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Digital Journey Planner as a Facilitator of Last Mile Transportation Services in a Peripheral Tourism Destination

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Abstract: Transport accessibility is a major concern for peripheral tourism destinations. Transport accessibility can be divided into three categories based on the travelled distance: Air transportation capacity, ground transportation from central hubs, and the last mile connectivity to the destination. Peripheral destinations often have rural characteristics, which adds another challenge of organising in-destination transportation system to enable travellers to reach all experiences and services in the destination. The increasing demand for sustainability also drives destinations to decrease the carbon dioxide emissions per passenger kilometre, which, in turn, drives transportation planning towards public transportation type of solutions instead of small capacity solutions.

Once the last mile and in-destination transportation services have been organised in a peripheral destination, there is a marketing dilemma ahead; how to be able to efficiently and effectively inform travellers via digital channels before and during their travel about the transportation services available. It is vital to manage to invite travellers to use these services for several reasons: a) high capacity utilisation secure the profitability and continuity of transportation services, b) high capacity utilisation decreases the carbon dioxide emissions per passenger kilometre and supports achieving the sustainability targets, c) it increases perceived destination satisfaction of destination customers, and d) it makes distant in-destination services reachable for destination customers.

Intelligent transport systems were developed to inform travellers real-time on transportation services available. Currently operated systems cover several major cities globally but rarely exist or provide accurate and comprehensive information in peripheral destinations. Utilising action design research methodology, this research reports the opportunities and challenges of a digital journey planner deployment in a peripheral destination, Levi, in Finnish Lapland. As a research finding, a major opportunity of increasing customer awareness on transportation services available is reported. Similarly, an interesting opportunity to increase perceived transport accessibility is found. However, by analysing the transport-related destination ecosystem, it is shown, that coordination and management of a complex cooperation network is required to able to provide sophisticated intelligent transport system in a peripheral destination with rural characteristics. Major challenges include building the required cooperation network, and finding an optimal partner for the digitalisation. The research findings increase understanding on the digitalisation efforts in the context of last mile transportation services in a peripheral destination. The results are transferable to another peripheral or rural destination with similar characteristics.

Nuottila, Jouko: Digitaalinen reittiopas viimeisen kilometrin kuljetuspalveluiden edistäjänä syrjäisessä matkakohteessa

Avainsanat: matkailun digitalisaatio, älykkäät liikennejärjestelmät, reittiopas, viimeisen kilometrin kuljetuspalvelut, matkakohteen hallinta

Tiivistelmä: Saavutettavuus on merkittävä huolenaihe syrjäisille matkailukohteille. Liikenneyhteydet voidaan jakaa kolmeen luokkaan kuljetun matkan perusteella: Lentokuljetuskapasiteetti, maakuljetukset keskeisistä solmukohdista ja viimeisen kilometrin yhteydet määränpäähän. Syrjäiset matkakohteet ovat usein maaseutumaisia, mikä tuo lisähaastetta matkakohteen sisäisen liikennejärjestelmän järjestämiseen, jotta matkailijoilla on käytettävissä kuljetuspalveluita myös kauempana sijaitsevien palveluiden luo matkakohteessa. Kasvava vaatimus kestävän kehityksen mukaisesta toiminnasta kannustaa matkakohteita myös vähentämään hiilidioksidipäästöjä matkustajakilometriä kohti, mikä puolestaan ohjaa liikennesuunnittelua kohti julkisen liikenteen tyyppisiä ratkaisuja pienen kapasiteetin ratkaisujen sijaan.

Kun viimeisen kilometrin ja matkakohteen sisäiset kuljetuspalvelut on järjestetty syrjäisessä matkakohteessa, on edessä markkinointiongelma: miten matkailijoille voidaan tehokkaasti ja vaikuttavasti tiedottaa käytettävissä olevista kuljetuspalveluista digitaalisten kanavien kautta ennen matkaa ja sen aikana. Matkustajia ohjataan käyttämään näitä palveluita useista syistä: a) kapasiteetin korkea käyttöaste varmistaa kuljetuspalvelujen kannattavuuden ja jatkuvuuden, b) kapasiteetin korkea käyttöaste vähentää hiilidioksidipäästöjä matkustajakilometriä kohti ja tukee kestävyystavoitteiden saavuttamista, c) se lisää kohdeasiakkaiden kokemaa tyytyväisyyttä matkakohteeseen, ja d) se tekee kaukana matkakohteesta sijaitsevista palveluista saavutettavia matkakohteen asiakkaille.

Älykkäitä liikennejärjestelmiä on kehitetty tiedottamaan matkustajille reaaliaikaisesti saatavilla olevista liikennepalveluista. Tällä hetkellä käytössä olevat järjestelmät kattavat useita suuria kaupunkeja maailmanlaajuisesti, mutta niitä on harvoin toteutettu syrjäisissä kohteissa ja niiden kattavuus on yleensä heikko. Tässä tutkimuksessa hyödynnetään action design research -metodologiaa. Tuloksina esitetään digitaalisen reittioppaan käyttöönoton mahdollisuuksia ja haasteita syrjäisessä kohteessa. Tutkimuksen kohde on Levi Suomen Lapissa. Tutkimustuloksena raportoidaan merkittäviä mahdollisuuksia lisätä asiakkaiden tietoisuutta tarjolla olevista liikennepalveluista reittioppaan avulla. Samoin havaitaan mielenkiintoisia mahdollisuuksia lisätä matkailijoiden kokemaa liikenteen saavutettavuutta. Liikennepalveluiden ekosysteemiä analysoimalla osoitetaan kuitenkin, että monimutkaisen yhteistyöverkoston koordinointia ja hallintaa tarvitaan, jotta voidaan tarjota kehittynyt älykäs liikennejärjestelmä syrjäisessä kohteessa, jossa on maaseutumaisia piirteitä. Suurimpia haasteita ovat tarvittavan yhteistyöverkoston rakentaminen ja optimaalisen kumppanin löytäminen digitalisointia varten. Tutkimustulokset lisäävät ymmärrystä digitalisointipyrkimyksistä viimeisen kilometrin liikennepalvelujen järjestämiseen liittyen syrjäisessä kohteessa. Tulokset ovat siirrettävissä toiseen syrjäiseen tai maaseutumaiseen kohteeseen, jolla on samankaltaiset olosuhteet kuin tutkimuksen kohteessa.

This thesis is dedicated to all women and men working in research and development, the world of wonder.

Foreword

There are plenty of individuals and organisations who contributed to this piece of work and made conducting this study possible. I would like to thank University of Eastern Finland for an opportunity to study Tourism Marketing and Management in an international program. It has been a great experience, we have had motivating teachers and it has been a pleasure to study together with students from all over the world. I would also like to thank my supervisors, professor Raija Komppula and professor Juho Pesonen for all the support during my studies, and research and for the patience they have expressed while I have been tied with the full-time work almost the whole time of my studies.

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I feel really thankful for an opportunity to collaborate with the Digitransit community on this research. They were kind and supportive by providing me with an access to the Digitransit development environment. Milla Laita and Joel Lappalainen helped me a lot to get my data package installed on the Digitransit for testing the journey planner. In addition, I am grateful for being able to use the open Digiroad platform for this study. Without the access to an open, transparent database it would have been impossible to conduct this study,

I am also grateful for several other organisations for supporting this study and inspiring my thinking and interest on the digitalisation of tourism-related transportation services. I would particularly like to mention VTT, CGI, Matkahuolto, and Traficom. Janne Jakola, and Tuomo Kinnunen from Matkahuolto, and Martin Johansson from Traficom who have devoted their time on several occasions to discuss with me on the topics related to this study.

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Abbreviations

ADR	Action Design Research
ATIS	Advanced Traveller Information System
ETIS	Effective Traveller Information System
IT IS	Intelligent Traveller Information System
ITS	Intelligent Transport System
POI	Point of Interest
STD	Smart Tourism Destination
TIS	Traveller Information System
WAP	Wireless Application Protocol

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Contents

1 Introduction

1.1 Background of the study

Transportation is the most important enabler of traveling and it is an integral part of the tourism industry. The expansion of the commercial transportation sector (Oxley & Jain, 2015) has been a great facilitator for the explosive growth of tourism in the past 50 years (Roser, 2017). Without global transportation services, enormous efforts would be required from individual travellers to plan their travels and reach their desired destinations. The contemporary transportation system has created efficient and affordable means to access popular destinations like Berlin, London, or New York. There are also lots of tourism-specific transportation services to holiday destinations like Bora Bora, Tahiti, or Phuket. However, smaller and peripheral destinations still have challenges to provide travellers with an ease of access, especially during the low season and when there are no larger cities nearby. In addition, the availability of transportation services at the destination is a key concern for peripheral destinations with long in-destination distances, as there usually are no public transportation services available (Gühnemann, Kurzweil, & Mailer, 2021). Thus, it is a difficult challenge for a peripheral destination to orchestrate the last mile transportation services from national transportation hubs to the destination[1], and provide travellers with in-destination transportation services during their stay (Last mile project, 2018).

Once the peripheral destination has managed to increase the coverage of transportation services in the region, it faces another major challenge; how to reach out and inform travellers about the regional transportation services (Gühnemann et al., 2021). Travellers are not able to include regional services into their travel choices if they are not aware of them (Le-Klähn & Hall, 2015). Additionally, it would be important for them to understand the capacity of transportation to decide whether they need to make an online seat reservation or an online ticket purchase, as they might feel insecure to delay the purchase until arrival. While at the destination, it might be

[1] In literature, there is an established term *last mile*, which means the last link of the travel from origin to destination (e.g., Amonde, Ajagunna, & Iyare, 2017, and Last mile project, 2018)

overwhelmingly difficult for travellers to comprehend the local geography, the locations of stations and bus stops, and the routes of local transportation (Rojas, 2020). Thus, it would be essential to be able to provide information and guidance on using transport services also during the traveller's stay at the destination (Le-Klähn & Hall, 2015). A variety of different types of information would be beneficial; travellers need to know the timetables and the routes, they need to know where to get on and what is the closest bus stop to reach their destination, they should be able to monitor the travel to know when to get off, and finally it would increase their confidence on travel to have walking guidance to reach their destination (Maas, Bugeja, & Attard, 2021). Advanced, transportation-related digital information services are currently available in major cities around the world but they rarely exist in rural areas and peripheral destinations (Last mile project, 2017). This should be a major concern for peripheral destinations as transportation system experiences has a remarkable impact of travellers' overall travel and destination experience, and satisfaction (Biswas, Deb, Hasan, & Khandakar, 2020).

1.2 Research gap and earlier literature

The lack of digital information on local transportation services in peripheral destinations relates to several challenging issues. Planning for different types of transportation services is usually fragmented. There are both public and private sector planning conducted, serving different types of demand, and this leads to sub-optimised solutions. Earlier studies have found that existing rural transportation systems are fragmented, underutilised and uncoordinated (Essakali, 2005; Federal Highway Administration, 2001; Goodwin-Hawkins & Callard, 2021; Salo, 2021; The World Bank, 2005). As a consequence, also the information services related to transportation services are fragmented (Finnish parliament, 2016; Salo, 2021). Peripheral destinations located in rural areas typically also have low population density, especially during the low season, which means that there are rarely opportunities to generate high turnover from transportation services. Low profitability combined with the high level of fragmentation makes it difficult for transportation operators, both private and public, to invest in digital services providing information for travellers. The challenge is especially difficult with real-time information like sudden timetable changes, delays, cancellations, traffic alerts, and location-based services of transportation vehicles. There

are some national and international digital information service providers aggregating transportation service data from numerous transportation operators but still these services do not cover data on rural areas and peripheral destinations in a complete manner.

The availability of digital information on transportation services is increasingly important for peripheral destinations for various reasons (Ali & Frew, 2013). Primarily, it should be easy for customers to find all transportation services available from national transportation hubs to the destination (accessibility) (Federal Ministry, 2020). As many of the peripheral destinations are located in rural areas with long in-destination distances, there should be information on intra-destination transportation services available in digital format (destination experience and perceived satisfaction) (Biswas et al., 2020). In addition, providing public transportation type of services in a peripheral destination decreases the carbon dioxide emissions per passenger kilometre and provides low-emission choices for the customers preferring environmental-friendly services (sustainability) (Gühnemann et al., 2021).

There are earlier scientific studies recognizing the last mile problem related to tourism and rural and peripheral destinations (Gühnemann et al., 2021; Holmberg, 2018; Jihong, 2020; Abe, 2021). However, I couldn't find any empirical studies on transportation digitalisation related to the last mile problem in tourism. Similarly, there are tourism related scientific studies on journey planners discussing the topic in general terms (Ali & Frew, 2014; Le-Klähn & Hall, 2015; Tang, Wang, Sun, Chen, & Waygood, 2020). Some papers also look into the features of tourism related journey planners (Ferreira, Martins, Silva, & Almeida, 2017; Maas et al., 2021; Shaker et al., 2020) but their focus is on other features, not on the last mile problem.

1.3 Objectives and research questions

The concern of accessibility has been one of the major headaches for the tourism industries of peripheral destinations in Finnish Lapland. The main focus of the accessibility discussion has been on aviation transport, i.e., how to secure high capacity of national and international flights to the airports located in Finnish Lapland from the most important target markets, and connecting

transportation hubs. However, during the recent years, accessibility discussion has taken a new turn. The increase of individual travellers, both national and international, has led to a situation in which there are travellers arriving to the transportation hubs in the area without professionally arranged travel plans, routes and ticketing. In addition, there are more travellers preferring ground transportation because of sustainability concerns. Finally, there are an increasing number of vacation property owners who stay for weeks, or even months in a destination. Together with a "living like a local" trend, this increases demand for transportation services to the municipality centre, to more distant service locations, and to other destinations in the area.

The planning of transportation services is based on forecasted demand built on the analysis of historical data. However, this is not enough, potential customers also need to be aware of transportation choices they have, to be able to plan their travel chain from origin to destination. Thus, an emerging challenge is how to manage the availability and content development of a digital, multimodal journey planner for a peripheral destination. The digital journey planner provides travellers with real-time information on timetables, routes, station and bus stop locations, cancellations, change information, real-time location information while travelling, and walking guidance on map. Such digital journey planners are not yet available in peripheral destinations. There are some national level journey planners in Finland but they are not comprehensive and do not cover the last mile transportations and in-destination transportation. My main motivation for this research was to find out the opportunities and challenges of a journey planner deployment in a peripheral destination. Main focus was to clarify the potential and the benefits of a digital journey planner for a traveller and for the tourism industry in a peripheral destination. In addition, another main goal for this study was to analyse the transport-related destination ecosystem in a peripheral destination. The target was to find out the structure of the cooperation network needed to be able to develop an intelligent transport system with a digital journey planner in a peripheral destination.

The research questions of this study are the following:

Research question 1 (RQ1): What are the benefits of a journey planner including last mile transport for travellers in a peripheral tourism destination?

Research question 2 (RQ2): What are the obstacles of a journey planner deployment in a peripheral tourism destination?

Research question 3 (RQ3): What are the characteristics of the operational environment in a peripheral destination for implementation of a journey planner?

Research question 4 (RQ4): What are the managerial challenges of improving destination experience with a journey planner in a peripheral destination?

1.4 Key concepts

Rural (tourism) destination

Rural tourism destination, or rural destination, means a destination located in the area of low population density, characterized by landscapes dominated by non-built environments like forests and agricultural fields. As a consequence, rural tourism destination is usually also characterised by low public transportation service density. (Roberts & Hall, 2001; Rosalina, Dupre, & Wang, 2021; UNWTO, 2022b)

Peripheral (tourism) destination

Peripheral tourism destination, or peripheral destination, means a destination located at a large geographical distance from a traveller's place of origin or residence, and/or from central transportation hubs (Brouder, 2013; Brown & Hall, 2000; Iliachenko, 2005; Paloniemi, Jutila, & Hakkarainen, 2021; Zurick, 1992).

Smart tourism destination

The concept of smart tourism destination has a close relationship to smart city concepts (Koo, Shin, Gretzel, Hunter, & Chung, 2016). Smart tourism destination means a destination utilizing connected technologies widely for improving destination services, also including transport accessibility related services, both for local residents, and travelers before, during, and after the trip (UNWTO, 2022a).

Last mile

Last mile, or final mile, is a concept that relates to the last part of travel before arriving at the final destination of that particular trip. Similarly, the first mile means the first link of travel from origin to the nearest public transportation node (Kumar & Khani, 2021). For this research, I use the last mile concept to consider the provision of transportation services for the first or the last part of a traveller's multimodal or multipart trip to/from a peripheral destination, and in a rural peripheral destination while on a stay (Gühnemann et al., 2021).

Intelligent transport system

Intelligent transport systems (ITS) are comprehensive technology solutions to manage traffic, transportation, and related infrastructure (United States Department of Transportation, 2022; WSP, 2022). An essential part of these ITS deployments is an integration of traveller information systems (Benckendorff et al., 2019; Sampson et al., 2019).

Traveller information system

Traveller information system provides passengers with information on public transportation timetables, routes, tickets, exceptions, cancellations, and delays (Chorus, Molin, & van Wee, 2006; Sampson et al., 2019). They can also be called as journey planners (Birth, Hoffmann, Strassberger, Roor, & Schlichter, 2015; Bize, 2004; Gomes Rocha, Santos, & Rossetti, 2009).

Journey planner

Journey planner means an installable application used on a smart device, or a cloud application used with an internet browser on a computer or on a smart device. Journey planner enables travellers to plan a complete journey from an origin to a final destination using different modes of transportation, and it provides walking guidance on a digital map including point of interests (POIs) in the area. (Cheung & Sengupta, 2016; Golovin, 2016; Jacob et al., 2014; Berlingerio et al., 2015)

1.5 Research context

Levi is a peripheral tourism destination in Finnish Lapland. It is located in the municipality of Kittilä. Population of Kittilä was 6 526 at the end of 2021. Kittilä is third largest (8 263 km^2) municipality in Finland and it is sparsely populated. Population density is 0.81 inhabitants/km^2. The location of Kittilä in Finnish Lapland is presented in figure 1.

Finnish Lapland has four airports operating at the moment: Enontekiö, Kittilä, Ivalo, and Rovaniemi. The most important ones for Levi are the ones in Kittilä and Rovaniemi. They serve as transportation hubs for Levi and other Lappish destinations. The most important railway stations in Lapland are in Kolari, Kemijärvi and Rovaniemi. Most of the travellers arriving by train to Levi are coming via Kolari and Rovaniemi stations. The relevant transportation hubs and the main roads are presented in figure 2.

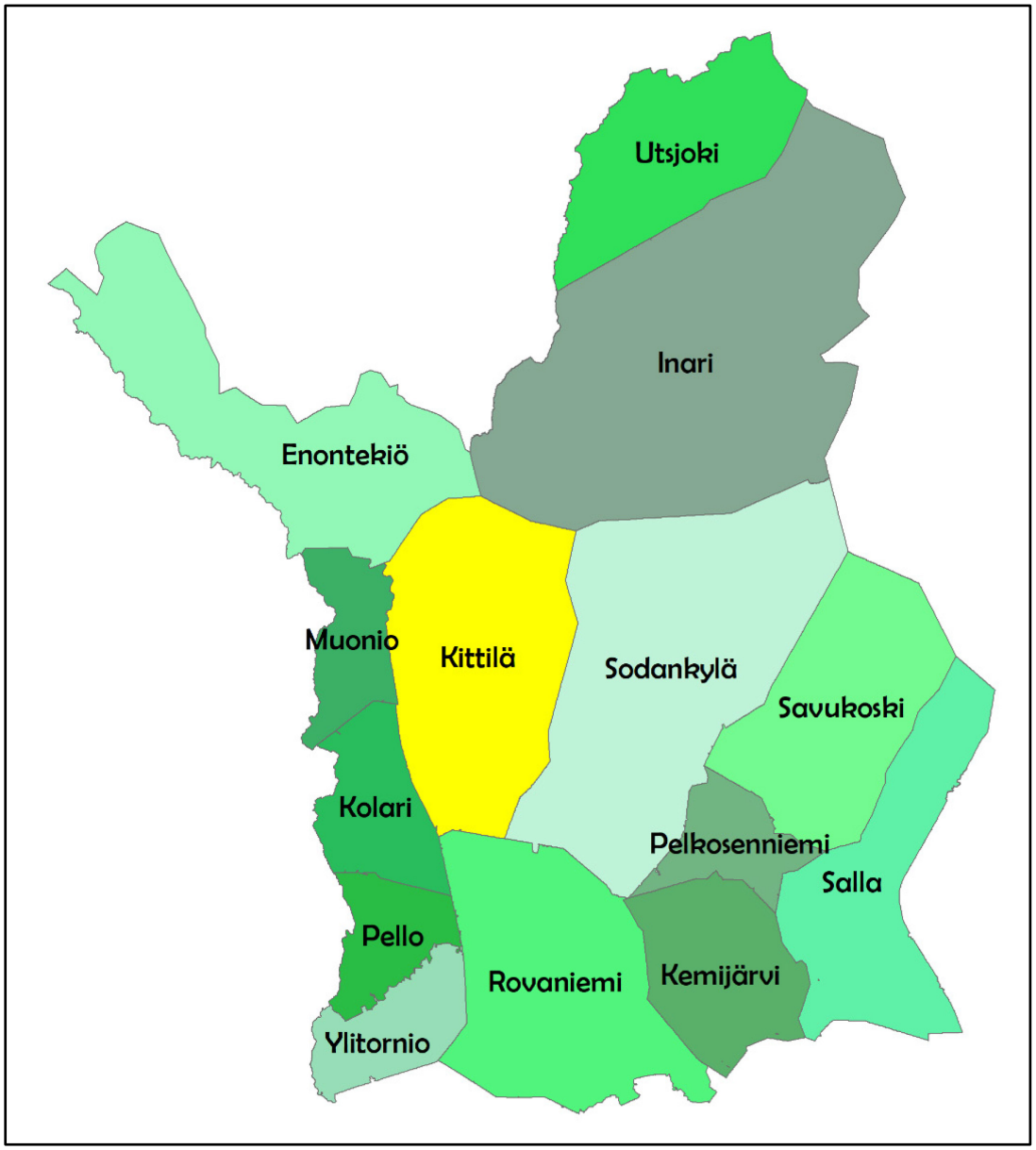

Figure 1. Kittilä is located in Finnish Lapland. Other municipalities in Lapland are also presented on the map.

Levi tourism destination is geographically located partly in the village of Sirkka, and partly on the fell Levi. The built environment consisting of leisure apartments has been expanded also around the fell Levi. Outdoor activity area has been further expanded to the fells of Kätkä and Pyhä. As illustrated in figure 3, Levi tourism destination has the characteristics of a rural destination. Even some of the tourism infrastructure is dense near to the village Sirkka, many tourism services, accommodation areas and outdoor experiences are sparsely located in a large geographical area.

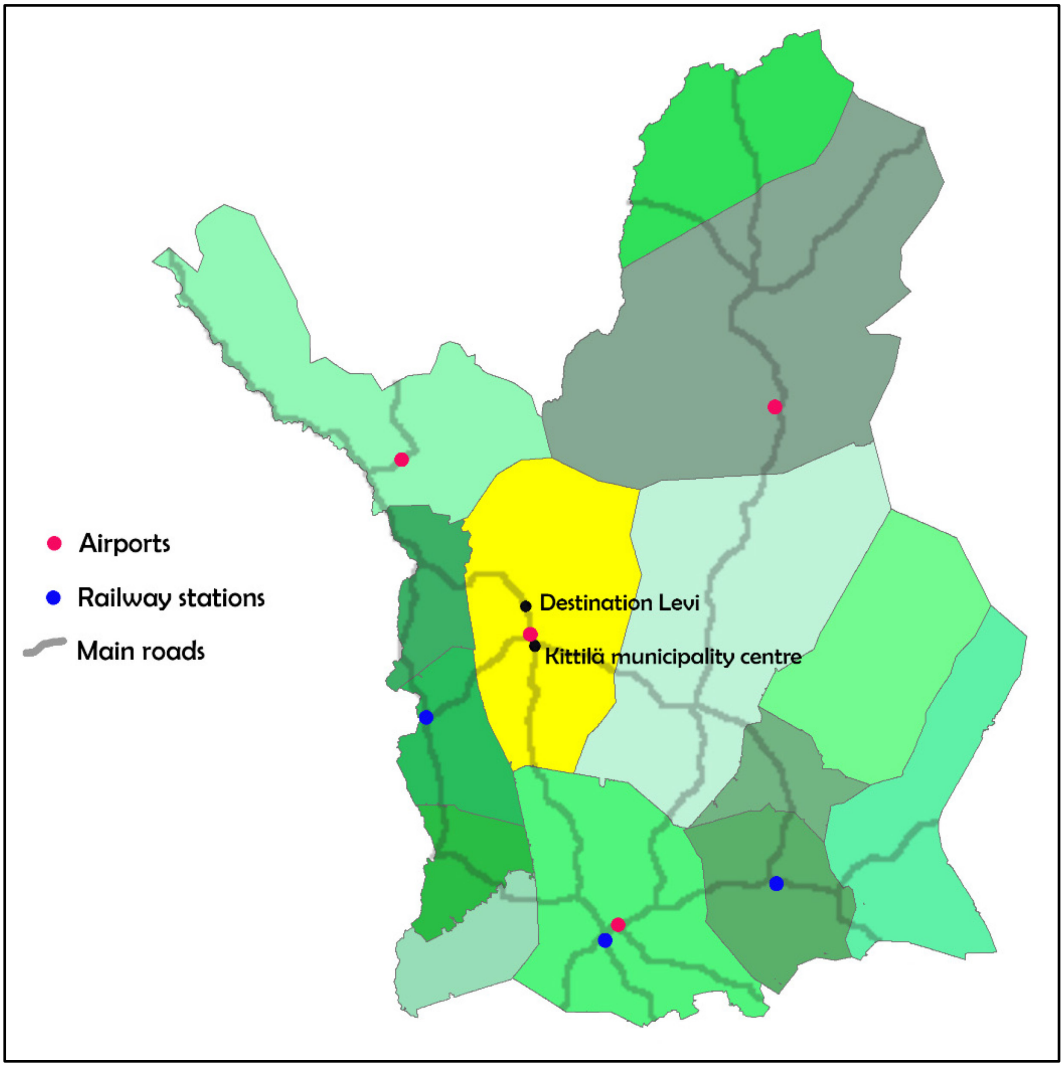

Figure 2. Main roads and transportation hubs in Finnish Lapland.

There is a destination marketing organisation operating in the area. The company is called Levin Matkailu and it uses Visit Levi as a brand name for destination marketing operations. In addition to marketing of destination Levi, Levin Matkailu[2] also operates as a travel agency, and as a rental agency for leisure apartments in the area. Levi Ski Resort is a company focusing on ski resort operations, management and maintenance. The company owns the ski resort land and ski lift properties. In addition, the company owns and operates several restaurants on the ski slopes. The company also operates Ski Bus transportation service in the area. Municipality of Kittilä is a major shareholder of Levi Ski Resort and a minor shareholder of Levin Matkailu.

[2] Levin Matkailu has registered two auxiliary company names “Destination Levi” and “Levi Destination Sales and Marketing” and operates the destination web site https://www.levi.fi/en

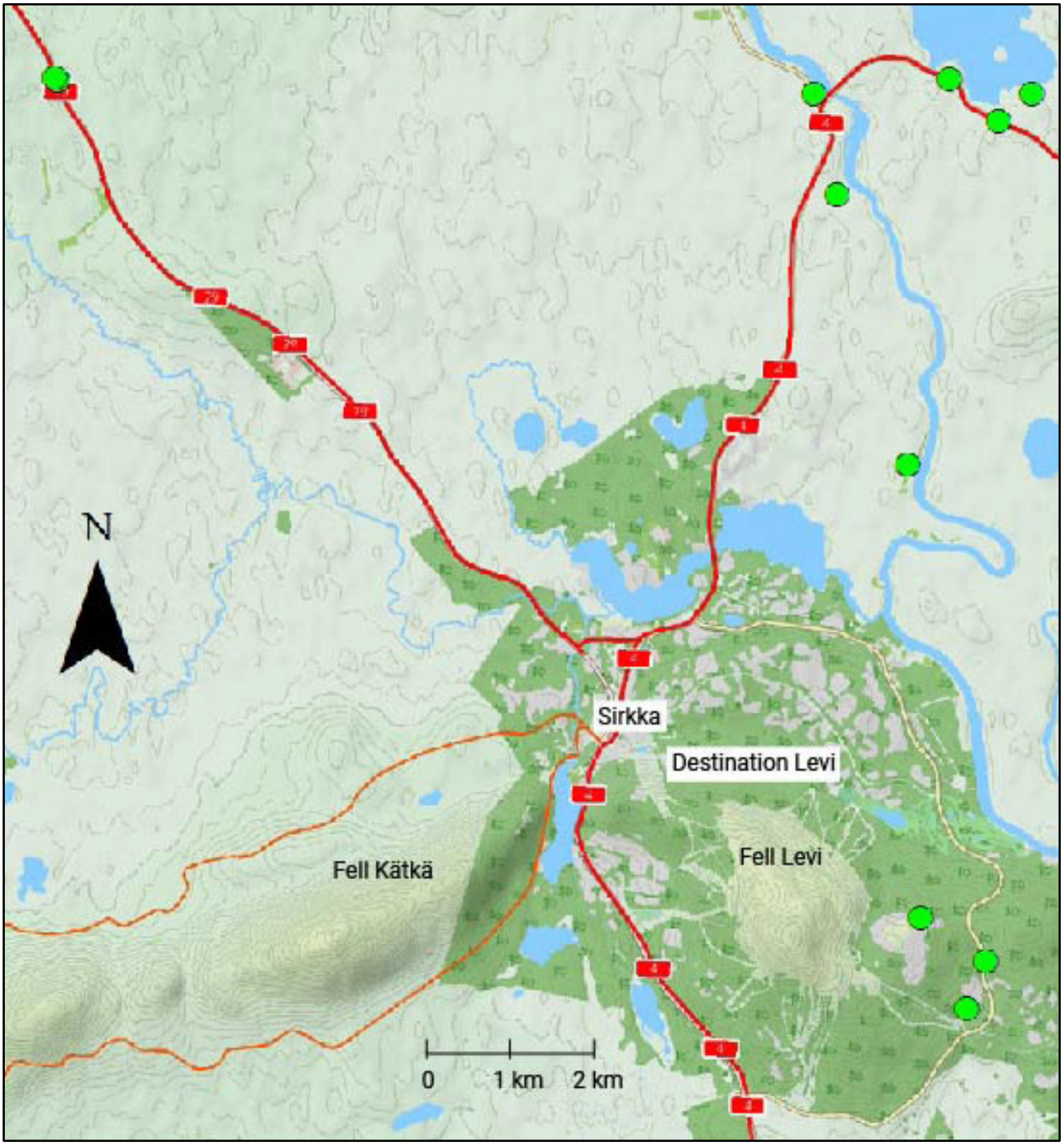

Figure 3. Levi tourism destination. Green circles illustrate a few of many tourism related services and attractions sparsely spread outside the inner boundaries of Levi. The destination has rural characteristics.

The rest of the research report is organised as follows. First, I will present the theoretical background of the study in chapter 2. Then, I will introduce the methodology in chapter 3 followed by the empirical phase of the study in chapter 4. Chapter 5 discusses the analysis and the findings of the research, and chapter 6 concludes the research.

2 Theoretical background

My research topic is a multi-disciplinary phenomenon combining concepts and literature from academic discussions on smart tourism destination, destination management, tourism geography, intelligent transport systems, and transport digitalisation. Thus, it is a challenge to identify and find all relevant earlier literature on the topic to build a solid base for the empirical study. Because of this, I adopted a systematic approach for the literature search which is described in details in appendix 1. Next, I will introduce the theoretical background of the study.

2.1 Literature related to the research context

2.1.1 Rural and peripheral destinations

Rural destinations can be defined as non-urban tourism destinations (UNWTO, 2022b). Rural tourism destinations have characteristics of low population density, landscape dominated by non-built environments like forests or agricultural fields, and traditional lifestyle and social life UNWTO, 2022b). Roberts and Hall (2001) point out that the "*definitions of 'rural' vary both in scale and philosophy*". Rural tourism can be defined as tourism activity located in a countryside with low population density (Roberts & Hall, 2001; Rosalina, Dupre, & Wang, 2021). But rural tourism also can be defined with a relation to more complex social and mental aspects (Lane, 2009; Rosalina et al., 2021). Thus, the term rural can be used to refer to the characteristics of social life (Lane, 2009; Rosalina et al., 2021), or to the tourism activities which are perceived as rural (Lane, 2009). For the use in this research, I adapted a definition of rural destination as a destination located in the area of low population density. The term rural destination also has another transport-related meaning; in rural destinations, there are popular attractions and experiences scattered around the destination with distances requiring transportation. This also applies to non-rural destinations, e.g., large cities, but it is the availability of continuous, all year round, dense public transportation that makes the difference between rural and non-rural destinations. Thus, rural destination means a destination located in the area of low population density, and low public transportation service density.

Peripheral destination can be defined as a destination located geographically far from target markets (Brown & Hall, 2000). Peripheral destinations may be geographically isolated (Zurick, 1992), they are characterised by being distant from "*core spheres of activity*" (Brown & Hall, 2000), and they are remote and poorly accessible from markets (Brouder, 2013; Iliachenko, 2005; Paloniemi, Jutila, & Hakkarainen, 2021). Similar to the definition of rural destination, also peripheral destinations are suggested to be characterised with social and philosophical meanings of peripherality, such as being marginalised on a national level in social, political, and economical decision making, and lacking power to influence on these decisions (Brown & Hall, 2000; Hohl & Tisdell, 1995). Schmallegger, Carson, and Tremblay (2010) have also developed peripherality further in conceptual and theoretical terms by distinguishing different types of peripheralities in tourism, but their work is built on economic geography and political economy, and as their contribution is highly valuable, it is not relevant for this research focusing on destination transportation systems. In the context of this research, peripheral destination means a destination located at a large geographical distance from a traveller's place of origin or residence, and/or from central transportation hubs. Though some exceptions exist (e.g., Fuchs, Höpken, & Lexhagen, 2014; Pantelidis, 2020; Ranjan & Chaturvedi, 2020), tourism research literature has rarely studied technology advancements in rural or peripheral destinations. Thus, there is a need to look into smart tourism destination literature for references on digital technologies in tourism destinations.

2.1.2 Smart tourism destinations

The concept of smart tourism destination (STD) has a close relationship to smart city concepts (Koo, Shin, Gretzel, Hunter, & Chung, 2016). The term smart refers to the wide utilisation of information and communication technologies in connection to technological, economic and social developments of cities, or tourism destinations (Gretzel, Sigala, Xiang, & Koo, 2015; Koo et al., 2016). Buhalis and Amaranggana (2014) argue that STDs utilise technology platforms and enable travellers to connect to these platforms with their own devices in order to create and facilitate real-time tourism experiences. STDs also use the collected data to enhance tourism resources management on both micro and macro level (Buhalis & Amaranggana, 2014). It is also suggested that smart tourism enable bridging physical and digital worlds during the trip (Gretzel et al., 2015). In addition, modern STDs utilise advanced technologies like big data, smart sensors, travellers'

smartphones, and digital transformation holistically (Gretzel et al., 2015; Jovicic, 2015). Holistic approach is important, Boes, Buhalis, and Inversini (2015) emphasize that technology is not enough to make a tourism destination smart but the transform towards smart requires human capital, leadership, social capital, and innovation. There are even wider definitions used on STDs; UNWTO (2022a) adds sustainability, accessibility, and concern on local residents as characteristics of STD:

> *"A smart destination is one with a strategy for technology, innovation, sustainability, accessibility and inclusivity along the entire tourism cycle: before, during and after the trip. A smart destination is also one with residents as well as tourists in mind, factoring multilingualism, cultural idiosyncrasies and seasonality into tourism planning."*

STD is a concept of a destination pursuing to utilize connected technologies widely for improving destination services, especially transport accessibility related services, for local residents, and travelers before, during, and after the trip.

2.2 Literature on transport services and transport digitalisation in tourism

2.2.1 Transport services in STDs

Smart tourism destination, as a term, was initiated in the literature for almost fifteen years ago. Jurin (2008) presented some of the foundational ideas of STD development. His ideas emphasised information technology usage to monitor destination financial indicators, brand value, customer satisfaction, and internal operational efficiency (Jurin, 2008). These efforts serve the strategical management of marketing and destination competitiveness (Jurin, 2008). However, in 2013, the term was used in a meaning it is now widely understood in contemporary tourism research (Buhalis & Amaranggana, 2013; Wang, Li, & Li, 2013). Buhalis and Amaranggana (2013) describe STD as a concept initiated from the conceptual development of smart cities. Wang et al. (2013) suggest that the service-dominant logic in tourism drives the development of STD and related technological solutions. Mobile applications and smartphones are suggested to be the main user interface for consuming information and producing user-generated content in STDs (Wang et al., 2013; Zhang, Li, & Liu, 2012). Early papers also suggest that in addition to mobile technologies,

cloud computing, Internet of things, and artificial intelligence are the central information technologies for STDs (Wang et al., 2013; Zhang, Li, & Liu, 2012).

Some STD related papers also cover transportation services and transportation digitalisation. Wang, Xiang, and Fesenmaier (2014) suggest that travellers often use their smart devices for purchasing transportation tickets, and navigating their travel routes. Mandić and Praničević (2019) note that fast development of digital technologies has induced the evolution of transportation systems making them more accessible for travellers. They suggest that digitalisation has made the provision of transportation services also more convenient and affordable for travellers (Mandić & Praničević, 2019). Indeed, there is room for improvement as traditional ground transportation has received critique from travellers (Kim, Park, Yun, & Yun, 2017). Transportation received the lowest score in a large study on STD tourist's reviews on different tourism related service segments in Paris (Kim et al., 2017). It is suggested that especially public transport systems should get developed into more convenient and sustainable directions to support future tourism development (Marin-Pantelescu, Popescu, & Ștefan Hint, 2021; Tung, Cheong, & To, 2019). Aviation being the most problematic transport mode in public discussion (Tervo-Kankare & Saarinen, 2013), road travel is also recognised to be one of the most important sources of greenhouse gas emissions in tourism (White & Buultjens, 2013), and thus it is important to take advantage of technologies to be able to decrease the carbon dioxide emissions per passenger kilometre (Dickinson, Robbins, & Lumsdon, 2010). Because of this, smart mobility solutions are suggested to be one of the key elements in the development of smart destinations (Boes et al., 2015; Buhalis & Amaranggana, 2014; Nuottila, Hakkarainen, Kinnunen, & Pihlajamaa, 2020).

2.2.2 Transport services in rural and peripheral destinations

One of the rare studies on transportation in rural destinations was conducted in the area of Purbeck, UK, in which there was a tension observed between the locals and the tourists arriving by their private cars and causing traffic problems in the area (Dickinson, Robbins, & Fletcher, 2009). Based on the study among residents and tourists, bus was seen as the main alternative to the private car (Dickinson et al., 2009). However, the study demonstrated that there was a need to substantial improvements for the bus service to be able to promote the use of it (Dickinson et al.,

2009). It was also suggested that travellers make decisions on the mode of transport in the light of their social reality, and draw on representations that support their behaviour in particular contexts (Dickinson & Robbins, 2008). Thus, social reality of travellers influences their transportation choice rather than the objective reality of buses, and other transportation services that many travellers don't know about (Dickinson & Robbins, 2008). For a rural destination, it is important to have transportation services available, but it is crucial to put emphasis on spreading information on them effectively, make the use of them convenient, and communicate the sustainability aspects clearly to be able to influence traveller's social reality in favour of public transportation use. Destination management, public transport organisers, and transport providers should be able to develop innovative and effective alternatives to private and small capacity cars to avoid traffic-related problems and improve sustainability measures (Buonincontri & Micera, 2016; Dickinson & Robbins, 2008). Similarly, it is suggested that tourism planning activities should put more emphasis on developing travel chains, a concept of integrating different means of travel and transport into a single package (Schiefelbusch, Jain, Schäfer, & Müller, 2007). For individual travellers, the concept of travel chains is important as it enables planning from origin to destination easily before the travel by reducing the information barriers (Schiefelbusch et al., 2007). With well-functioning travel chains, it is possible to use transport to add value to the leisure experience (Schiefelbusch et al., 2007; Zhang, Wei, Fu, Hua, & Wang, 2019).

In a study of bus transportation characteristics in a rural destination, there are three elements listed differing leisure travel from utility travel (Guiver, Lumsdon, Weston, & Ferguson, 2007). First, leisure travel involves high level or discretion. Travellers do not only make decisions whether or not to travel in the first place, but they also make decisions of destination, mode, and time of the travel (Guiver et al., 2007). Second, leisure travel produces intrinsic value, it is perceived to create benefits itself in addition to having value of reaching a destination (Guiver et al., 2007). Third, travellers are usually not familiar with the destination area and the transport infrastructure there (Guiver et al., 2007). It was also found that the availability of scheduled buses in rural destination areas attract new market segments to the destination (Guiver et al., 2007). However, there were some prerequisites for this: a) travellers need better information on transportation services with real-time information and local information, b) transportation services need stability to allow

cross-business synergies, promotion and utilization, and c) travellers need complementary information on combining several types of transportation and activities in destination (walking, hiking, mountain biking etc.). Zhang et al. (2019) have later reported similar findings. Improving transport services and facilitating smart mobility can support several important sustainability targets in tourism destinations. Smart mobility solutions can decrease local transportation related emissions (Della Corte, D'Andrea, Savastano, & Zamparelli, 2017), increase local transportation utilisation rate (Guiver et al., 2007), and improve general service level for local residents (Li, Yang, Shen, & Wu, 2019).

An emerging tourism related trend which influences transportation choices and might have an influence on the management of rural and peripheral destinations is slow travel. There is an increasing number of travellers who have pro-environmental concerns (Hares, Dickinson, & Wilkes, 2010), and thus react to the high carbon travel practices in tourism by travelling according the concept of slow travel (Dickinson, Lumsdon, & Robbins, 2011). Slow travel, as a concept, has three paths of research literature. First, some studies relate slow travel specifically to the transportation modes with lower environmental impacts, or to less travel generally (Dickinson et al., 2011). These studies relate slow travel with slow tourism, meaning longer stays at the destination (de la Barre, 2012; Murayama & Parker, 2012), and transportation modes of train, sailing and buses (Dickinson et al., 2011). There are big differences in emission levels between different transportation modes (table 1). Second, other studies relate slow travel to the nature of superficiality of modern tourism, and emerging need for better and more meaningful tourist experiences (Dickinson et al., 2011). Third, some studies relate slow tourism to the new approach on transport as a tourist experience (Dickinson et al., 2011). It is argued that transportation phase of the travel doesn't need to minimised but instead it can be a valuable experience itself (Salomon & Mokhtarian, 1998).

Table 1. CO_2 emissions of transportation modes (Dickinson & Lumsdon, 2010)

Transportation mode	**kg/passenger km**
Aviation <500 km	0.183
Aviation 500-1000 km	0.134
Aviation 1000-1500 km	0.130
Aviation 1500-2000 km	0.121
Aviation >2000 km	0.111
Car	0.121
Rail	0.033
Coach (Bus)	0.027
Cycle	0
Walk	0

Slow tourism is also connected to a cultural development in urban areas which can be called as a search for a better life (Murayama & Parker, 2012). This development makes representation of rural area living, or spending vacations there, as an experience which is spiritually fulfilling (Murayama & Parker, 2012). Slow tourism can increase demand for rural vacations and longer stays in peripheral areas (Markwell, Fullagar, & Wilson, 2012; Mohamad Noor, Nair, & Mura, 2015) which can benefit the local economies (Petroman, Văduva, & Marin, 2021). It is important to compensate the increased number of travellers by managing the environmental impact and transport emissions by offering efficient public transportation solutions to avoid endangering sustainable transition possibilities (Zamparini, 2021).

2.2.3 Last mile transportation

Last mile, or final mile, is a concept that relates to the last part of travel before arriving at the final destination of that particular trip. It can be defined as the last link of travel from origin to destination (Last mile project, 2018). The last mile can be a walk or a bus ride from a railway station to an attraction in a rural area, or it can be the last train connection to the city of Swansea in Wales after a long-haul flight and a ride with Heathrow Express (Visit Britain, 2017). The last mile can also

be a walk, or a bicycle or bus ride to a recreational area in nature from a metro station (Holmberg, 2018). Wang (2019) defines the last mile as a travel from the nearest public transportation node to a traveller's home or other final destination. Similarly, the first mile means the first link of travel from origin to the nearest public transportation node (Kumar & Khani, 2021). In this study, the last mile concept considers the provision of transportation services for the first or the last part of a traveller's multimodal or multipart trip to/from a peripheral destination, and provision of transportation services in a rural peripheral destination during the stay.

Often the tourism destinations lack the last mile transportation services (Gühnemann et al., 2021). Because of this, in many tourism destinations there are temporary, or on-demand based, services developed. Ski buses, hiker's taxis, dial-a-bus systems are for example offered in tourism destinations in Austria (Federal Ministry, 2020; Gühnemann et al., 2021). Carpooling, carsharing, free city bikes, and short-term rental of bicycles, cars or boats are also considered as a solution for the last mile problem in the Nordic cities (Holmberg, 2018). Last mile topics still are most often discussed in the urban and city contexts. For example, the question of last mile transportation is very relevant for the stations of high-speed railways (Jihong, 2020), and urban rail stations (Abe, 2021) because of the high number of travellers. In large cities, autonomous vehicles are currently investigated as a promising, sustainable future solution providing last mile transportations (Abe, 2021).

There are some challenges identified in providing last mile transportation in tourism destinations. Poor cooperation and communication between relevant regional stakeholders for achieving sustainable tourism mobility has been seen as a problem (Last mile project, 2017). Also, the lack of experience in implementation and operation of last mile services by the transport organisers can hinder the service development (Last mile project, 2017). Travellers might not have used different types of last mile transportation services and thus are not familiar with them, especially if they have preferred private or rental cars earlier (Last mile project, 2017). Finally, it is recognised that comprehensive public transportation system, e-mobility, intelligent transportation system and related mobile applications for traveller's journey planning could attract more users and

visitors for destinations, and increase economic and social benefits for local communities (Holmberg, 2018; Last mile project, 2018).

In a recent study in Austria, it was reported that one of the main reasons why travellers didn't take a train on their winter of summer vacation, was the lack of sufficient mobility at the destination (Gühnemann et al., 2021). The lack of information was also mentioned. The authors suggest improvements of local public transport provision to be conducted, including improvements for the information and ticket booking systems (Gühnemann et al., 2021).

2.2.4 Intelligent transport system

Intelligent transport systems (ITS) are comprehensive technology solutions to manage traffic, transportation, and related infrastructure (United States Department of Transportation, 2022; WSP, 2022). These systems utilise information and communication technologies to improve safety, efficiency, performance, and sustainability of the transport system (Benckendorff, Xiang, & Sheldon, 2019; United States Department of Transportation, 2022; WSP, 2022). There are various architectures of intelligent transport systems which are governed by public administration. Some of them cover cities, e.g., in Tampere (Viiri, Aunimo, & Aramo-Immonen, 2019), New York City, Paris, or Seoul (Asiag, 2021), while some of the systems can operate on national (ITS Australia, 2022), or international level (ERTICO, 2022). ITS deployments by public administrations can include data on weather, traffic flow, road conditions, accidents, and other real-time information (Tahir, Mäenpää, Sukuvaara, & Leviäkangas, 2021). ITS can also be used to automatically collect road tolls, change the speed limits, inform drivers real-time on electronic message boards, and give a traffic light priority to buses and trams in the cities (Benckendorff et al., 2019; United States Department of Transportation, 2022). Private ITS deployments can include fleet management features, location and freight information (Benckendorff et al., 2019). ITS related to passenger transportation can also include data on capacity, number of free seats available, and delays (United States Department of Transportation, 2010). Both, public traffic management organisations and private transportation service providers have ITS deployments managing passenger transport operations (Chorus, Molin, & van Wee, 2006; Giannopoulos, Mitsakis, & Salanova, 2012). An essential part of

these ITS deployments is an integration of traveller information systems (Benckendorff et al., 2019; Sampson et al., 2019).

2.2.5 Traveller information system

Terminology regarding traveller information systems[3] (TIS) is still a bit vague as there are two meanings and applications attached to it. Firstly, traveller information systems can be implemented as a service for private and commercial drivers (Benckendorff et al., 2019; Chorus, Molin, & van Wee, 2006). In this case, it provides real-time information for drivers on road conditions, traffic, traffic jams, and accidents (Benckendorff et al., 2019). It can also provide location information on available parking lots, car services, and other commercial POIs (Sampson et al., 2019). TIS can also be used to inform drivers, for example, on traffic direction changes on reversible lanes during rush hours (Wu, Sun, Gao, & Zhang, 2009). Sometimes, also in-car navigation systems (Benckendorff et al., 2019), in-car digital dashboards (Meschtscherjakov, Wilfinger, Scherndl, & Tscheligi, 2009), and driver assistance systems (Anthony & Whenish, 2021) are considered to be part of TIS. Secondly, TIS can also be implemented as a service for passengers (Benckendorff et al., 2019; Sampson et al., 2019). In this case, TIS provides passengers with information on public transportation timetables, routes, tickets, exceptions, cancellations, and delays (Chorus, Molin, & van Wee, 2006; Sampson et al., 2019). These TIS services focusing on passengers as target customers are also often called as journey planners (Birth et al., 2015; Bize, 2004; Gomes Rocha, Santos, & Rossetti, 2009).

[3] There is a vast amount of literature on traveller information systems as their development started already in 1960s. Lyons (2001) argue that currently we have already observed three generations of traveller information systems: 1st generation applications were traveller information systems mainly for traffic surveillance, 2nd generation applications were (web-based) advanced traveller information systems (ATIS) for passenger and drivers, 3rd generation applications were intelligent traveller information systems (ITIS) utilising artificial intelligence. In addition, Lyon (2001) also argues there is an emergence of effective traveller information systems (ETIS) ongoing. Chorus, Molin, & van Wee (2006) cover the early phases and rationale of ITS comprehensively.

2.2.6 Journey planner

Journey planner is an installable application used on a smart device (Birth et al., 2015), or a server-side application used with an internet browser (Jakob et al., 2014). Journey planner enables travellers to plan a complete journey from an origin to a final destination using different modes of transportation like flights, trains, trams, metros, buses, and ferries (Birth et al., 2015; Jakob et al., 2014). It might also include some local, niche transportation modes and on-demand services (Matkahuolto, 2020). Journey planners usually include information of transportation services inside certain regional boundaries, cities, municipalities, counties, states, or countries. Advanced journey planners provide travellers with walking guidance (Yang & Hsu, 2016) on a digital map including POIs (Rojas, Delva, Colpaert, & Verborgh, 2020) in the area. Journey planners are also called trip planners (Sierpiński, Staniek, & Celiński, 2016), route planners (Ferreira et al., 2017), multimodal trip planners (Casey, Bhaskar, Guo, & Chung, 2014), or intermodal journey planners (Casey, Bhaskar, Guo, & Chung, 2015) depending on the context. Examples of well-established journey planners can be found in Helsinki or in Antwerp. The application described here is the similar to the one in Helsinki[4] or in Antwerp[5].

2.2.7 Journey planners in tourism

The major part of the literature on journey planners relates to the context of cities with high population density. However, there are also studies on journey planners in tourism context too. One of the first ideas on a service similar to journey planners was introduced in "The world in your hands on the move project" in Greece (WHAM, 2013; Zografos & Madas, 2002). A prototype of a server-side application was developed to be used with a WAP or a mobile Web client (Zografos & Madas, 2002). The prototype was suggested to provide travellers with information on (Zografos & Madas, 2002):

[4] Helsinki city transport journey planner at https://www.hsl.fi/en
[5] Antwerp city transport journey planner at https://www.slimnaarantwerpen.be/en/home

- actual (if changes compared to timetables) schedules of different modes of transportation with specific focus on intermodal trips between Greece mainland and islands,
- expected travel time with guidance on optimal departure time for intermodal trips,
- destinations and tourism destinations in Greece,
- accommodation options,
- activities and experiences in tourism destinations, and
- other services in tourism destinations.

Some of the features faced technical challenges, mainly because of the problems in communication protocols between background servers, but the journey planner features were demonstrated successfully (Zografos & Madas, 2002; Zografos, Madas, & Salouras, 2004). Interestingly, on the same project, funded by the European Commission, internet services for travellers were developed also in Madrid and Levi (WHAM, 2013). In Levi, the internet services covered static information on tourism services and activities, special offers, and schedules of public transportations and ski buses (WHAM, 2013).

There are some tourism related papers published discussing journey planners. Ali and Frew (2014) studied information and communication technologies in tourism. They suggest that improved ground transport system with digital information will make travellers more aware of all transportation services available and will lead to increased usage of public transport (Ali & Frew, 2014; Le-Klähn & Hall, 2015; Tang et al., 2020). Based on a survey among destination management organisations, ITS was ranked as the second important application to advance sustainable tourism (Ali & Frew, 2014). Journey planner can inform travellers of exact times of public transport in destination and by facilitating wider usage, journey planner leads to energy savings and protection of the environment (Ali & Frew, 2013).

Journey planners are also envisioned to have additional features in the future. In a conceptual study, journey planner was integrated with a user's Facebook account to fetch information on user's interests and preferences (Ferreira, Martins, Silva, & Almeida, 2017). Based on the preferences, the application would be able to suggest attractions and other POIs and guide the route to the one traveller is interested going to (Ferreira et al., 2017). The authors consider the

suggested application to be a “digital concierge” recommending travellers nice places and restaurants to visit, as do the traditional concierges at hotel lobbies. Similarly, Golovin (2016) suggests personalising features to journey planners to remember the most used transport modes and routes and making them visible first for the users. Similar approaches were tested in Malta, when researchers developed a prototype of a journey planner to include several categories of tourist activities as POIs (Maas et al., 2021). After selecting the activity which they are interested participating in, the journey planner suggests transportation routes and modes which are available at the time (Maas et al., 2021).

Journey planner has also played a role in other loosely tourism related studies. Recreational cyclists were in the focus of a research, which studied if the journey planners could be used not to find the shortest route but a scenery road of certain length (Souffriau, Vansteenwegen, Berghe, & Van Oudheusden, 2011). Cyclists often have a target length in their mind as for an exercise. The study was conducted in East Flanders, Belgium, which is marketed as towards cyclists with a number of products (Souffriau et al., 2011). Rojas (2020) studied conceptually if the semantic web extension could be used to educate journey planners for example to find public transport routes accessible with wheelchairs, or to guide travellers for scenery walk-arounds in a strange city, or help cyclists to avoid highly polluted road areas. Similar concept was suggested for a national park in Belgium by utilising a smart phone application (Shaker et al., 2020). Visitors are given route suggestions on the applications based on their preferences on length, landscape, and level of accessibility for their visit in the park (Shaker et al., 2020). Deployment of a journey planner was also suggested for a national park in England to encourage visitors to choose bicycles instead of a private car while visiting the park (Shaker & Hermans, 2021).

Quite naturally, journey planners are studied intensively in the discipline of computer science. Journey planners require route optimisation calculations (Aemmer, Ranjbari, & MacKenzie, 2022; Gavalas et al., 2015; Nair, Coffey, Pinelli, & Calabrese, 2013), data processing (Birth et al., 2015; Garcia, Arbelaitz, Linaza, Vansteenwegen, & Souffriau, 2010; Rodríguez, Molina, Pérez, & Caballero, 2012), and many algorithms (Koszelew, 2011; Vansteenwegen, Souffriau, Vanden Berghe, & van Oudheusden, 2011; Vuurstaek et al., 2020), which are studied extensively.

2.3 Management of transport digitalisation in peripheral destinations

Digitalisation of ground transport services are closely connected to tourism development. This close connection is acknowledged and demonstrated in professional literature (e.g., Federal Ministry, 2020; Last mile project, 2017; Latvasalo & Björk, 2019; Visit Britain, 2017), but the important relationship between transport, digital transport information services and destination management has not been studied in details yet (Becková & Nováková, 2018; Lohman & Duval, 2014). However, some initial studies have been published. Christensen (2020) suggests that with a digital media, such as a journey planner, local government can improve the travel experience for tourists. This also increases the service level for local residents, and helps to mitigate the transport-related negative effects of tourism on environment (Christensen, 2020). The quality of transportation to destination was found to be a significant factor to visitors' overall holiday experience in a rural, peripheral destination (Mehmetoglu & Normann, 2013). In a study among international travellers in Ghana, it was found out that travellers were willing to use small intra-city buses, and larger buses for longer distances if the route was feasible for the destination, and was available at the time needed (Nutsugbodo, Amenumey, & Mensah, 2018). The traveler preferring public transportation also saw the affordability as an important factor for their choice of buses (Nutsugbodo et al., 2018).

Gühnemann et al. (2021) observed that there are financial, legal, institutional and partly technical barriers hindering the development of the last mile transportation development. They suggest that strong cooperation between the actors is needed, and there should be a local cooperation framework in place to develop last mile transportation and related digital services (Gühnemann et al., 2021). It is also suggested that strategic partnerships between tourist operators and transport companies should be built to ensure sustainable mobility in environmentally fragile areas with attractive public transport (Imhof, Vogel, & Ruiz, 2009; Poltimäe, Rehema, Raun, & Poom, 2022; Shah, Dawood, Jalil, & Adnan, 2019). As discussed above, digitalisation efforts are needed to achieve these targets. Local governments are seen as an important actor who should increase their responsibility for the development of digital applications (Christensen, 2020). It is also suggested that destination management organisations should demonstrate leadership locally by pioneering in utilization of technology and driving towards higher rate of digitalization (e.g. Del

Vecchio and Passiante, 2017; Boes, et al., 2015). Tourism system is a complicated network of different actors. There is a symbiotic cooperation between tourism business and facilities with transport service providers (Lohman & Duval, 2014). Municipalities, cities, and local governments also play a major role in tourism development and public transport provisioning in rural and peripheral destinations (Carson, Carsin, & Hodge, 2014; Last mile project, 2018; Putro, Pradono, & Setiawan, 2021). Thus, a wide cooperation between different parties is needed to improve transport services and related digital information services in destinations to encourage travellers to use public transportation and facilitate sustainability transitions (Gühnemann et al., 2021; Zamparini & Maltese, 2021).

3 Methodology

I apply pragmatism as a research paradigm for this research (Biesta, 2010; Feilzer, 2010; Jacobs, 2010; Morgan, 2014; Simpson, 2018). Pragmatism considers truth being provisional (Jacobs, 2010) and situational (McCaslin, 2008), rather than absolute and fixed (Jacobs, 2010). In science, pragmatism is suggested to be a tool for continuous scientific consideration in which theories are instruments for scientific work, not an ultimate goal of research (James, 1907; Peirce, 1905). If theories are not representing actions and activities under scientific inquiry correctly, then there is a need for an improved idea to explain these actions and activities more precisely. Thus, pragmatism closely links theory and praxis (Greenwood & Levin, 2005). Pragmatism often builds the foundation for methodologies used in social sciences (Ansell, 2016; Joas, 1993; Morgan, 2014), business and management research (Pfeffer, 2008; Pansiri, 2005; Simpson, 2018), and information systems research (Goldkuhl, 2004, 2011, 2012; Hevner, March, Park, & Ram, 2004; Mendling, Berente, Seidel, & Grisold, 2021). The research questions consider development of information systems in tourism context as well as management decisions related to them, and thus, pragmatism is a suitable choice.

My choice for methodology of this research is design science (Dresch, Lacerda, & Antunes, 2015; Goldkuhl, 2011; Kuechler & Vaishnavi, 2008; Peffers, Rothenberger, Tuunanen, & Vaezi, 2012; Peffers, Tuunanen, Rothenberg, & Chatterjee, 2007; Vaishnavi & Kuechler, 2015; Wieringa, 2014). Design science, more specifically design science research in information systems and technology, means the process of learning and studying through the act of building (Kuechler & Vaishnavi, 2008). Design science creates new scientific knowledge in the process of developing and testing an information systems artefact (Hevner et al., 2004; Kuechler & Vaishnavi, 2008), that will address an identified problem (Peffers et al., 2007; Wieringa, 2014). The artefact can include social innovations, and it can develop new properties of technical, social, or informational resources to create solutions for an important business problem (Dresch et al., 2015; Peffers et al., 2007).

As the research questions do not only focus on information system design and development but also on the operational environment and management decisions, I adopted a specific version of design science research which would be suitable for the context. This is Action Design Research

(Bilandzic, Venable, 2011; Cole, Purao, Rossi, & Sein, 2005; Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011; Venable, Pries-Heje, & Baskerville, 2017) which combines elements from action research and design science research (Järvinen, 2007; Venable et al., 2017). As for the method of reasoning, action design research adopts abduction, deduction and induction in different phases of the study (Gregory & Muntermann, 2011; Venable et al., 2017). I will next introduce the action design research in detail.

3.1 Action Design Research (ADR)

ADR project may have several goals. Artefact design goals relate to the content and technical choices of the digital application or solution (artefact), and instrument design goals relate to the development of research instruments (Hevner et al., 2004; Wieringa, 2014). Knowledge goals relate to the interaction of the artefact in a context of users and stakeholders (Venable et al., 2017; Wieringa, 2014). Prediction goals relate to an objective to create future scenarios of the context with or without the artefact in place (Wieringa, 2014). In addition to these possible research goals, ADR may also pursue to achieve social context goals which are often presented as external stakeholder goals (Hevner et al., 2004; Wieringa, 2014).

In this research, I have artefact design goals, knowledge goals, and social context goals. The artefact design goals relate to the research question 1 and 2, they focus on the journey planner and its technical functionality in the front-end visible for the users, as well as in the backend. This goal also concerns the content development environment required to convert information on transportation services into digital format suitable for journey planners. The knowledge goals, and social context goals related to the research questions 1, 3 and 4. These goals focus on the operational environment in which the journey planner is managed by interconnected organisations, and used by travellers to improve the current situation in the context. The research setting is illustrated in figure 4.

3.2 ADR Process

The traditional action research involves stages for defining the problem, planning the action, implementing the action, observing the outcomes, and reflecting and reporting the results (Walter, 1993). It is often used in social sciences. ADR adopts similar tools for studying human computer interaction between information systems and users in the research context (Järvinen, 2007). In addition, ADR focuses on the aspects of implementing and deploying information systems (Wieringa, 2014).

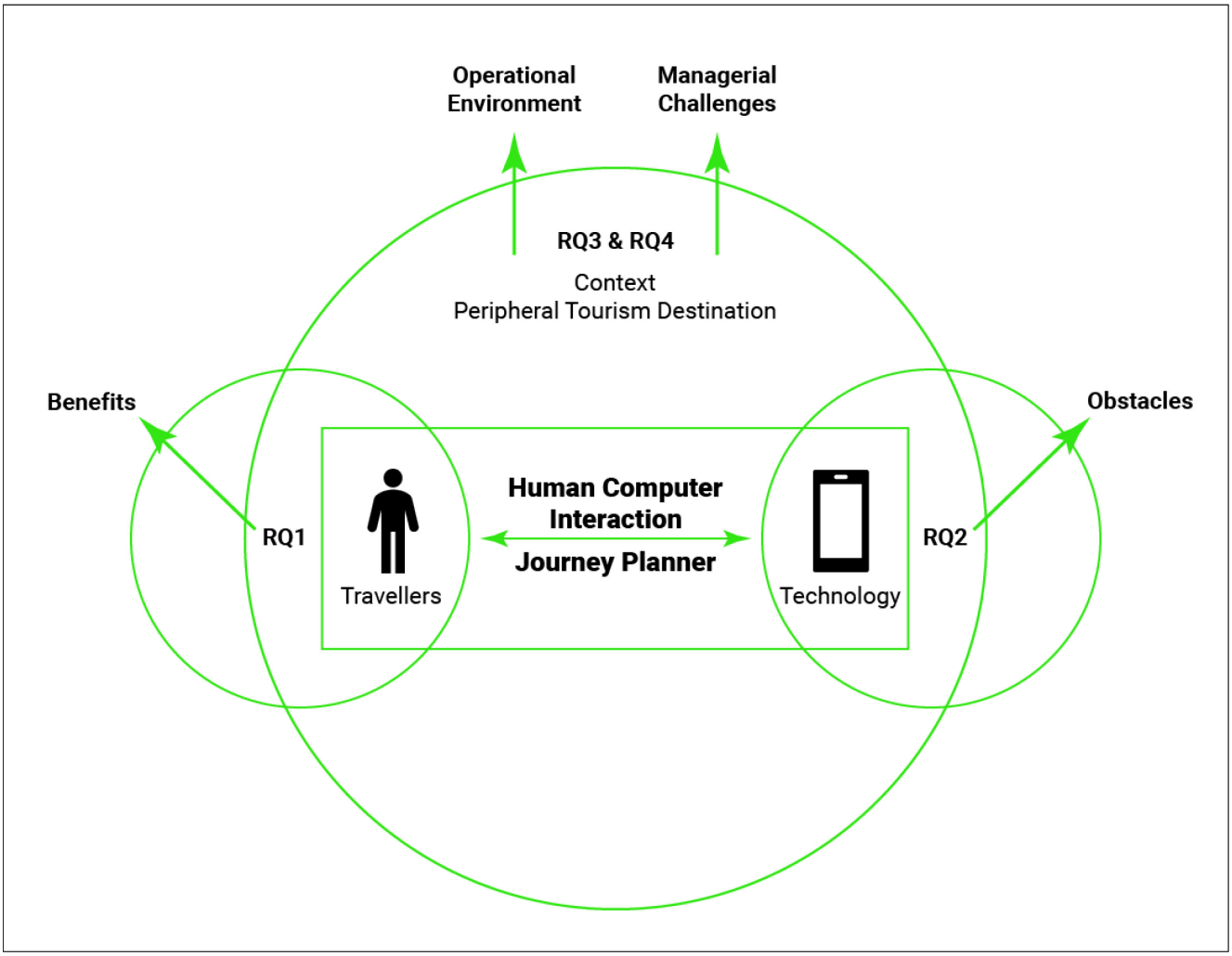

Figure 4. Research setting including research questions.

Because of this multifaceted approach combining technology development and the larger, social context, ADR is capable of studying information systems holistically (Sein et al., 2011). ADR project is divided into 4 stages (Sein et al. 2011; Venable et al., 2017): 1. Problem formulation, 2. Building,

Intervention, and Evaluation, 3. Reflection and Learning, and 4. Formalization of learning. Each stage is further divided into smaller tasks. The main stages and the tasks utilised in this research are presented in figure 5. Problem formulation is presented in chapters 1 and 2. Building, intervention and evaluation is presented in chapter 4. Reflection and learning are presented in chapter 4, and in discussion chapter 5. Formalisation of learning is presented in discussion and conclusions in chapter 5 and 6.

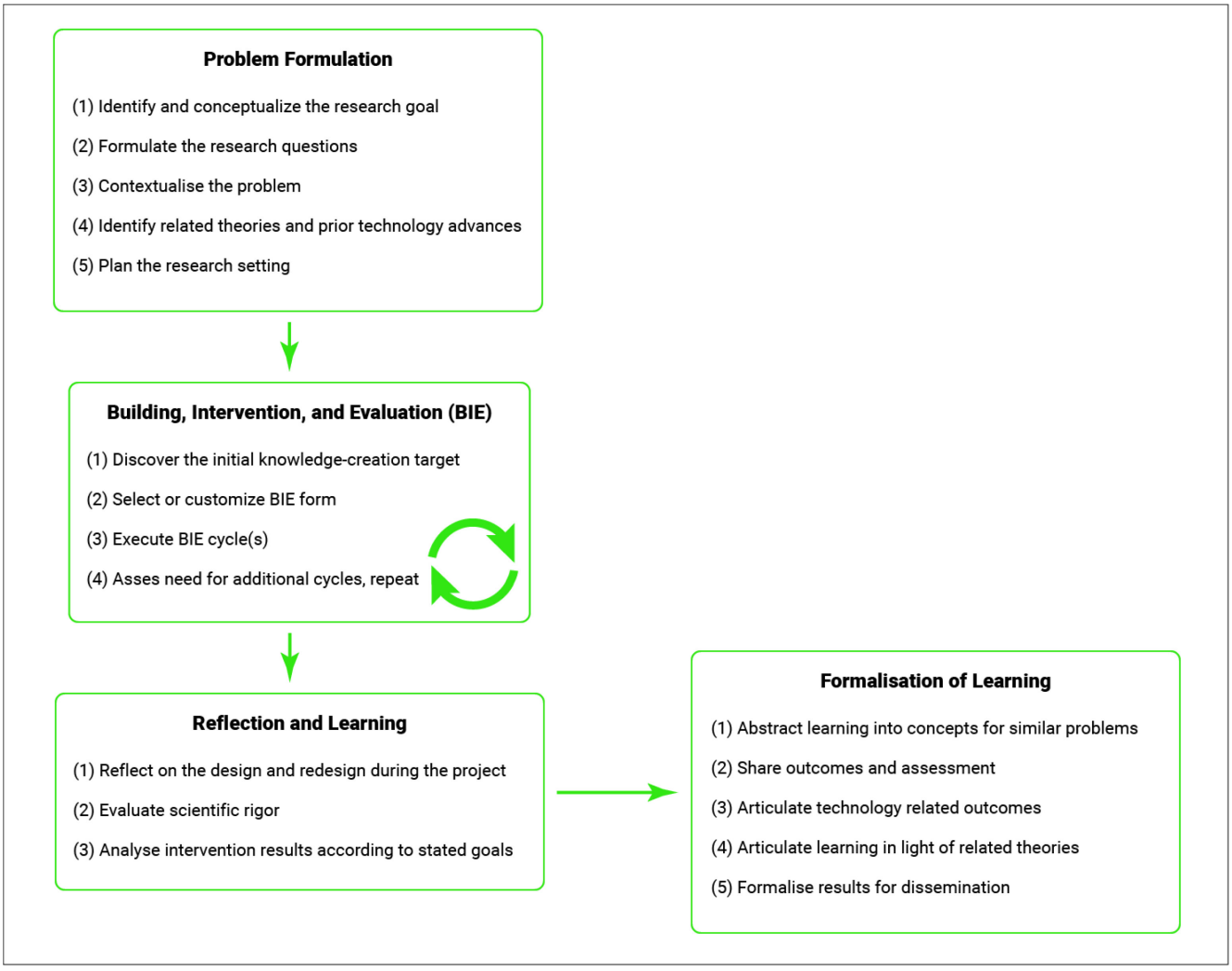

Figure 5. ADR stages and tasks adopted for this research.

3.3 Methods of data collection to support ADR

ADR is not conducted in isolation but in a larger social context. Thus, it was necessary to collect data in the research setting to increase understanding within stakeholders and the context to be able to develop the artefact. There were several meetings organised with the Office of Economic

Development (Municipality of Kittilä) between June 2019 and January 2020 in which the lack of comprehensive digital traveller information on transportation services were discussed. During the meetings, municipality representatives presented their target to increase the usage of Levi Ski Bus by a larger group of travellers, but were concerned about the limited visibility of Ski Bus services among travellers.

There was one online meeting with the Chief Executive Officer, and two online meetings with the Commercial Director of Levi Ski Resort organised between February and April in 2020. The meetings covered topics related to Ski Bus operations and the digital information on them for travellers.

During, and after the development of the artefact, I presented the artefact (by providing online access) and the intervention (in a form of videography), and evaluation (in a form of a report) for the representatives of Levi Ski Resort and the municipality of Kittilä between April and October in 2020. The evaluation was discussed with the representatives of the municipality in a series of meetings between October 2020 and September 2021 to support the municipality with concrete actions based on the evaluation.

As for the larger context of tourism related transportation services and digitalisation, I have participated in several meetings, workshops, and seminars on the topic in Lapland between 2018 and 2021. I have also met with the transportation service providers, industry representatives, and government organisations several times between 2018 and 2020. In addition, for this study, I have conducted a large desk research on journey planner services in Finland and in Europe to be used as a basis for this study. Furthermore, I have familiarized myself with the technical specification and tools required to develop the artefact. Selected service design tools were also adopted for the potential customer definition while making decisions on the detailed scope of the artefact.

4 Building, intervention, and evaluation

In this chapter, I will present the process followed in this research as well as stakeholder communication during the research. I will also present the current state analysis before ADR was initiated. I will describe the phases of building the artefact, method of intervention, and evaluation. Finally, I will present the additional data produced during the evaluation to be used in the analysis.

4.1 Current state analysis

There are different channels used to inform travellers on transportation services available at the destination. Printed timetable books, or printed timetable leaflets are rarely used anymore, but they still keep appearing in destinations' internet pages (e.g., Levi ski resort, 2022a; Ruka ski resort, 2022; Ylläs ski resort, 2022a). Travellers are also informed about transportation services by advertisements on local free newspapers (e.g., Levi ski resort, 2022b; Ylläs ski resort, 2022b). These information channels include timetables of in-destination transportation services, the list of bus stops, and sometimes even the map locations of the bus stops. However, they do not have information on connecting services into and from the destination, aggregated view on linked connections, their timetables and the bus changes needed. In addition, they can't provide walking guidance for travellers who are not familiar with the destination. These are the features currently introduced only in journey planners of larger cities, and in few nationwide journey planners.

4.1.1 Transportation characteristics in Levi

Levi is located in the northwest part of Lapland. The nearest airport is located in Kittilä, 18 kilometres from Levi (figure 2). There is a bus connection between the Kittilä airport and Levi for all flights during the high tourism season. For the low season, there is a demand-responsive transport. Customers need to make the reservation 24 hours before the flight arrival or departure. The Enontekiö airport is located 129 kilometres, the Rovaniemi airport 173 kilometres, and the Ivalo airport 260 kilometres from Levi. There are no scheduled bus connections from these airports to Levi. However, there are transportations organised by private companies from the Rovaniemi airport as many customer groups arrive at the Rovaniemi airport.

There are three major railway stations in northern Lapland. The Kolari railway station is located 83 kilometres from Levi, the Rovaniemi railway station 170 kilometres, and Kemijärvi railway station 200 kilometres from Levi. From the Kolari railway station, there are bus connections from all trains year-round. There are also several bus connections from the Rovaniemi railway station on a daily basis. The buses travel via the bus station in Rovaniemi, which is the only important bus station in the area.

Levi Ski Resort operates Ski Bus service in Levi. There are two different circle routes, one is operating in the northern part of the destination, another in the southern part. Ski Bus transportation services are available during the winter following the opening hours of the ski lifts i.e., from 9 am until 7 pm. In November, and in May, the buses leave once in an hour, otherwise they leave twice in an hour. Passengers are allowed to travel with a valid ski lift pass, they can buy a full-season Ski Bus ticket, or they can travel with a single ticket.

There are also other transportation services in the area. Municipality of Kittilä organises school bus services in the area to take students to schools in the municipality centre during the terms. School buses used to be open for public, but in the recent years they have only been available for students. The municipality currently considers opening some of the school buses again for a larger audience. The largest gold mine in Europe is located in Kittilä. There are bus transportations from Kittilä to the gold mine via Levi. Currently the service is only available for the employees of the gold mine. There are also several rental car companies operating at the Kittilä airport. In Kittilä and Levi, there are also a few dozens of taxicabs available for travellers.

4.1.2 Public transportation services in Levi

There are three transportation service providers operating in the area: J.M. Eskelisen Lapin Linjat, OnniBus, and Tunturilinjat. Tunturilinjat operates the routes from the Kittilä airport, and from the Kolari railway station to Levi, others operate long distance buses from Rovaniemi to northern Lapland via Levi. Levi Ski Resort operates the Ski Buses in destination Levi. The routes and operators are illustrated in figure 6. In this research, only the routes which are publicly available,

and have at least one bus stop at the destination Levi are included for further study. Figure 6 also includes the codenames for different routes to be used in the next steps of analysis.

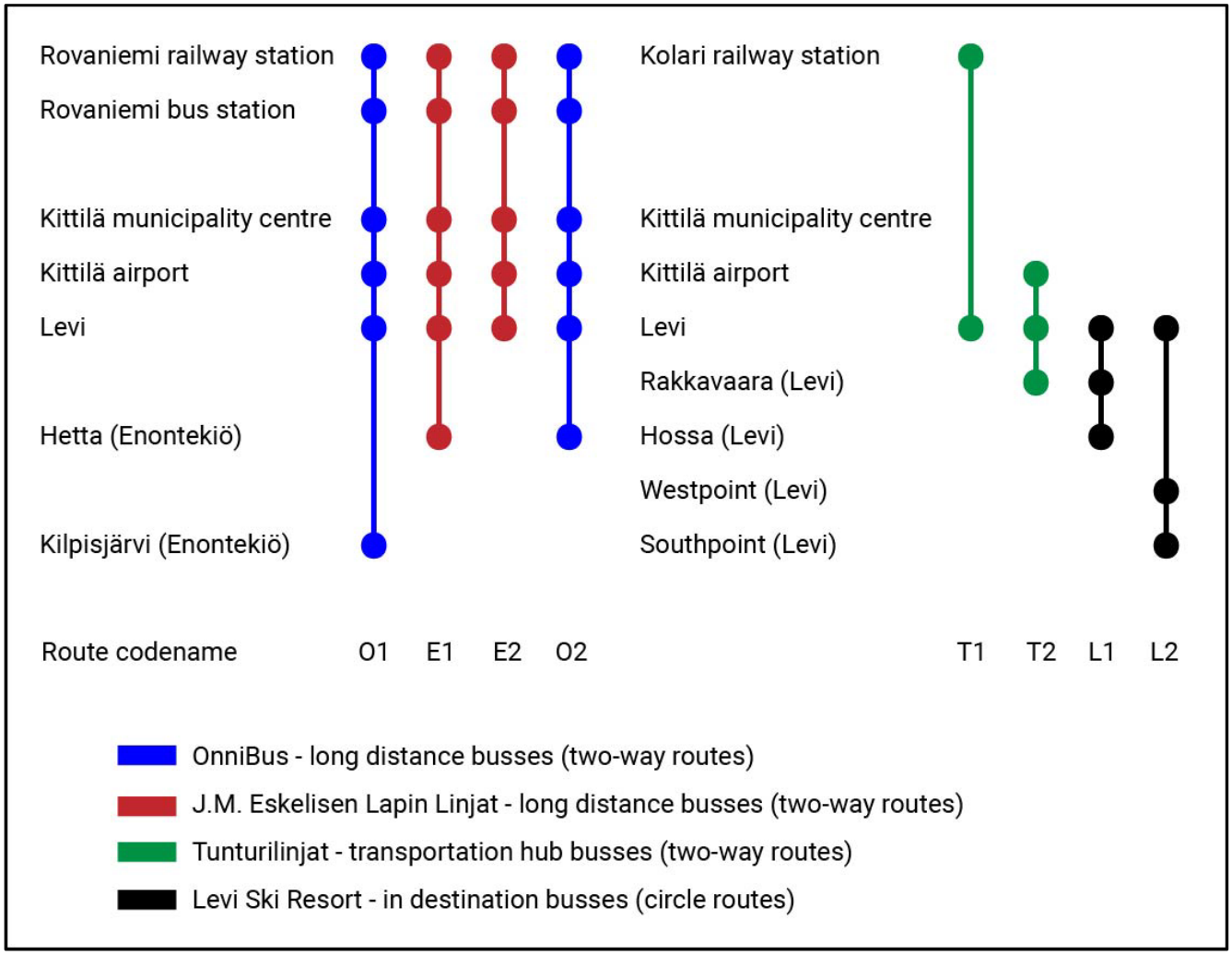

Figure 6. Bus routes and operators relevant for travellers in destination Levi.

4.1.3 Information on public transportation services in Levi

There are several sources of information for travellers seeking information on transportation services at the destination Levi. The destination website offers travellers with links to several other websites for searching transportation services to get to and around the destination. All transportation service operators have the timetables of their routes available at their own websites. Levi Ski Resort also has an application for ski resort customers which includes timetables for Ski Buses.

Almost all of the private transportation service providers in Finland are members of the Finnish Bus and Coach Association. It provides vocational cooperation and lobbying services for bus and passenger transport operators in Finnish market-based and contract-based public and tourist transport. The association owns a private company called Matkahuolto, which is a Finnish service and marketing company for bus transport. Matkahuolto focuses on both parcel and passenger transportations. Matkahuolto has invested in digitising its information services during the recent years. Earlier, it used to have a search function for timetables of its member companies at the Matkahuolto website, and in September 2020 the company introduced a journey planner application for smart devices (Matkahuolto, 2020). In addition, Matkahuolto also offers a commercial service for non-members to have their transportation services included in its digital channels and application.

The public administration in Finland also offers an online journey planner called Matka in which the transportation service providers may publish their routes and timetables if the data is allowed to be published as an open data. Open data can then also be used by third parties in other services. An example of this kind of usage are the services called Perille and Matkakeisari. These online services provide travellers with timetable search and some additional travel planning services.

Information on transportation services can also be found from online map platforms. Google Maps has a feature called Google Transit which provides an international journey planner. These features are also available in smart devices running on top of the Android operating system. Google Maps, including Google Transit, is also available for Apple devices. Here Technologies is a company owned by several car manufacturers and Intel Corporation, which is a global semiconductor chip manufacturer. HERE Technologies' core business is to provide cars with maps and navigation solutions, but the map product called HERE WeGo is freely available for online users. It also includes a journey planner. HERE WeGo application is available for Android and Apple devices. Apple has a map product called Apple Maps, which is integrated in iOS smart devices. It also includes a journey planner for public transportation.

The details of information service providers on transportation services related to Levi are presented in figure 7. For comparison, the figure also presents the features of the information services available. The most relevant Finnish applications for this study, Levi Ski Resort application and Matkahuolto application are illustrated in appendix 2. There are differences in the contents of information the service provides. In figure 8, there is an illustration on which routes are presented in information services currently available.

Service/Features	online service	Android app	iOS app	time-tables	search	search by address	search by POI	routing	bus stops on map	busses on map	walking guidance
OnniBus	✓	✓	✓	✓	✓	✘	✘	✓	✘	✘	✘
J.M. Eskelisen Lapin Linjat	✓	✘	✘	✓	✓	✘	✘	✓	✓	✘	✘
Tunturilinjat	✓	✘	✘	✓	✘	✘	✘	✘	✘	✘	✘
Levi Ski Resort	✓	✓	✓	✓	✘	✘	✘	✘	✓	✓	✘
Matkahuolto website	✓	NA	NA	✓	✓	✘	✘	✓	✓	✘	✘
Matkahuolto application	NA	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓
Matka	✓	✘	✘	✓	✓	✓	✓	✓	✓	✘	✓
Perille	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘
Matkakeisari	✓	✓	✓	✓	✓	✘	✘	✓	✘	✘	✘
Google Transit	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓
HERE WeGo	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓
Apple Maps	✘	✘	✓	✓	✓	✓	✓	✓	✓	✘	✓

Figure 7. Information service providers on transportation services related to Levi.

Journey planner/Routes	01	E1	E2	02	T1	T2	L1	L2
OnniBus	✓	✘	✘	✓	✘	✘	✘	✘
J.M. Eskelisen Lapin Linjat	✘	✓	✓	✘	✘	✘	✘	✘
Tunturilinjat	✘	✘	✘	✘	✓	✓	✘	✘
Levi Ski Resort	✘	✘	✘	✘	✘	✘	✓	✓
Matkahuolto website	✓	✓	✓	✓	✓	✓	✘	✘
Matkahuolto application	✓	✓	✓	✓	✓	✓	✘	✘
Matka	✓	✘	✘	✓	✘	✘	✘	✘
Perille	✓	✓	✓	✓	✓	✓	✘	✘
Matkakeisari	✓	✓	✓	✓	✓	✓	✘	✘
Google Transit	✓	✓	✓	✓	✓	✓	✘	✘
HERE WeGo	✓	✘	✘	✓	✘	✘	✘	✘
Apple Maps	✓	✘	✘	✓	✘	✘	✘	✘

Figure 8. Routes included in different transportation information services available.

4.2 The artefact

The artefact built in this ADR was a functional prototype of a journey planner for the destination Levi including also the Ski Buses currently missing in generally available journey planners. The prototype was meant to enable combining the timetables of long-distance buses and transportation hub buses with the timetables of Levi Ski Buses in the journey planner. This would enable routing the travellers' trip to use Levi Ski Buses with other type of buses and make the last mile connectivity visible for travellers.

4.2.1 The artefact building phase

I collected the timetables of the routes E1, T2, L1, and L2 (figure 6 and appendix 4). I utilised the digital development environment, RAE tool, which is provided by the Finnish Transport and Communications Agency Traficom[6]. The tool is available for transportation service providers by request and registration. With the tool I digitised the data on selected routes, relevant bus stops, and relevant timetables. I exported the digitised content package in the General Transit Feed Specification (GTFS) format (Google, 2022; McHugh, 2013; MobilityData, 2022), and tested the validity of the data with a GTFS data validator obtained from the open source repository GitHub[7]. I have also made the technical data publicly available (Nuottila, 2020a). Next, I contacted the Digitransit[8] administrators and delivered the content package for upload. Digitransit administrators verified the content validity and uploaded it to the development environment which is an accurate replicate of the production environment. The content package was agreed to be accessible for ten days to give enough time for intervention and evaluation. The content was

[6] The Finnish Transport and Communications Agency Traficom is an authority in permit, licence, registration, approval, safety and security matters. They also promote the development of the information society and of the transport system.
[7] FeedValidator is on open source software application available for download and installation at https://github.com/google/transitfeed/wiki/FeedValidator
[8] Digitransit is a service platform for journey planners for cities and municipalities in Finland. It operates as an open source service development platform and invites all interested parties to develop the platform.

accessible with any internet browser as the content is optimised for different browsers on the server-side. The device used for evaluation was a Samsung Android OS smartphone.

4.2.2 The artefact intervention phase

The intervention phase is developed on five realistic use case scenarios of transportation service usage by travellers in Levi. The use case scenarios are built based on the selected traveller profiles in Levi. Traveller profiles are elaborated in appendix 3. Originally, the use case scenarios were planned to be evaluated in real-life situations with travellers arriving in Levi. However, the COVID-19 pandemic changed the situation. Due to travel restrictions, there were no travellers in the Levi area. In addition, most of the bus services were cancelled, including Levi Ski Buses. Because of this, I followed a contingency plan to conduct the intervention phase. With a research assistant, the use case scenarios were carried through in a real-life setting, in which I acted as a traveller performing the use case scenarios. A private car was used to drive the routes of the buses to be able to perform the situations in which the location-aware features of the journey planner were needed to be evaluated. The use case scenarios were recorded with two devices, one was recording the use in the context, the other one was recording the screen capture video of journey planner activities. Also, research notes were created about the observations while performing the use case scenarios. The recordings were then combined in a video editor tool to illustrate the use case scenarios. The use case scenario video recordings were published (Nuottila, 2020b, 2020c, 2020d, 2020e, 2020f). Five video recordings and research notes were used to analyse the intervention phase and conduct the artefact evaluation phase.

4.2.3 The artefact evaluation phase

During the evaluation phase, the themes related to the research questions were emphasised. The evaluation, and findings are reported separately for each use case scenario below.

Use case scenario 1

Origin: The airport of Kittilä

Destination: A leisure apartment at the address Tolvatie 10

Buses used: First leg T2, second leg L1

Findings:

time on recording – finding in details

00:50 – GPS positioning used to recognise the origin of the journey

01:00 – Journey planner doesn't recognise the name of the leisure apartment, user needs to type in the address [DEFICIT]

01:30 – Journey planner combines the routes and timetable of T2 and L1 and suggests this combination

01:50 – Journey planner suggests walking guidance to the bust stop

02:16 – Journey planner supports English in addition to Finnish and Swedish

02:50 – Journey planner acknowledges the user about the need to change the bus

02:55 – Journey planner suggests walking guidance to the leisure apartment

03:10 – Journey planner shows the selected bus route on the map

03:35 – Journey planner shows the bus stop needed to use for a bus change

04:05 – Journey planner shows the walking route on the map for the user

04:30 – All the bus stops on route L1 seems to have the same name [DEFICIT]

04:55 – Journey planner shows the travel time needed to reach the destination

Use case scenario 2

Origin: Library in Kittilä

Destination: Restaurant Draivi in Levi at the address Golfväylä 9

Buses used: First leg E1, second leg L1

Findings:

00:24 – Origin (library) is found as a POI on the journey planner

00:50 – Destination (restaurant) is found as a POI on the journey planner

01:05 – Journey planner combines the routes and timetable of E1 and L1 and suggests this combination
01:40 – Journey planners suggests walking guidance to the bus stop
01:42 – Journey planner suggests walking guidance between two bus stops during the bus change
01:44 – Journey planner does not show the bus stop in the front of the restaurant [DEFICIT]
01:44 – Journey planner suggests walking guidance to the restaurant

Use case scenario 3

Origin: Levi South Point
Destination: A leisure apartment at the address Niestatie 10
Buses used: First leg L2, second leg L1

Findings:
00:40 – GPS positioning used to recognise the origin of the journey
00:54 – Destination (leisure apartment) is found as an address on the journey planner
01:10 – Journey planner combines the routes and timetable of E2 and E1 and suggests this combination
01:53 – Journey planner does not show the bus stop in the front of South Point, instead it shows that the nearest bus stop is located 1.3 kilometres away [DEFICIT]
01:54 – Journey planner suggests walking guidance to the bus stop 1.3 kilometres away [DEFICIT]
02:19 – Journey planner acknowledges the user about the need to change the bus
02:19 – Journey planner acknowledges the user about the waiting time needed to change the bus
02:19 – Journey planner shows the bus stop needed to use for a bus change
02:30 – All the bus stops on route L1 seems to have the same name [DEFICIT]
02:42 – Journey planner suggests walking guidance to the leisure apartment

Use case scenario 4

Origin: A leisure apartment at the address Jutatie 16
First destination: A grocery store at the address Leviraitti1

Final destination: Levi World Cup slopes

Buses used: First leg L1, second leg L2

Findings:

00:14 – GPS positioning used to recognise the origin of the journey

00:39 – The destination only visible in Finnish [DEFICIT]

01:10 – Journey planner enables user to input a via point between the origin and destination

01:55 – Journey planner combines the routes and timetable of L1 and L2 and suggests this combination

01:56 – Journey planner acknowledges the user about the need to change the bus

01:58 – Journey planner suggests walking guidance between two bus stops during the bus change

02:31 – Journey planner does not show the bus stop in the front of the final destination [DEFICIT]

02:31 – Journey planner suggests walking guidance to the final destination

02:42 – Journey planners suggests walking guidance to the bus stop

02:55 – Journey planner follows and displays the location of the user on the map while walking to the bus stop

03:40 – Journey planner confirms that the user is on the correct bus stop

04:00 – Journey planner follows and displays the location of the bus and the user on map during the bus ride

05:42 – Journey planner shows the location of the bus and the location of the bus stop in which the user needs to step out of the bus

06:18 – Journey planner suggests walking guidance to the grocery store

07:05 – Journey planner follows and displays the location of the user on the map while walking to the grocery store

07:40 – Journey planner shows the travel time, including the estimate walk time, needed to reach the destination

Use case scenario 5

Origin: A leisure apartment at the address Jutatie 25

Destination: Art Gallery Raekallio

Buses used: First leg L1, second leg E1

Findings:

00:20 – GPS positioning used to recognise the origin of the journey

00:55 – Destination (art gallery) is found as a POI on the journey planner

01:15 – Journey planner combines the routes and timetable of L1 and E1 and suggests this combination

01:25 – Journey planner acknowledges the user about the need to change the bus

01:47 – Journey planners suggests walking guidance to the bus stop

02:00 – Journey planner acknowledges the user about the waiting time needed to change the bus

02:35 – Journey planner follows and displays the location of the user on the map while walking to the bus stop

03:10 – Journey planner confirms that the user is on the correct bus stop

03:55 – Journey planner displays all the following buses driving via the bus stop user is currently at

04:05 – Journey planner displays the time before the next bus arrives in minutes, based on the static timetable of the buses

5 Discussion

The artefact was used to digitise the timetable and route information of the buses in a peripheral destination Levi in GTFS format which was suitable for a digital journey planner. In addition, the artefact displayed the local ski buses first time in a digital journey planner together with other long-distance buses and transportation hub buses operation in a peripheral destination Levi. As expected, the intervention and evaluation demonstrated several beneficial features for the travellers. First of all, travellers will be able to be aware of the transportation services available at the destination. Levi Ski Bus is potentially solving the last mile problem in Levi, as similar services do in other tourism destinations, and thus it is important for travellers to know about the service to be able to use it. Location-awareness of the journey planner supports travellers in using public transportation in a destination they are not familiar with. The journey planner also facilitates traveller taking longer journeys by suggesting combinations of different transportation services, and guides travellers in using them.

Journey planner enabling the search function with addresses or with point of interests facilitates the usage of last mile transportation services. Traveller can use the address they have received, for example, in the reservations confirmation to find transportation services there. They also can use the name of the apartments or the commercial names of the services and attractions they are interested in. Journey planners also support the location-awareness while on the move, which increases traveller's confidence to step out of the bus on the correct bus stop.

The evaluation demonstrated also some major problems of deploying a digital journey planner in a peripheral destination. First of all, some bus stops were missing completely. In fact, this was acknowledged already at the time when I was digitising the content for the artefact. The information of the all national bus stops is located in an open, national database called Digiroad. It is managed and maintained by a public organisation. Among other street, road, and transport related data, it includes information of all bus stops in Finland. Digiroad stores the location of the bus stops, information about the physical structures related to the bus stop, the direction of the traffic on the bus stop, and also information on who is responsible for the bus stop. The bus stops including particular physical structure need to a party recorded as an owner who takes care of the

maintenance of the bus stop including the snow removal form the bus stop during the winter. In Finland, bus stop can be owner by a municipality, a city, or a governmental office. All the bus stops in Finland are also categorised into three types, a local bus stop (for example in cities), a long-distance bus stop, or a virtual bus stop. A virtual bus stop does not have a physical structure at all. At the location of the virtual bus stop, there might be a sign of a bus stop but no other structures. But in a Digiroad database, the virtual bus stop is similar to others. There can be transportation services routed via virtual bus stops, and they will be visible on journey planners utilising the Digiroad database.

Some bus stops in Levi, which were missing from the journey planner, do not exist in a digital world. They are not added as virtual bus stops in a Digiroad databases. There are other bus stop databases, for example Matkahuolto has one, but I am not aware if the missing bus stops exist in any database. The virtual bus stops can be added into the DIgiroad database by request. This point of missing databases demonstrates the importance of having a high-quality, accurate data available for tourism related digitalisation projects. The service is only as good as the data behind it.

Another technical problem with the artefact was that it displayed several bus stops with exactly the same name. This of course will confuse the users. This problem is also related with the Digiroad database. It was used as the maintenance and management tool for the bus stop infrastructure long before the digitalisation efforts started and the digital twin thinking was developed. The bus stops were most probably created when they were physically built, and there was no effort put in the thinking of naming them differently for the future use in a digital world. Thus, the naming was done based on the street name they all were located in. This further emphasises the importance of having accurate data for building the digital services.

Based on the evaluation, it was also observed that journey planner didn’t include all the POIs users were searching for. This related to the background services of the journey planner. The platform used for the journey planner utilises an open platform called Open Trip Planner. It is an open source project used for several journey planner platforms internationally. In addition to the Open

Trip Planner, which calculates and optimises the routes, two important components are needed: a map platform, and a POI database. The journey planner in this research integrates Open Street Map as a map platform. It is used to display the map, and it contains some of the POIs also. The Open Street Map includes content generated by the community, so tourism businesses, destination management organisation, and municipalities can add content and important POIs for the travellers which are then integrated as part of the journey planner. POIs can be added with several languages to support international tourism. Journey planners also integrate POI databases including location names, street names, and addresses which are then used for the journey planner search function.

The operational environmental of the studied peripheral destination is fragmented between different actors. There is a long history of working together to arrange transportation services in the area, but the lack of advanced digitalisation efforts is obvious. There are lot of small actors, who might struggle to develop large digital systems, or services. Levi Ski Resort has developed an application for its customers, which is advanced compared to the rest of the industry. It also includes the timetables of the Ski Buses. However, the application is mainly attractive for the Ski Resort customers, and it is not able to contribute in solving the last mile problem. This study affirms the earlier findings of rural transportation systems being fragmented, and uncoordinated (Essakali, 2005; Federal Highway Administration, 2001; Goodwin-Hawkins & Callard, 2021; Salo, 2021). This is especially the case with the intelligent transport systems.

The management of the digitalisation of the transportation services in a peripheral destination faces two major challenges. First of all, there is a dilemma of make or buy considerations. There is not a perfect solution available in the market but on the other hand, building one is an enormous effort, and requires continuous maintenance. So, it most probably is more efficient to partner with an existing solution provider. This study demonstrated that there are both national and international operators in the market. Google and Apple are global companies, who have a lot of resources to develop the digital services. However, they do not have local knowledge, and maybe not the interest either, to support digitalisation efforts of the local tourism. Matkahuolto and other national companies might have interest and means to look into details on the national level, but

their resources on developing digital services might be limited. In addition, there is a question of who should lead the efforts and cooperation regarding digitising services on the destination level. Should it be the transport service providers, destination management organisation or the municipalities. Municipalities might have the strongest interest to do so on a regional level.

5.1.1 Theoretical contributions

On this study, I affirmed the earlier findings on the critical role of the intelligent transportation system to facilitate travellers' possibilities to use local last mile transportation services. The features of a digital journey planner can encourage travellers to use public transportation and thus advance the sustainable transition in destinations. In addition, digital journey planner can contribute to the increased satisfaction among the travellers on destination.

This study also demonstrated the fragmented nature of digitalisation effort related to the last mile transportation services in a peripheral destination. There are several, small operators with limited resources to develop digital services. On the management level, the study affirmed earlier findings on the need for strategic cooperation related to rural and peripheral destination transportation. The lack of coordinated efforts is also confirmed in this study and require actions in the future to improve transportation services as one key action towards sustainable transition.

5.1.2 Managerial contributions

There is a huge opportunity to improve travellers' service level with intelligent transportation services. It is a strategic question to build a cooperation network to combine efforts to develop last mile transportation services and related digital journey planner. While building the digital services, it is important to pay attention to the quality of data, particular emphasis should be on obtaining accurate data used in the services. Finally, an important consideration should be on the partner selection. There are global and national operators and careful consideration is needed to find the best solution or combination for a peripheral destination.

6 Conclusions

This piece of research has demonstrated the opportunities and challenges of a digital journey planner to increase awareness of different transportation choices in a peripheral destination. In many situations there is public transportation in destinations of which international and national travellers are not aware of. Similarly, there are local residents who are not aware of tourism specific public transportation types of services. This leads to a lack of operational efficiency in transport services. It takes a lot of resources from private and public sectors to organise transportation services but the return of investment is limited if the potential customer base is not aware of all the choices they have. The problem can be addressed with a digital journey planner as demonstrated in this study.

The development of a journey planner requires a lot of resources. Partnering with a global or a national service provider is another solution to solve the last mile transportation related information delivery issues. In each case, there is a need for coordinated, strategic cooperation between the tourism businesses, transportation services providers, and the local authorities. The coordination is needed for improving the last mile transportation services and especially for developing the digital solutions, such as a journey planner to support travellers to find and use the last mile transportation services. This is a priority task for peripheral destinations to initiate and achieve the successful sustainability transition.

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Appendix 1. Literature searches.

I started the literature search by identifying the relevant databases to be used. Based on the descriptions of databases and earlier tourism related literature reviews, I chose Scopus, Web of Science, EBSCO Academic Search Complete, and SAGE Premier. I limited the search to cover only peer-reviewed papers written in English. I did several test searches on the above-mentioned databases. As Scopus seemed to be the most comprehensive one, I always started the search with it and used it to modify the search strings. Then I continued the search with the other databases, and removed duplicates to have a collection of unique, scientific articles. Finally, I used the snowball technique to evaluate the refence lists of the found papers and downloaded the relevant ones to be utilised in this research. Other details of the literature search are presented below.

Transport services in smart tourism destinations

I was interested in the papers discussing transportation related topics in connection to smart tourism destinations. Thus, I used the following search string:

> TITLE-ABS-KEY("smart tourism destination*" OR "smart destination*") AND TITLE-ABS-KEY("transport*" OR "mobility").

I searched for papers published in English with smart destination or smart tourism destination, and transport or mobility mentioned in the publication title, abstract or keywords (TITLE-ABS-KEY). I decided to use the term smart in connection to the tourism destination for two reasons: 1) the focus of my study is on the digital information services related to destination transportations, and 2) without using the term smart, all papers discussing traditional issues of planning and managing transportation in destinations would have been found. I tested the approach in Scopus; with the term smart, 13 papers were found, and without the term smart 347 papers were found. Thus, it was reasonable to limit the search to cover only the STD literature. Next, I repeated the search for all four databases, reviewed the abstracts and based on the evaluation selected the ones relevant for this research. Finally, I used the snowball technique to evaluate the refence lists of the found papers and downloaded the relevant ones to be utilised in this research.

Journey planners in the tourism context

I was interested in papers discussing journey planners in the context of tourism. Thus, I made the following searches:

TITLE-ABS-KEY("touris*") AND TITLE-ABS-KEY("journey planner" OR "trip planner" OR "route planner") AND ALL("public transport*" OR "bus" OR "coach" OR "train" OR "tram" OR "metro" OR "underground" OR "tube").

There is no widely established, single term for a journey planner, thus I used also two other alternatives. Test searches completed earlier confirmed the assumption that there are only a few research papers published on journey planners in the tourism context. This is the reason I searched with several modes of transportation even if the focus on this research is in bus transportation. The search needed to have the transportation mode as a refining search term, without it lots of papers discussing the planning activity of a whole trip, including accommodation and activities, would have been found. This was confirmed with the test searches. Next, I reviewed the search results based on abstracts and selected the ones relevant for this research.

Management of transportation services in a destination

I was interested in papers discussing how the transportation services are organised and managed in tourism destinations. Thus, I made the following five searches:

1. ALL("destination transport*") AND ALL(tourism) AND ALL(destination AND management)
2. ALL("transport* information") AND ALL("tourism destination" OR "destination management")
3. ALL("transportation service*" OR "transport service*") AND ALL("tourism destination" OR "destination management")
4. TITLE-ABS-KEY("transport* management") AND TITLE-ABS-KEY("tourism destination" OR "destination management")
5. TITLE-ABS-KEY("transport* management") AND TITLE-ABS-KEY("tourism" OR "tourist")

It was challenging to define the search terms in a meaningful way. I tried several terms and combinations to come up with the ones above. The search results with the last two search strings included many of the papers found in the previous searches, which can be interpreted as a weak sign of saturation. Next, I reviewed the search results based on titles and abstracts and selected the ones relevant for this research.

Appendix 2. Transportation services information in Levi

Examples of the applications containing transportation information of transportation services in Levi are illustrated below.

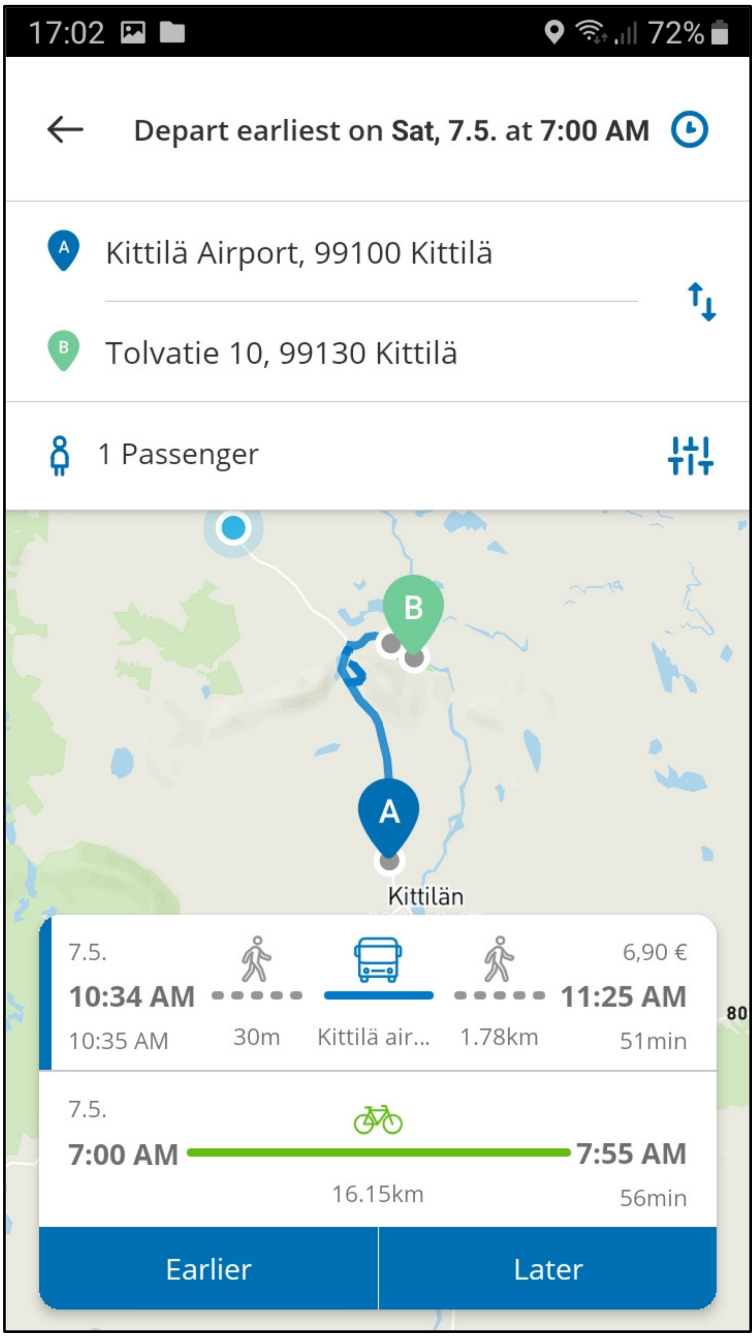

Figure 9. Matkahuolto journey planner application.

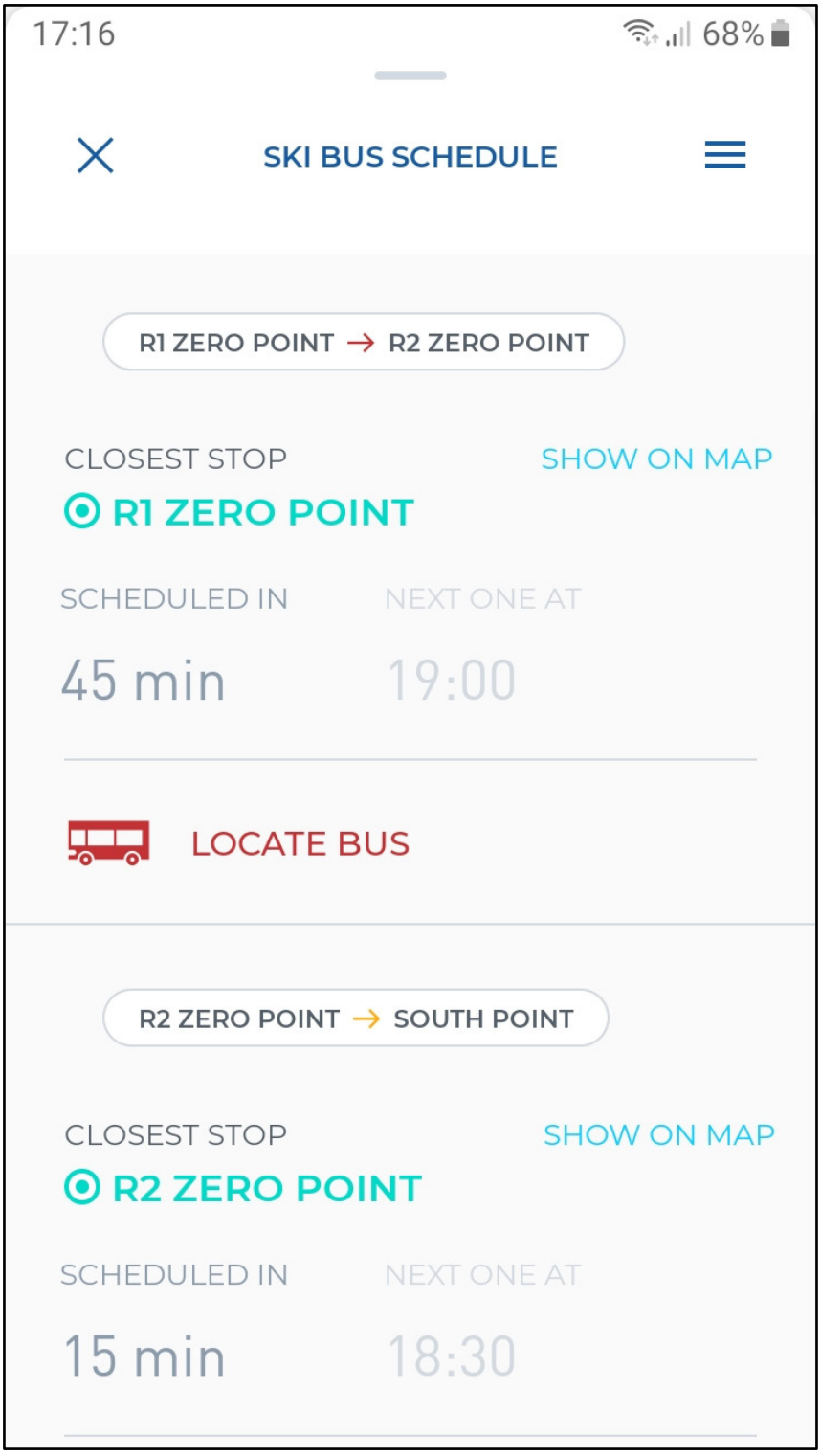

Figure 10. Levi Ski Resort application.

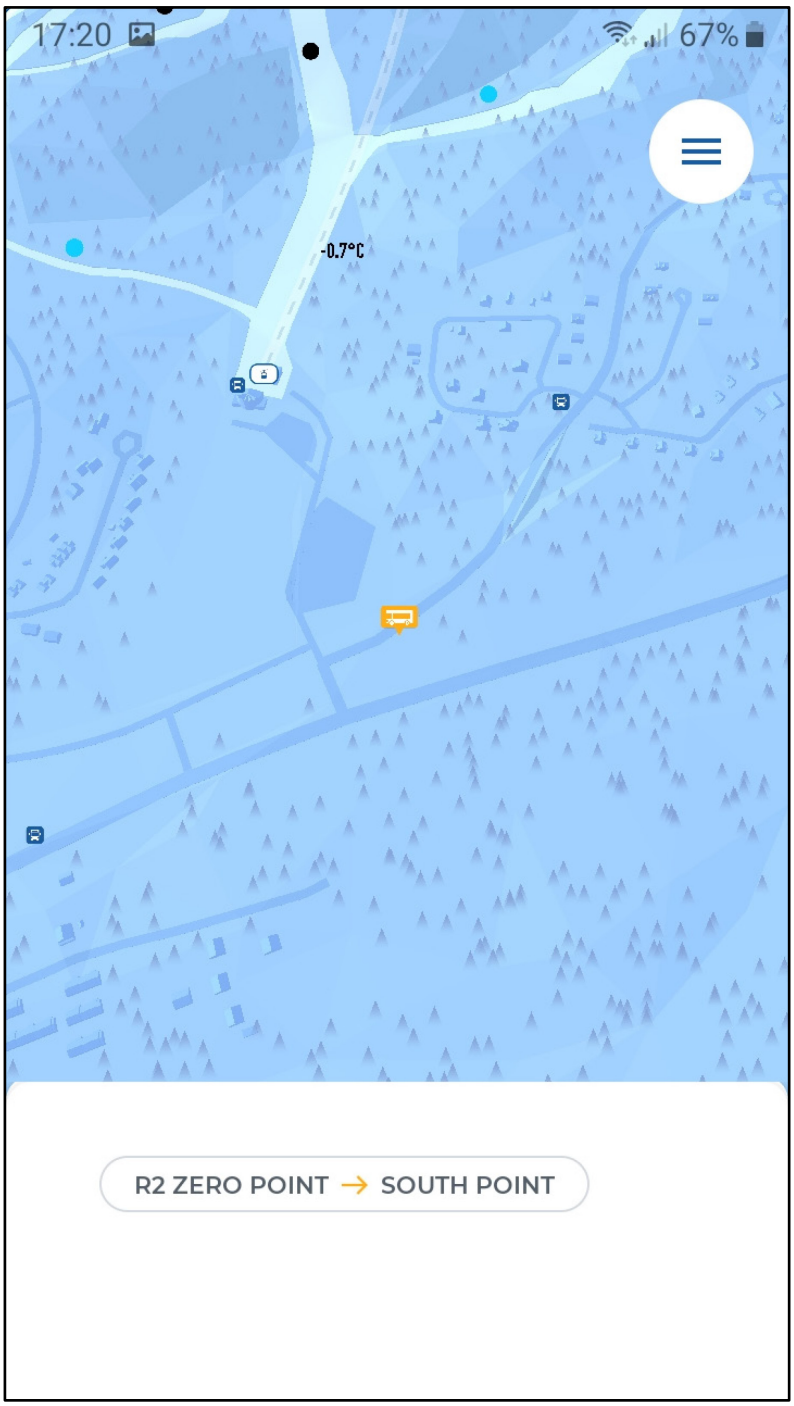

Figure 11. Levi Ski Resort application showing the bus location.

Appendix 3. Traveller profiles based on statistics in Levi

Based on the accommodation and travel statistics by Visitory[9], the visitor profiles of Levi in hotels and in the premises of other registered accommodation providers are presented in table 2. Most of the travellers arriving by flight, travel in a group organised by a travel agency. For these travellers, ground transportation is usually arranged by the agency. However, there is an increasing number of international individual travellers arriving by flight and by train to Lapland and to Levi, who do not have a pre-arranged transportation from transportation hubs to Levi.

Table 2. Registered bed nights by country of arrival in Kittilä between May 2021 and March 2022.

Country	Amount
Total	431,000
Finland	260,000
Non-Finland	171,000
United Kingdom	50,800
France	23,600
Netherlands	18,300
Germany	15,000
Belgium	8,600
Austria	7,200
Norway	6,800
Estonia	5,400
Sweden	3,100
Switzerland	2,800

In addition to the officially registered accommodation, there is a vast number of privately-owned leisure apartments in Lapland. These apartments are used by the owners for their family

[9] Visitory is a service created by a company called TAK Research, which provides travel research and consultancy services. It provides statistics on Finnish destinations. The specific statistics used for this research were retrieved at https://visitory.io/en/kittila/2021-05/2022-04/

vacations, but a large number of them is also utilised in business. Leisure apartments are often offered for long-term rental for example for the winter season for seasonal workers, or for short-term rental for vacation purposes. With the increasing popularity of Booking and Airbnb, there are also more international travellers renting leisure apartments and houses in Lapland. In the municipality of Kittilä, there are 3,800 leisure apartments[10], most of them in the area of Levi. Many of the owners of the leisure apartments, and the renters, are travelling from southern Finland, and the Finnish capital area[11]. While many of them drive, there are also lots of travellers arriving by flight and train.

Based on the above-mentioned data on travellers and their transportation service usage patterns, I came up with the realistic use case scenarios on potential customers willing to use Levi Ski Bus as a public transportation service but not currently being aware of such a service. The use case scenarios are used in the intervention and evaluation phases of the artefact.

Use case scenario 1: A father of an Austrian family. The family has reserved an accommodation (villa) in the Rakkavaara area of Levi. They arrive by plane and are seeking a public transportation to their place of accommodation.

Use case scenario 2: An elderly woman who owns a cottage in Levi and stays there for couple of weeks in a year after getting retired. She knows her cottage neighbours and when they headed back to southern Finland, she travelled with them to Kittilä to do some shopping and visit the library. She would now like to get back to her cottage, but first have a lunch in a nearby restaurant.

Use case scenario 3: A young snowboarder who stays with her friends in a rented villa. She headed in the morning straight to the slopes (with the walking distance) and has now moved to

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[10] Souce: Statistics Finland, retrieved at https://www.tilastokeskus.fi/tietotrendit/blogit/2020/mokkeilijoiden-maara-lasketaan-miljoonissa-vapaa-ajan-asumisen-suosio-kasvussa/ and

[11] Source: Environment – Joint website of Finland's environmental administration, retrieved at https://www.ymparisto.fi/download/noname/%7B4BE047BD-8FC6-412E-AF85-E06717B79E9D%7D/111096

the other side of the fell. She would like to get back to the villa but is already tired and would like to get a ride there. She sees a bus stop next to the ski lift and wonders if she could take a bus.

Use case scenario 4. A sport enthusiastic who came to Levi to watch the World Cup. He is staying in a rented cottage in Rakkavaara and would like to use a ski bus to get to the World Cup area but he needs to visit the grocery store first.

Use case scenario 5. A young woman living in Helsinki. She has no driving license and she is used to get everywhere with public transportation. She is interested in culture, and would like to visit Art Gallery Raekallio, which is located 15 kilometres from Levi. She wonders if there is a bus to get there from the rented villa she’s staying at.

Appendix 4. The bus routes used to build the artefact

The following bus routes were selected to be used in building the artefact (figure 6):

E1 – from Rovaniemi to Hetta

T2 – from Kittilä airport to Levi

L1 – Levi – Hossa – Levi

L2 – Levi – South point – Levi

The routes are illustrated in figures 12, 13, 14, and 15.

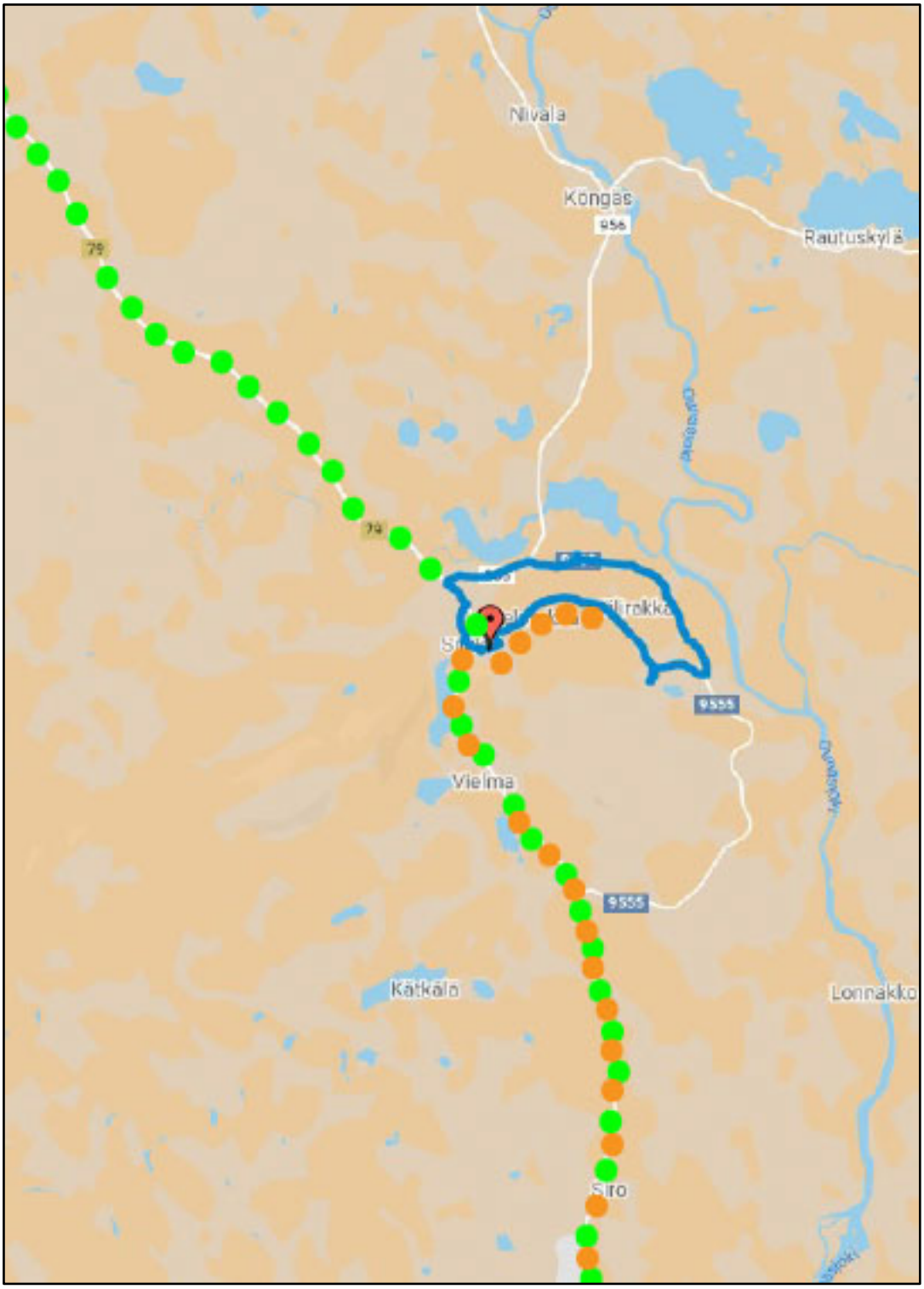

Figure 12. The bus routes E1 (green circles), T2 (orange circles), and L1 (blue line).

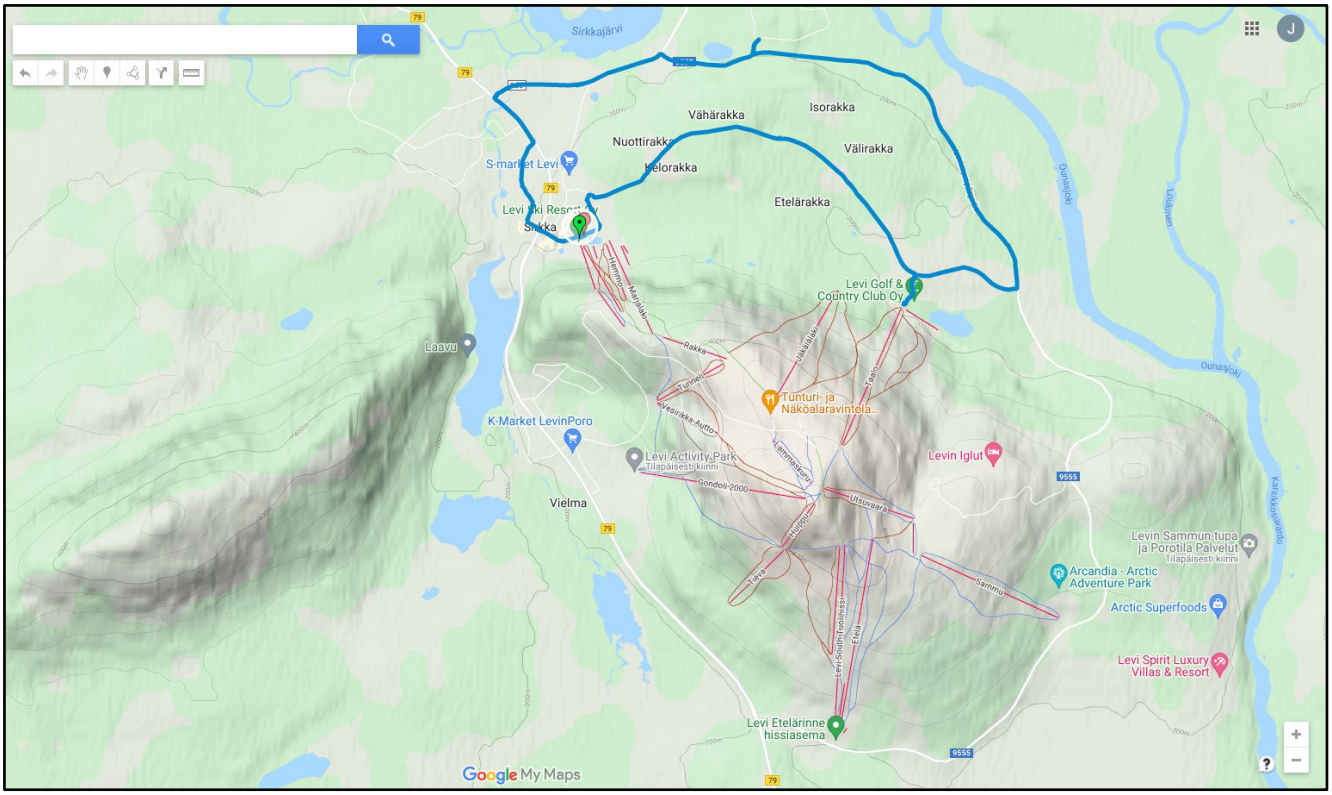

Figure 13. Ski Bus route L1.

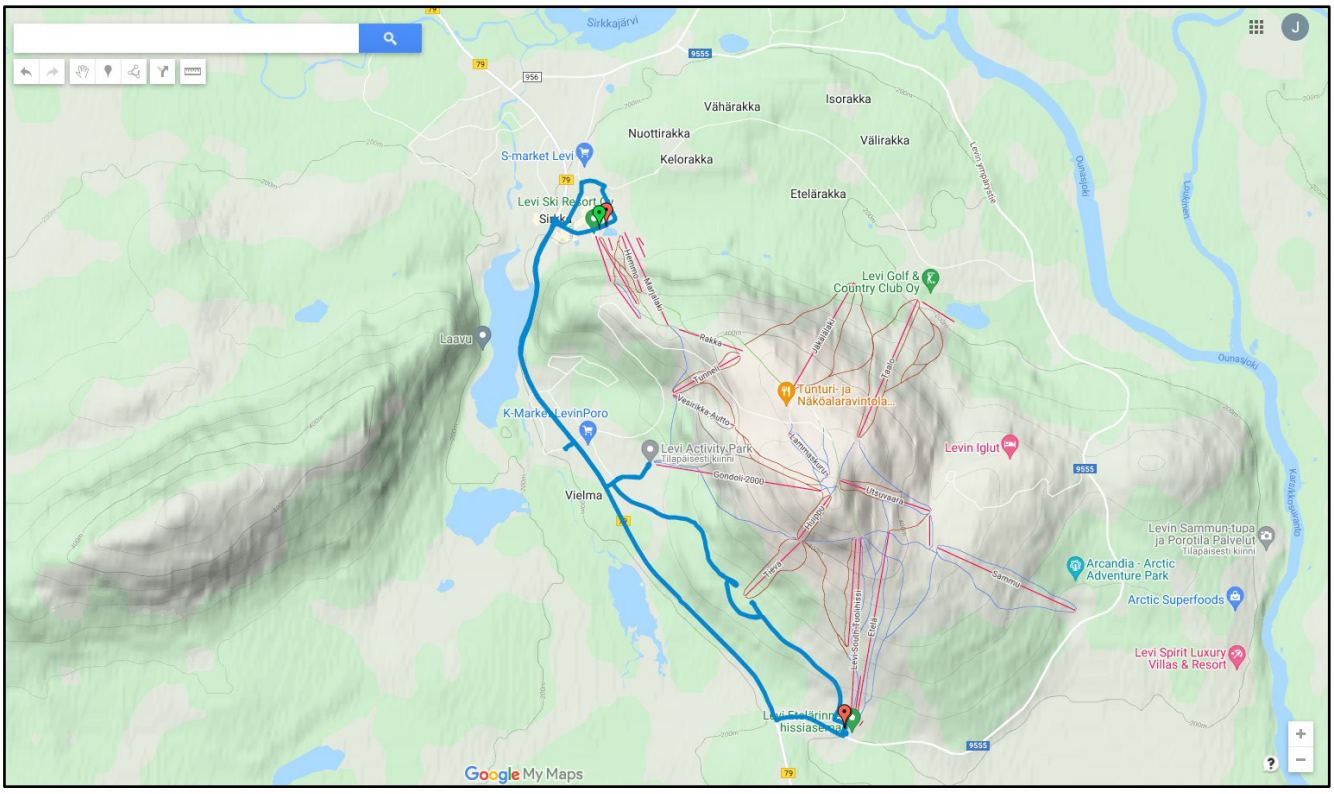

Figure 14. Ski Bus route L2.

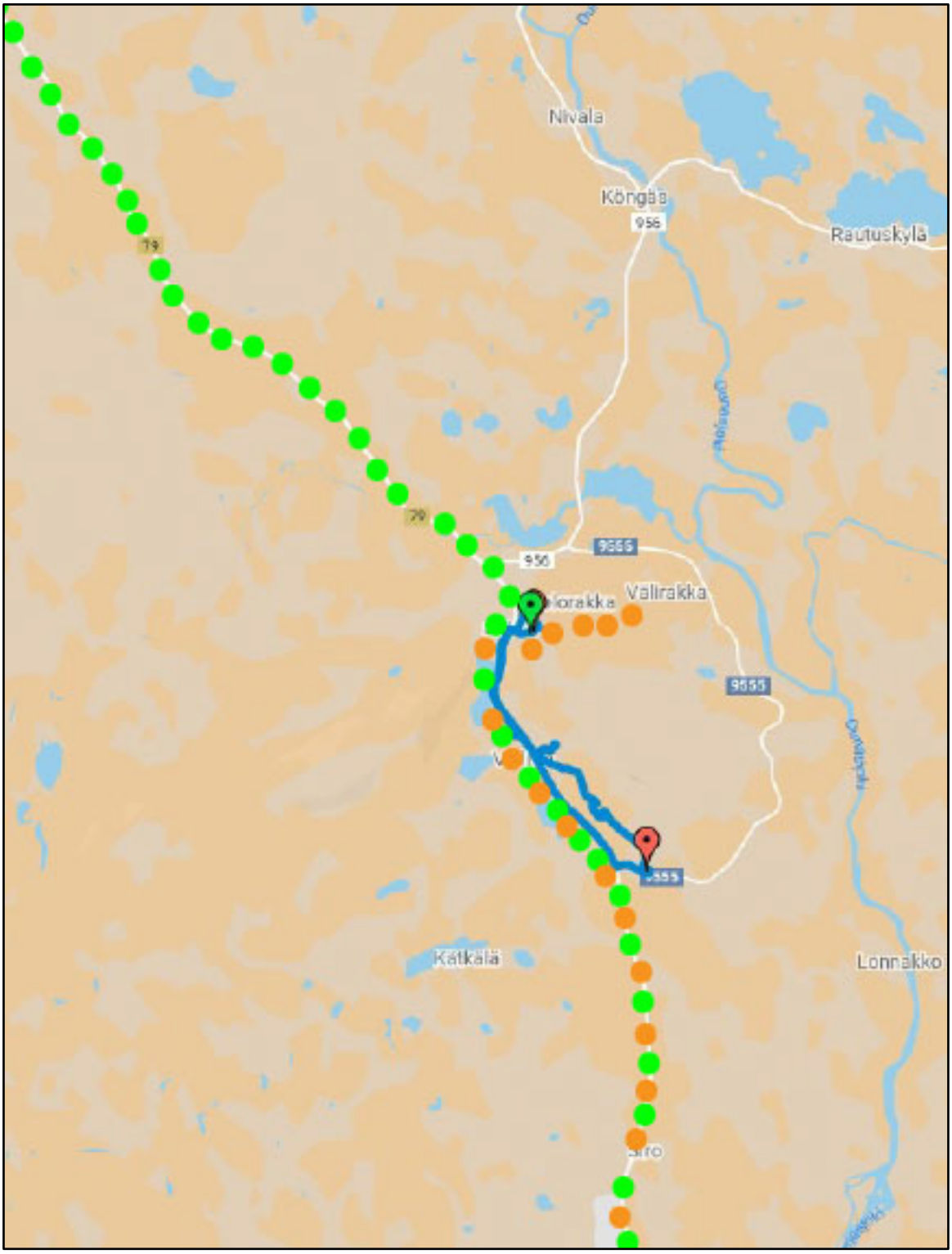

Figure 15. The bus routes E1 (green circles), T2 (orange circles), and L2 (blue line).