15 offers a punctual and reliable service	○	○	○	○	○	○
Light rail 15 serves my needs well	○	○	○	○	○	○

If you want, you can write down examples of how light rail line 15 has affected your journeys:

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Light Rail line 15

Background questions

How old are you?

Age ☐

Your gender?

- ◯ Male
- ◯ Female
- ◯ Other
- ◯ I don't want to answer

What is your post code? *

Post code ☐

What best describes your employment status at the moment?

- ◯ Employed
- ◯ Unemployed
- ◯ Student or schoolchild
- ◯ Retired
- ◯ On parental leave
- ◯ In military or civilian service
- ◯ Out of the labor force in some other way

Over the past six months, how often have you on average used public transport in the HSL area?

- ◯ Every day or almost every day
- ◯ Several times a week
- ◯ Once a week
- ◯ 2–3 times a month
- ◯ Once a month or less often
- ◯ Not at all

Over the past six months, which mode of transport did you use most often to move from one place to another? Select the option that best describes your travelling.

- ◯ By car
- ◯ By car and public transport
- ◯ By public transport
- ◯ By public transport and on foot
- ◯ On foot
- ◯ Cycling
- ◯ Other, please specify [ ]

Please evaluate the following statement from your own perspective:

"I often think about the environmental impact of the modes of travel I use."

- ◯ Strongly agree
- ◯ Somewhat agree
- ◯ Neither agree nor disagree
- ◯ Somewhat disagree
- ◯ Strongly disagree

What type of ticket do you most frequently use on HSL public transport?

- ◯ HSL card season ticket
- ◯ HSL card value ticket
- ◯ HSL app season ticket
- ◯ HSL app single ticket
- ◯ HSL app multi-journey ticket
- ◯ Single ticket purchased from a ticket machine
- ◯ Single ticket purchased from a sales point
- ◯ Some other ticket, please specify [ ]

How many months have you had a valid HSL season ticket over the past 12 months? Select the most suitable option.

- ◯ 0 months
- ◯ 1-2 months
- ◯ 3-5 months
- ◯ 6-8 months
- ◯ 9-10 months
- ◯ 11-12 months

If you want, you can write down your thoughts on light rail line 15 here:

Previous Submit