PUBLIC TRANSPORTATION IN VIHTI

Future scenarios

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Abstract

This thesis revolves around the future alternatives for organizing public transportation in Vihti. The study aims at examining the complex issue from various societal viewpoints, at recognizing the desired future path and further examining the measures that need to be carried out in order to achieve the desired future.

The theoretical framework consists of different sectors in future studies. The research methodology includes mapping of the current circumstances and defining the key factors. Furthermore, the theory section covers the field of futures studies on a general level and the most distinct research principles and methods are presented.

The circumstances in Vihti today are challenging regarding public transportation. Vihti is not a member of a regional transit joint local authority, even though regional transport system plans cover Vihti as well. There are no railway connections for public transportation in Vihti. Public transportation is organized with bus connections on a market-basis and the share of public transportation users among all commuters is rather small.

This study aims at recognizing societal chains of influence regarding public transportation. A most desirable future image was chosen through workshop procedure using a futures table. The objective is to describe the deeper understanding of entities that form through futures research. Furthermore, the study aims at recognizing the processes that need to be changed or developed in the municipality in order to achieve the desired future.

Keywords
Public transportation, future research, field anomaly relaxation
Tiivistelmä

Tässä opinnäytetyössä tarkastellaan Vihdin julkisen liikenteen tulevaisuuden vaihtoehtoja. Työn tarkoituksena on tutkia monitahoista aihetta useista eri yhteiskunnallisista näkökulmista, tunnistaa toivottu vaihtoehtopolku ja tarkastella toimenpiteitä sen saavuttamiseksi.

Työn teoreettinen viitekehykko koostuu tulevaisuudentutkimuksen eri osa-alueista. Tutkimusmetodologiaan sisältyy lähtökohtien selvittäminen ja eri vaikuttimien tunnistaminen. Teoriaosuudessa on lisäksi käsitelty tulevaisuudentutkimuksen alaa yleisesti sekä merkittävimpiä tutkimusperiaatteita ja -metodeja.


Tällä opinnäytetyöllä pyritään tunnistamaan yhteiskunnallisia vaikutusketjuja julkiseen liikenteeseen liittyen. Työpajatyöskentelyn kautta löydettiin Vihdin kunnan kannalta toivottavina tulevaisuudenkuvina, joka luotiin tulevaisuustaulukoinnin avulla. Tällä työllä pyritään kuvaamaan tulevaisuudentutkimuksen kautta muodostuvaa asiakokonaisuuksien syvemäällä hahmottamista sekä havainnoimana niitä prosesseja, joita kunnassa tulisi muuttaa tai kehittää toivotun tulevaisuuden saavuttamiseksi.

Avainsanat
Julkisen liikenne, tulevaisuudentutkimus, field anomaly relaxation
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1 INTRODUCTION

The objective of this thesis is to carry out research on alternatives for developing and maintaining the public transportation level of Vihti municipality in the future. The research problem revolves around the challenging circumstances of public transportation in Vihti today: Vihti is not a part of a regional public transportation system (such as Helsinki Region Transport, HRT), it has no railway connections open to people, public transportation is organized with market-based bus connections and there are only a few internal public transportation routes. In addition, the share of public transportation users among all commuters is rather small.

The study is carried out using future research methodology. Different future research methods were explored and examined to determine a suitable form to work with. The study begins with a mapping of the present status. What aspects of the present day can be regarded as a weight of history? What are the pushes of the present and the pulls of the future? The study goes on to examine alternate future scenarios in the aims of recognizing a desirable future scenario regarding public transportation. The research was chosen to be carried out through a futures workshop, using a FAR (field anomaly relaxation) table integrated with PESTE analysis. This scenario is closer analyzed through SWOT analysis, in order to create a vision on low-emission traffic in Vihti 2050.

The workshop took place in Vihti municipal hall. Participants included the acting municipal manager Hannu Nummela, technical and environmental manager Kari Setälä, development manager Timo Tuomi, head of town planning Suvi Lehtoranta, route planner Salla-Mari Rintala and a member of the workgroup on climate strategy Pentti Pulkkinen.

The workshop resulted in numerous different future scenarios and the choice of the desired future scenario was unanimous. The workshop also produced a SWOT analysis of the desired scenario.

The outcome of the workshop is analyzed in this study and a vision for low-emission traffic in Vihti in 2050 is created. Furthermore, in the spirit of futures workshops, the vision is finally aligned with the present day. The present day is further examined through the vision created, whether there are operations or issues that need changing or developing.

The study aims towards a better overall understanding of what strategic objectives made for the future mean in the practices of today. In addition, the study examines the topic through a method that is rarely used in municipal decision-making.
The study is not directly a part of any development project. However, the study can function as a helpful addition to many ongoing processes in the municipality. The strategic masterplan of the municipality is being drawn up and some of the land-use decisions made in the masterplan could be further explained with the aid of this study. In addition, the Helsinki Regional Transport membership is on the table of the municipal board. This study can provide a broader insight into the issue, as it is a complex matter with many stakeholders. Also, the planning process of the high-speed rail link between Helsinki and Turku is underway. Vihti might be a stop along the high-speed railway in the future, but other future scenarios need examining as well. This study combines different projects and circumstances concerning public transportation in one paper.
2 MAPPING OF THE CIRCUMSTANCES

Vihti today is considered as part of the Helsinki region and the Metropolitan area. It has a population of 28,995 people which is approximately 2% of the population of the entire Helsinki region (1,420,284 inhabitants). Helsinki region is the most densely populated area in Finland and its population is expected to grow to 2,000,000 inhabitants by the year 2050 (Helsingin seudun maankäyttösuunnitelma 2015).

2.1 Helsinki region and public transportation

Helsinki region is located in Uusimaa province. It consists of the capital region (Helsinki, Espoo, Vantaa and Kauniainen) and the so-called KUUMA municipalities (Hyvinkää, Järvensjö, Kerava, Kirkkonummi, Mäntsälä, Nurmin perä, Pornainen, Sipoo, Tuusula and Vihti). The ground surface area of the entire Helsinki region is 3697 km² in total. The region’s population density is approximately 384/km² which is sparse compared to other Nordic capital regions. However, when comparing the entire province of Uusimaa to similar European provinces, its population density is in accordance with the basic European level. (Uudenmaan liitto 2018.)

FIGURE 1. A map of the Helsinki region. The green area represents the capital area and the yellow area is the wider Helsinki region. (Helsingin seudun aluesarjat, 2018.)
Regional public transportation today consists of long-distance bus or train connections, local and regional buses and trains, the underground in Helsinki and Espoo and the trams in Helsinki. Public transportation is organized either by a government operator (VR), a joint authority (such as Helsinki Region Transport, HRT), by the regional center for economic development, transport and the environment or on a market-basis (mainly bus routes).

The Finnish railroad network is owned by a government organization, Finnish Transport Agency. VR is the soul operator on the railroad network in the present-day situation. However, the Finnish government has decided to open passenger rail transport to competition over the forthcoming decade. This will allow other operators to take on different rail connections. (Finnish Ministry of Transport and Communications 2017.)

The main passenger rail connections in the Helsinki region include the railway between Helsinki and Turku, the railway from Helsinki towards Lahti and Tampere and the airport rail link. HRT procures the commuter train services in the region.

FIGURE 2. Map of the main transportation routes in Helsinki region (HRT 2018). The approximate location of Vihti is pictured with a red outline.
Bus connections in the region are organized either on a market-basis or by HRT. Market-based transport is open for free competition. Private operators plan their routes and timetables freely and decide on travel fares. No public funding is involved in market-based transportation. However, municipalities are able to buy transport connections from the operator in cases where it is not considered profitable by the operator, but necessary by the municipality.

HRT member municipalities include Helsinki, Espoo, Vantaa, Kauniainen, Kerava, Kirkkonummi, Sipoo, Siuntio and Tuusula out of which Siuntio and Tuusula joined most recently, in 2017. HRT is funded mainly by ticket revenue, municipal contributions and subsidies.

[FIGURE 3. A map of the HRT area (HSL 2018).]

2.2 KUUMA region and public transportation

KUUMA region is a consortium between municipalities surrounding the capital region. There are 10 KUUMA municipalities: Hyvinkää, Järvenpää, Kirkkonummi, Kerava, Mäntsälä, Nurmijärvi, Pornainen, Sipoo, Tuusula and Vihti. The population of the region was 318,117 people at the end of 2016 (Kuuma 2018).

Vihti joined the KUUMA municipalities in 2011 and it is the chairman for the year 2018. Four out of ten KUUMA municipalities have joined HRT. In regards to public transportation and development possibilities, the KUUMA region is not coherent. Some municipalities in the region are located by main rail connections and have their urban structure strongly and traditionally based on railway stations. Some municipalities are currently making
efforts to emphasize their role structurally as a railway-station-based municipal center. Furthermore, some municipalities in the region are currently unreachable via railways.

2.3 Location and structure of Vihti

Vihti is located approximately 45 kilometers west from Helsinki. The nearest regional center outside of the Metropolitan area is Lohja, the western neighboring municipality of Vihti. The other neighboring municipalities include Siuntio, Kirkkonummi, Karkkila, Loppi, Hyvinkää, Nurmijärvi and Espoo. Vihti has a surface area of 567 km² in total (Statistics Finland 2018).

![FIGURE 4. Location of Vihti in the region (Vihti 2018).](image)

2.3.1 Vihti in the regional context

In regards to the entire Helsinki region, structurally Vihti is distant from the rest of the region. The main focus in developing Helsinki region is naturally the capital area and
municipalities along the main railways. Vihti is situated reasonably far from both. In addition, Vihti is not a member of HRT, which emphasizes the distance between Vihti and the main development focus areas of the region.

![Map of Helsinki region](image)

FIGURE 5. A map portraying zones in Helsinki region. The zone coloration indicates travel forms by which services and workplaces are typically reached. In the red zone destinations are reached by low-emission travel forms. People in yellow zones typically use private cars or public transportation connections with interchange. Grey areas indicate necessity of using private cars. (HRT 2015.) The approximate location of Vihti is pictured with a red outline.

However, the Helsinki region transport system plan 2015 covers the entire Helsinki region. The plan is divided into two phases: the first phase ends in 2025 and the second in 2040. The first phase mainly focuses on developing the existing connections, when in the second phase there are also a few new connections mentioned, such as the Eastern subway.
The listed development projects are mainly situated in the capital region. (Helsingin seudun liikennejärjestelmäsuunnitelma 2015.)

One of the focal points of the transport system plan was to reinforce the connection between the transport system and land-use plans of the area. Therefore, the Helsinki region transport system plan and the Helsinki region land-use plan 2050 were carried out simultaneously. The renewal of the transport system plan is underway as the new MAL2019 plan combines the aspects of land-use, living and transportation into a total plan for the Helsinki region. Comments on the draft of the MAL2019 plan are gathered until January 2019.

KUUMA region does not have its own transport system plan, as it is integrated into HRT. Additionally, a regional transport system plan has been made for Western Uusimaa in 2014 and Vihti is included in this plan as well. The plan has been made in co-operation between the municipalities of the area along with the Uusimaa regional council and the Uusimaa Centre for Economic Development, Transport and the Environment. The plan is targeted at the year 2035. The municipalities included in the plan are Hanko, Inkoo, Karkkila, Kirkkonummi, Lohja, Raasepori, Siuntio and Vihti. (Länsi-Uudenmaan liikennejärjestelmäsuunnitelma 2014, 4-5.)

The vision of the plan is to support the sustainability of the urban structure in the region. The emphasis of the plan is in traffic safety and in reinforcing the existing population centers and the connections between them. In regards to public transportation, the plan aims to achieve an excellent service level by the year 2035 from Lohja, Nummela and Kirkkonummi towards Helsinki. An excellent service level in public transportation means:

- commuting between centers is punctual and equal to a car in terms of travel time,
- the selection of routes does not restrict the use of public transportation and
- passenger information is available on paper at the stations and at stops in the form of timetables and route maps (Länsi-Uudenmaan liikennejärjestelmäsuunnitelma 2014, 25-29.)

There is a number of actions listed in the plan that need to be carried out in order to achieve the aims mentioned. For instance, rapid connections between centers are essential for public transportation to compete with private cars in travel time. The selection of routes must be increased. Furthermore, the fluency of connecting between different travel forms (such as changing from a bus to a train) must be improved to make public transportation a sensible choice for commuters. This can be achieved by improving the infrastructure of public transportation, ticketing and information systems and marketing. In addition,
land-use planning plays a key role in improving the public transportation system. In order for bus travelling to be able to compete with private cars, the network of bus routes must be based on main corridors/routes. Land-use based on sustainable transportation should be located by these main corridors. (Länsi-Uudenmaan liikennejärjestelmäsuunnitelma 2014, 40-45.)

2.3.2 Vihti in correlation to the main routes of transportation

In regards to the main roads in Finland, Vihti is situated rather well. The main routes from Helsinki to Turku (highway number 1) and Pori (highway number 2) run through Vihti. The main population center in Vihti, called Nummela, is located in between three important routes: the previously mentioned highways 1 and 2 and the logistically significant route number 25.

The traffic volumes on route number 1 within the borders of Vihti have been approximately 25,000 cars daily in the year 2017. On route number 2 towards Pori the volume has been less than 15,000 cars daily. Route number 25 runs from Hanko harbor towards Hyvinkää. It is a logistically significant corridor, as approximately 10% of its traffic volume consists of truck traffic. In the year 2017 its total traffic volumes within the borders of Vihti were approximately 10,000 cars daily, depending on the measurement point. (Finnish Transport Agency 2018.)

FIGURE 6. Traffic volumes of different roads in Vihti (Finnish Transport Agency 2018). The approximate location of Vihti is pictured with a red outline.
In addition, the routes 110 and 120 run through Vihti. Route number 110 is the old main route from Helsinki to Turku and it is located north from highway number 1. Route number 120 is the old main way from Helsinki to Pori. It merges to highway number 2 just north from Vihti village.

Hanko-Hyvinkää railway passes through Vihti. The railway was originally privately owned and it was opened at the end of 19th century (Nummelan kylähistoria 2014). Other municipalities along the railway include Hyvinkää, Nurmijärvi, Lohja, Raasepori and Hanko. The public transportation to and from Nummela ended in 1983. Today, public transportation on the railway exists only between Karjaa and Hanko. The population centers in Vihti by the railway include Nummela, Ojakkala and Otalampi along with the rural village of Selki.

2.3.3 Urban structure of Vihti

The planning of the Vihti strategic masterplan is underway. The plan is being drawn up and interested parties are provided with an opportunity to express their opinion at the end of the year 2018. The plan aims to a coherent vision of land-use planning in Vihti in the future. It strives for strategic alignments in local land-use. The draft of the masterplan is based on growth both in population and in job opportunities. The draft is drawn up with the presumption that most growth will occur in Nummela population center. (Vihti 2018.)

About one third of the population in Vihti currently lives in rural areas. There are four population centers in Vihti: Nummela and the rural localities of Vihti village, Ojakkala and Otalampi. Out of these four, Nummela is the most populated center with 13,185 inhabitants. Nummela is also the fastest growing out of these centers. Vihti village is the historical center of the municipality and it is listed as a nationally significant cultural environment. It has 3,802 inhabitants. It is also a growing population center but not in the volumes of Nummela. The other population centers are Ojakkala and Otalampi. (Vihti 2014.)
FIGURE 7. An illustration of the urban structure of Vihti showing the locations of population centers, rural villages and main roads (Vihti 2018).

Nummela is located in the southern parts of Vihti. The ridge of the 2nd Salpausselkä, called Nummelanharju locally, characterizes the main municipal center. Nummela is situated in the crossroads of routes 1, 2 and 25. Nummela began developing rapidly after Nummela station opened by the Hanko-Hyvinkää -rail at the end of 19th century. Nummela is the main center for different services in Vihti, both public and private services. Land-use planning in Nummela today focuses mainly on supplementing the existing infrastructure in order to increase the efficiency of the infrastructure. Also, the aim of Nummela urban planning is to expand the urban structure south towards the main transportation routes.
The historical municipal center in Vihti is located approximately 10 kilometers north from Nummela by the lake Hiidenvesi. The strength of Vihti village is the historical aspects of the center, such as the village main street and the buildings by it. Even though several services, including health care services, are centralized in Nummela, the center offers many daily services. Planning focuses on supplementing the existing infrastructure and emphasizes on cherishing the valuable surroundings.

Ojakkala is a smaller population center northeast from Nummela. The two centers are located rather close to one another and the urban structure is nearly intact. There is a daycare center and a school for grades 1-6 in Ojakkala. Private services include a small grocery store and a pizzeria. Land-use planning in Ojakkala focuses on updating the existing plans to better suit the needs of present day.

Otalampi is situated by route 120. There is a large daycare center and elementary school complex in Otalampi. In addition to the children living in Otalampi, the school is the place of learning for many children living in rural areas of Vihti. There is a grocery store in Otalampi as well. As in Ojakkala, urban planning in Otalampi focuses on updating the existing plans with small openings of new housing areas.

Large areas of Vihti are considered countryside or rural villages. There are only a few master plans in Vihti rural areas, which means that land use in rural areas is often unplanned. The aim is to produce master plans for rural villages to help maintain their vitality.

2.4 Population of Vihti

The population of Vihti municipality in the year 2017 was 29 054. Approximately half of the entire population resides in Nummela and 25 per cent live in other population centers (Vihti village, Ojakkala or Otalampi). 25 per cent of Vihti’s population live in rural areas, as the degree of urbanization is 74.9 per cent. The degree of urbanization is lower in Vihti than in its neighboring municipalities, Siuntio and Loppi excluded. (Statistics Finland 2018.)

2.4.1 Projections on population growth

Population growth in Vihti was dramatic in the beginning of 21st century as the population grew by more than 2 per cent in the years 2002, 2004, 2007 and 2008. The trend is in correlation to other KUUMA municipalities. Population growth has decreased in recent years in Vihti, which is also the development in the rest of the KUUMA region. In this decade the
population growth has been less than one per cent in Vihti. The population even decreased in the year 2015. (Statistics Finland 2018.)

![Graph showing population development](image)

**FIGURE 8.** The population development of Vihti from year 1987 to 2017 (Statistics Finland 2018).

Statistics Finland has projected that population in Vihti would grow up to 30 030 inhabitants by 2020. This represents an approximate 1 per cent annual population growth. It is also projected that by the year 2040 the population would reach 32 494 inhabitants. This represents a far more moderate growth, approximately 0.4 per cent annually. (Uudenmaan liitto 2018.)

If Vihti’s population continues to represent 2 % of the population of Helsinki region and if the population growth estimate of the region is reached in 2050 (2 million inhabitants), it could be concluded from this that the population of Vihti will reach 40 000 in 2050. This stands for a steady 1 per cent population increase yearly. In addition, the strategic master-plan that is being drawn up also stems from an approximate 1 per cent population growth annually.
2.4.2 Population structure

Approximately 19 per cent of the population of Vihti is less than 15 years old. 63 percent represent the largest age group of 15 to 64 years of age. 18 per cent of the population is over 64 years of age. The share of the aged population has been growing drastically in the 21st century, which is a national trend. The share of the population over 64 years of age in the entire Uusimaa province is 17 per cent. (Statistics Finland 2018.)
Approximately 13 000 Vihti inhabitants are employed, 40 per cent of whom also work in Vihti. There are approximately 8000 places of employment in Vihti. (Statistics Finland 2018.)

2.5 Public transportation in Vihti

Public transportation in Vihti today is organized as a market-based system. The main operators in Vihti include Pohjolan Liikenne, Tervon Liikenne and Vainion Liikenne. The current main route of public transportation is between Nummela and Helsinki. It is operated from 5 am to 1 am daily and it has a large selection of departures. Furthermore, there are straight connections from Vihti village, Ojakkala and Otalampi to Helsinki, but with significantly less departures. Additionally, there are connections between Lohja/Karkkila and Nummela/Vihti village. The internal bus connections mainly serve school transportations, but the connections are open for all public. (Vihdin joukkoliikenneselvitys 2018, 5, 12.)

Out of the largest age group of people between 15 and 64 years of age, approximately 13 000 are employed. Approximately 40 per cent of them work in Vihti municipality. About 2500 are employed in Helsinki, which makes approximately 20 per cent of this entire age group. Another 2 500 people work in Espoo or Kauniainen and 1 000 in Vantaa. It could
be concluded from this, that the capital region is a major employer for Vihti residents. (Statistics Finland 2018.)

There are no commuter statistics available concerning the market-based public transportation system (Vihdin joukkoliikenneselvitys 2018, 6). Previously, when Vihti bus card was available, it had approximately 500 users monthly. In addition, Vihti residents buy approximately 160 HRT cards monthly. It is presumed that roughly 10 per cent of Vihti commuters use public transportation. (Rintala 2018.)

During the preparation of the report on Vihti public transportation in 2018, an interactive blog was also maintained. A few key development points can be highlighted from the blog and comments made on its posts. A ticketing system that is not dependent on the operator is desired. Route information and the information channels should also be improved. However, the largest criticism is directed at the route selection itself. There is not enough variety on destinations of direct routes. Often there is a too large time gap between connections. Furthermore, the option of joining HRT has come up in comments. (Vihdin joukkoliikenneselvitys 2018, 19.)

There is a number of development projects ongoing regarding public transportation that concern Vihti, the most influential of them being the “One Hour Train”: a highspeed rail link between Helsinki and Turku. The connection was originally planned in the 1970s but the plan was abandoned as the existing connection was improved. In the 21st century the need for a rapid connection emerged again. The planned connection runs through Vihti, crossing the southern parts of Nummela. If a station exists for this connection in Nummela in the future, it would conclude a 30 minute commute to Helsinki and a 45 minute commute to Turku. (Tunnin juna 2018.)

Vihti has examined the possibility of joining HRT along with other KUUMA municipalities in 2010-2011. In 2011 Vihti municipal board decided not to pursue HRT membership. The motives behind this decision lie in the operational expenses that would have become larger than the expenses of the current system. The expenses would not have covered the additional bus routes Vihti provides. Furthermore, there are little possibilities for Vihti to influence decision-making in HRT. (Vihdin kunta 2012.)

In 2017 a motion from the Social Democratic party initiated the discussion of the topic again. In march of 2018 Vihti municipal board decided to suggest HRT an investigation to be carried out about Vihti joining the HRT. This process is ongoing. (Vihdin kunta 2018.)

The planning project of electrification of the railway from Hanko to Hyvinkää is ongoing. The project includes improving the safety of the level crossings along the way. The
planning officially began in the spring of 2018 and the aim of the project is to increase the cost-efficiency of railway transportations. For now, public transportation is not included or considered in the planning process. (Finnish Transport Agency 2018.)

In December of 2017 the making of a joint transport system plan for Lohja and Vihti began. The aim of the plan is to increase the share of sustainable travelling within the area and in commutes towards the capital region. The plan especially aims at integrating the future Espoo-Salo rail link into a long-term transport plan. The plan is at draft-phase and it is set to be finalized by the end of 2018. There will be a number of development projects listed in the plan, through which the current transport services will be improved and new forms of service enabled. There will be a list of ways to influence people’s choices in travelling. It will also provide suggestions on sustainable urban planning and efficient logistics. (Uusimaa Centre for Economic Development, Transport and the Environment 2018.)

2.6 Carbon neutrality objectives

Emission reduction is a global challenge. For the first time in recorded human history, we have a universal, legally binding agreement on goals for mitigation and adaptation. The agreement was reached in December 2015, in the Paris conference of the parties, COP21. The Paris agreement entered into force on 4th November, 2016 (United Nations Climate Change 2018).

The agreement aims to strengthen the global response to climate change. The parties have agreed that the aim will be achieved by holding the increase of the global average temperature well below 2°C above pre-industrial levels. In addition, the parties have agreed to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels (Paris Agreement 2015, 3.)

Furthermore, the agreement states that each party must peak in their greenhouse gas emissions as soon as possible. Thereafter the emissions should take on a rapid reduction and each party must pursue national mitigation measures in regards to greenhouse gas emissions (Paris Agreement 2015, 4.)

Finland is one of the signing parties as Finland finalized its national ratification on 14th November 2016 (Finnish Ministry of the Environment 2018). The Climate Change Act (609/2015) in Finland entered into force on 1st June 2015. The Act includes long-term objectives on emission reduction in Finland. Nationally we aim to reduce the total amount of anthropogenic greenhouse gas emissions in the atmosphere by at least 80 per cent by 2050 compared to 1990 levels (Climate Change Act 609/2015, section 6.)
The European Union has set unionwide targets on green growth. The European Union aims to cut greenhouse gas emissions to at least 20 per cent below 1990 levels by 2020. Furthermore, the EU leaders have agreed on climate targets for 2030. By then the greenhouse gas emissions should be cut by at least 40 per cent compared to 1990 levels. Finally, by 2050 the emissions should be cut by 80-95 per cent compared to 1990 levels. (European Commission 2018.)

The province of Uusimaa aims for carbon neutrality by the year 2035 (Uudenmaan liitto 2017, 39). One of the most important tools for Uusimaa regional council to pursue this aim is the regional plan. The new regional plan Uusimaa2050 is currently being drawn up. The draft aims towards a more efficient regional urban structure, that strengthens the role of the existing population centers. This supports the hopes of maintaining the province's larger forests and other green areas, that function as carbon sinks in the region. Emphasizing and strengthening the role of current infrastructure and existing population centers also aids in the endeavors of developing and enhancing public transportation systems in the region. (Uudenmaan liitto 2018, 16.)

Vihti municipality has updated its strategy in 2018. The new strategy is designed for the time period of 2018-2021. Regarding climate, the strategy emphasizes that Vihti is committed to the aims stated in the climate strategy for KUUUMA municipalities (Vihti 2018). The KUUUMA region aims at a 25 per cent in emissions by the year 2020 and at carbon neutrality by the year 2050 (KUUUMA 2018).

2.6.1 The role of public transportation in carbon reduction

The total greenhouse gas emissions in Finland in the year 2017 were 56.1 million tons CO\(_2\)-ekv. The total emissions were approximately 21 % lower than the level of year 1990. The most significant greenhouse gas in Finland is carbon dioxide, as it represents 80-85 per cent of all greenhouse gases produced in Finland between 1990-2017. Furthermore, the energy sector in Finland is the most significant factor in greenhouse gas production as it produced 74 per cent of all greenhouse gases in the year 2017 (41.6 million tons CO\(_2\)-ekv). The energy sector includes energy production, domestic traffic, industry and construction. Domestic traffic represents approximately one fifth of all greenhouse gas emissions in Finland in the year 2017 and roughly 27 per cent of the greenhouse gases produced in the energy sector. (Statistics Finland 2018.)

As these statistics show, domestic traffic has a high potential in greenhouse gas reduction. When the focus is on traffic and emission reduction, sustainable forms of travelling play a key role in the topic. Sustainable forms of traveling include zero emission travelling,
such as walking or cycling, and low emission travelling meaning public transportation, such as railway or bus connections.

Organizing public transportation is also an expense: to a private operator, a municipality, a joint authority or even a nation. In a situation where the passenger volumes are not very high, the operating efficiency often clashes with strategical expectations. Public transportation is in straight correlation to the urban structure: the more passengers along a bus route, the more profitable the connection becomes. And furthermore, the closer one lives to a regular bus connection route, the more sensible it is to use public transportation. The average carbon dioxide emission of a private car in Finland in the year 2016 was 151 g/km. A bus emitted 798 g/km on average. It could be concluded from this that if a bus has six or more passengers travelling the same distance, it would be the sustainable choice of travel form. A train is a carbon dioxide emission free travel form, when the energy source for the electricity is disregarded. (Lipasto yksikköpäästöt 2017.)

2.6.2 The interaction between land-use and public transportation

Land-use, infrastructure and the overall built environment have an impact on people’s traveling choices. In a densely built urban area, distances are shorter and easier to travel by foot or bicycle. Furthermore, a densely built area is favorable for public transportation efficiency as more passengers live in a compact-size area. In addition, these circumstances lead to better possibilities to increase service level. A dense and centralized urban structure can be justified by a better public transportation level. It is generally thought that a radius of 800 meters from a transit station or a stop is the area that should have the highest population density. The 800-meter radius correlates to an approximate 10-minute walk. (Weckström 2016, 8, 13.)

Land-use of mixed operations, diversity of urban structure, also benefits the use of public transportation. In a diverse urban setting, people are more likely to walk distances to transit hubs, workplaces, shops or extra-curricular activities. This is due to the shorter distances the structure enables. In addition, a mixed land-use is often considered more interesting, which makes the travel appealing to a pedestrian. In fact, the quality of the urban structure from a pedestrian point of view also plays a key role in people’s choices of travel forms. Attention should be paid on the quantitative factors, meaning the actual walkability of population centers (sidewalks, intersections or block sizes). Additional attention is needed on examining the quality of the walking environment. These factors include the building proportions along the sidewalk, the liveliness of the street and the activities found along the way. (Weckström 2016, 15-16.)
3 PURPOSE OF THE DEVELOPMENT PROJECT

3.1 Research problem

The circumstances today are challenging for Vihti in regards of public transportation. In a regional context, Vihti is located in between two different types of areas. On the one hand, it is considered a part of Helsinki region, although it is logistically distant from the capital region, and its structure is not that of an urbanized municipality; while on the other hand, it is considered a part of the Western Uusimaa and in that context, Vihti is one of the most urbanized and fastest developing municipalities.

The estimates and aims of population growth in Vihti indicate more traffic towards the capital region. Congestion on the main roads is already a widely known issue in the Helsinki region and people are encouraged to use public transportation. Still, the share of commuters in Vihti using public transportation is small (approximately 10 per cent).

In regards to the aims of greenhouse gas emission reduction on different levels, it is not justified to consciously plan new residential areas and aim for population growth that essentially adds traffic based on private cars. Actions need to be taken to strengthen the role of public transportation in commuting traffic in Vihti.

There are several projects ongoing that have the potential to significantly improve the status of public transportation in Vihti. Is Vihti going to get a train station in Southern Nummela and if so, when? Should Vihti join HRT to improve and simplify the ticketing system and by doing so, more Vihti inhabitants would start using public transportation? Should a new ticketing system be created? What kind of future scenarios can be found for Vihti public transportation?

Regarding public transportation in Vihti, the weight of history can be found in the urban structure of Vihti. Vihti is traditionally a rural municipality and long distances are descriptive to the municipality. The use of public transportation has not been common in the recent decades. In the competitive spirit of the modern society, this has led to a decrease in the public transportation service level. It has also centralized to the largest population center of Nummela.

The pushes of the present are related to the competitiveness of the modern society as well. To maintain and to develop the service level of the municipality today population growth is essential. However, when nearly 50 per cent of all commuters travel to the capital region daily, the effortless commute plays a key role when deciding on places to reside.
Commuters in Vihti already call for more selection among the routes and direct connections.

The pulls of the future revolve around population growth prospects and the goals on emission reduction. Without a functioning public transportation system, the population growth estimates and the goals on emission reduction are in contrast with each other.

### 3.2 Aim of the research

The aim of this research is through a workshop to identify different future perspectives for Vihti in regards to public transportation. Future studies are rarely taken into consideration in municipal decision-making, which might result to short-sighted resolutions. Therefore, the goal is to increase awareness of positive and negative possibilities and relations between different phenomena in the society. Furthermore, the study aims to recognize a desirable future scenario regarding public transportation through the futures workshop. The scenario is closer analyzed through SWOT analysis in order to create a vision of how this scenario could be achieved in the future. The study begins with the practices and circumstances of today, then aligns the practices with strategic goals and a vision of the future. Then returns to examine the practices of today, whether there are changes to be carried out. The study aims towards a better understanding of what strategic objectives made for the future mean in the practices of today.

![FIGURE 11. A process image on how the study is carried out (the author).](image-url)
4 RESEARCH METHODS

4.1 Future research

Future studies tackle wicked problems, problems that seem difficult or even impossible to solve. Wicked problems are present in our everyday lives and an attempt to solve a wicked problem might create new wicked problems. They are changing and morphing issues which makes causes and effects difficult to define. Wicked problems always have multiple stakeholders and they involve overlap of different sectors in a society, meaning any solutions to a wicked problem influence several authorities, for example in a political or a societal sense. A resolution to a wicked problem could mean changes in a person’s or a nation’s way of life, dramatic changes in the world’s political circumstances or it could even lead into an environmental crisis. (Weber & Khademian 2008.)

Public transportation can be viewed as a wicked problem. It is definitely an issue that has many stakeholders: passengers, operators, municipalities, joint authorities and nations. In some cases, public transportation affects multiple nations. Public transportation routes have effects on how different residential areas are viewed: those with excellent public transportation service level are often desirable areas to live or work in. This has the potential to have impacts segregationally, as demand increases property values. New public transportation routes, especially new rail openings, are expensive and need the funding of different authorities in the society. Competition on these new development projects can be tough and stakeholders have a variety of opinions on which the most significant project is. If a new rail connection is opened in some parts of the region, other parts could suffer for example population reduction. An attempt to solve one municipality’s challenge in improving its public transportation conditions could lead to a need to improve conditions in other municipalities as well. It could also lead to challenging situations in other issues within the municipality, such as segregation or need for other large investments.

Future research is not only about finding historic continuums, but also about discontinuations and new phenomenon. It functions as a way to understand change in our lives and in society. It focuses on understanding the dynamics and the probability of change. (Wilenius 2015, 16-19.)

Future researchers also work to identify the so-called weak signals. They are small phenomena that exist today, but they can be perceived as being insignificant. These weak signals could however grow into megatrends in the future. In the past, information and communication technology has been a weak signal. The manager of IBM predicted in 1943 that a total of five computers will suffice for the world of the future. In 1970s the
thought of anyone wanting a computer in their home was astonishing even to pioneers of digital technologies. (Wilenius 2015, 44.) As we know today, ICT turned into a megatrend and it has changed the core functions of the modern society.

There are six basic concepts in future thinking:

- Used future
- A disowned future
- Aligning the future
- Alternative futures
- Model of social change
- Future skills

A used future is something that a person, a society or a nation has seen before, perhaps in another context. It has seemed like a preferable one and therefore it is pursued. A good example of a used future view is the way the Asian countries have followed in the footsteps of the Western civilization in terms of industrial growth, despite the evidence showing it has not been a sustainable development globally. A disowned future could be described as something of a self-deception. It means being focused on a future goal without being fully aware of the resources it takes to achieve it. A municipality might create a strategy with beautiful foresights, but does not actually have the resources to achieve its strategic goals. Aligning the future is a way to change a disowned future. There should be an alignment between actions done daily and the strategies made. Furthermore, there should be an alignment from the strategy to a vision and finally, the vision should be aligned with the daily actions. The alternative futures thinking views the future as different options. Alternative futures thinking helps people and society prepare for different scenarios for the future. The fifth concept is everyone’s model of social change. How does a person, an authority, a company or a municipality see the future? Finally, there is the concept of future skills. It is about broadening the thinking of individuals and organizations. Knowing of these concepts and being aware of their thought-limiting-effect could result to more innovative ideas. (Inayatullah 2008, 5-6.)

Furthermore, future studies has six pillars: mapping, anticipation, timing, deepening, creating alternatives and transforming. All these pillars and methods can be used in futures workshops. Mapping the past, present and the future is an important foundation for a futures research. These three aspects of mapping create a triangle, where the pulls of the future are on top. On the sides there are pushes of the present and the weight of history. Anticipation revolves around emerging issues and what kind of impacts they might have on lifestyles of tomorrow. This is often examined through a futures wheel. The third pillar
is timing the future. This pillar revolves around the grand patterns: What essentially makes the world change? How do we see time? Is it linear, cyclical, spiral, or something else?

The fourth pillar is about deepening the future. When we have a complex problem or an issue, it often has a broader context: regional, societal or national. It is usually also linked to a global matter. When we deepen the future regarding a limited issue, we can observe solutions to it on each level. This sort of thinking deepens the issue at hand and also deepens our understanding of it. When deepening the future, we are able to reach a very abstract level of a myth or a metaphor. Casual layered analysis (CLA) is often used to examine this pillar. The fifth pillar is about alternatives and scenarios and there are multiple methods created to examine them. Scenario thinking is considered to be the essence of future studies. The final pillar is about transforming the future. What type of future do we want and how are we going to achieve it? (Inayatullah 2008, 7-18.)

Future research or future assessment can be carried out using one of three approaches. The first is the probable futures thinking, based on probabilities. It is widely used in the field of economics as a method of forecasting the economic trends. It is a method that perceives the future as a continuum of the past. The other approach focuses on possible futures. It is based on alternative futures thinking and scenario methods. It was first developed during the cold war and it aims on creating different alternatives for the future. It is not attached to probabilities. The final approach is based on live organisms and ecosystems and the thought of the future being made every day. The viewpoint stems from the need to create appropriate circumstances for the preferable future. (Wilenius 2015, 20-22.)

4.1.1 Different methods of future research

Possible futures thinking is based on creating and analyzing different scenarios of the future. A future scenario can be characterized as a rationalized story of the future. It is not a future forecast as such. It is clear and logical, not vague. Scenarios must differ from one another and they must address the essential matters. They should be linked to the strategic main questions. (Wilenius 2015, 46.)

Futures studies are often carried out using participatory methods. Likely the most known method of future research is the Delphi method. The Delphi is a research method that includes a number of experts. It is a structured communication process, that is led by a facilitator. The experts taking part in a Delphi research are anonymous to each other, which is often considered to be one of the key benefits of the method. The anonymity of the process eliminates the phenomena of group thinking, where people might be dominated by others’ opinions. The facilitator approaches the participants with questionnaires, then
collects the answers for monitoring. Participants are then given feedback on the results and they have a possibility to review their answers or explain them further. A Delphi research is often conducted in two or more rounds of questionnaires and feedback in order to achieve a consensus among the experts of the matter at hand. (Santonen & Kaivo-Oja & Myllylä 2013, 4-5.)

The field anomaly relaxation method or FAR methodology was first introduced by Russell Rhyne in the 1970s. It is a technique that focuses on relations between different drivers or factors regarding a complex issue. It begins with a structured table with named indicators or drivers. For each driver different varying futures are created. If, for example, seven different drivers are chosen and each driver has seven alternate futures, this would conclude a matrix of more than 800 000 possible future scenarios. However, it is often clear that some parts fields are not likely to coexist. This leads to the phase of deleting the anomalies from the matrix. This can be done through a pairwise comparison of each field. Finally, tree-like structures are drawn over the fields that are linked with each other to create alternate futures. After this, the alternate futures can be named and then described. (Stephens 2006, 42-44.)

Crowdsourcing can also be used as a methodology in futures research. Crowdsourcing is a term describing situations where organizations turn to audiences for insight, thoughts, ideas or options regarding a specific issue or a development project. Crowdsourcing can benefit organizations through fresh ideas. Crowdsourcing can be carried out in numerous different ways, for example through discussions in social media, through questionnaires or surveys or through public events.

Casual Layered Analysis (CLA) is a method used when deepening the future. The analysis has four layers, first of which being an issue from our daily lives. It can seem like a simple challenge, one with a relatively simple solution. But when the issue is taken to the second level the viewpoint is widened, perhaps to a regional level. The issue becomes more complex and the solution influences other sectors of the society. The third level of the Casual Layered Analysis handles the issue from a global scale and the solution revolves around global phenomenon, such as the Western society as a whole. The last layer of the analysis is the most abstract one, a myth or a metaphor. (Inayatullah 2008, 12.)

The futures wheel is a method of exploring interactions between the issue and its impacts. The method also allows the interactions between the impacts of the issue be explored. First, the emerging issue or development project at hand is written in the middle of the wheel. The direct impacts are then written on the closest ring to the issue. The indirect
impacts are written on the second ring and the relations between the project or issue and its direct and indirect impacts are then explored. Additional rings can be created if it is needed. (Inayatullah 2008, 9.)

4.1.2 The choice of method and justification

This study was carried out as a participatory research and it included a workshop with the key experts in the municipality. A variation of the field anomaly relaxation (FAR) future table was utilized as a method when creating different future scenarios regarding public transportation in Vihti. The viewpoints or drivers were selected beforehand in order to clarify the task at hand for the participants.

The drivers were chosen according to the PESTE logic. The PESTE or STEEP analysis is a widely known tool in the field of economics and it is created for observing changes in the operating environments. The name PESTE is derived from the following words:

- political
- economical
- social
- technological
- ecological

The topic in question is analyzed through each of these drivers. The PESTE analysis results in future visions of the topic regarding each of the pre-mentioned societal drivers.

After creating tree-like structures of possible future scenarios, the workshop determined the future scenario most desirable for Vihti. This scenario was then closer analyzed through SWOT analysis. SWOT analysis is originally created by Albert Humphrey (Rouse 2014). It is a framework where the strengths, weaknesses, opportunities and threats of a specified issue are identified and explored. It is a widely known and used method behind strategies and visions made by companies and other authorities.

The research method was presented during the Master’s Degree studies in Lahti University of Applied Sciences, in class of the course societal change and future foresight methods. It was also the method with which the groupwork of the course was carried out. Despite the fact that the use of the method seemed unclear at the time of the course, the method and future research as a field of studies was perceived as appealing. Urban planners make choices through their work daily that have a significant impact on the future. And yet future research is rarely present at their daily operations. Furthermore, considering the fact that plans made on municipal or regional level are always political decisions,
future studies might assist decision-makers comprehend the reasons behind structural choices made.

The decision of a participatory methodology was made early on in the process. The topic of public transportation has several different stakeholders and it is a complex issue. Therefore, to gather experts of different fields all around the same table discussing the topic seemed like the best option to go for.
5 WORKING PROCESS

The workshop took place in Vihti municipal hall in November of 2016. Participants included the acting municipal manager Hannu Nummela, technical and environmental manager Kari Setälä, development manager Timo Tuomi, head of town planning Suvi Lehtoranta, route planner Salla-Mari Rintala and a member of the workgroup on climate strategy Pentti Pulkkinen. In addition, the invitation included transport planner Elisa Pajunen, head of environmental inspection Kirsi Järvinen and the chairmen of the planning and technical board and municipal board. The subject of the workshop was explained beforehand and all invited parties have excellent knowledge of the circumstances of the issue.

FIGURE 12. Participants Nummela, Rintala and Tuomi at the workshop.

The research methodology was presented to the participants in the beginning of the workshop. The year 2050 was chosen as the target year. This is due to the fact that many plans in the region carried out today aim at the year 2050. These plans include for example Helsingin seudun maankäyttösuunnitelma 2050 and the strategic masterplan of Vihti. The year seemed too distant for some participants of the workshop and the possibilities for us knowing today what the future might hold seemed impossible. The process of the workshop was then explained along with what the workshop is expected to produce. After the introduction the empty PESTE-table was presented to the participants and the role of the presenter altered into a chairman and a secretary. The workshop began with filling the PESTE-table with different scenarios.
TABLE 1. The empty PESTE table (Appendix 1).

Vihti public transportation 2050

<table>
<thead>
<tr>
<th>A</th>
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<th>C</th>
<th>D</th>
<th>E</th>
<th>n</th>
<th>n+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political situation and decision making</td>
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<td></td>
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<tr>
<td>Economic development</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social situation and population development</td>
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<td></td>
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<tr>
<td>Technological achievements</td>
<td></td>
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</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

5.1 The PESTE table

The method of the research was new to all participants and the discussion around the topic started out slowly. This was, however, a seemingly interesting way to approach the issue, which resulted in numerous different future alternatives. These alternatives were discussed during the workshop and explanations were given to each option. It was emphasized to the participants that the purpose of naming different options for each sector is to later create scenarios that vary significantly from each other. At this phase of the process, it is crucial to focus on each line rather than thinking further on the scenarios.

5.1.1 Political situation and decision making

By the year 2050 there is a great possibility that road tolls will be in use in the Helsinki region. A road toll is a form of payment over road use and road tolls are in use in several capital regions around Europe, in Stockholm for example. A study has been made by HRT in 2016 about road pricing in the region. In the study, there were different models of road pricing introduced. One was a model in which there was only one toll zone around the central Helsinki city area. One alternative was to introduce two toll zones: the inner zone around the Helsinki city center and the outer zone along the road Ring III. In addition to the inner and outer zone, one alternative had three toll lines along the Ring roads as well. Finally, there was the alternative of charging by the kilometers driven within different zones. The study concludes that road charges can contribute to a more compact urban structure. However, the study states that the impacts of road charges can be negative in
the areas outside the ring roads, especially outside the rail corridors. Implementing road charges demands legal adjustments. (HRT 2016.)

At the beginning of the year 2018 it became possible in Finland for all transportation services to be provided freely (The Act on Transport Services 320/2017). The Act enables the improvement of links between different services, such as bus and train. Furthermore, the Act allows market entries for new operators. The Finnish government has already decided to open passenger rail transport to competition over the next decade. This will allow other operators than VR to take on different rail connections. Even Hanko-Hyvinkää -rail along with the municipalities and population centers by it might seem appealing to a smaller operator in the future. In 2010 approximately 700 Vihti inhabitants commuted to Lohja and approximately 200 to Nurmijärvi. Furthermore, nearly 900 Lohja inhabitants commuted to Vihti (Länsi-Uudenmaan liikennejärjestelmäsuunnitelma 2014, 24). Hanko-Hyvinkää -rail could potentially function as a public transportation corridor between these centers and increase the attractiveness of these commute routes.

The Act on Transport Services opens Finland to the opportunity to test the system of Mobility as a Service (MaaS). Mobility as a Service means a trip planning system which provides smooth travel from the start point to the destination, with only one ticket and travel fare (Finnish Transport Agency 2018). It would likely be based on a mobile application to which travel destination is set. The application would then provide the travelling information, such as which leg of the route is to be travelled by taxi, bike, bus etc. Then the traveler would simply accept the route plan, buy a ticket and know when the trip is about to begin. Finland is pioneering the mobility as a service project. If it succeeds, Helsinki region will presumably be the area of origin for the system.

The future could also lead to a heavy national guidance in the matter of public transportation. This could mean that government organizations would take on the service management sector in total. It could also mean new legal obligations for municipalities concerning the issue.

One scenario discussed in the workshop was the possibility of joint authorities, such as HRT, coming apart. HRT has expanded its area of operation in the recent years into municipalities in the KUUMA region and even Siuntio. The area of operation might become too large for one authority to handle. If the authority were to break down, its operations would then fall upon smaller stakeholders.

A political decision that would have major impacts on public transportation’s attractiveness towards commuters would be to offer public transportation services free of charge. The European Commission conducted a survey in 2013 on improving urban transport. The
survey resulted that lower ticket prices and better public transport are the two best measures for improving the topic. Free-fare public transportation (FFPT) is unusual in present day regions in the world, but not unheard of. In 2013 in Tallinn Estonia became the first capital city in the European Union to offer free public transport to all its citizens. As of 2018 public transportation has become free of charge throughout the country for Estonians. This means that the service provider must subsidize the loss of ticket charges in order to cover the costs of organizing public transportation. (Cats 2016.)

As an opposite scenario to the previous one, we might have travel fares in the future. In regards to political decision-making, this would be the scenario where measures have not been made in order to improve public transportation service level in Vihti. However, depending on the service provider and the level of subsidize from the service provider, the ticket prices could still be competitive with private cars.

TABLE 2. The PESTE table filled with future scenarios on political situation and decision-making.

<table>
<thead>
<tr>
<th>political situation and decisionmaking</th>
<th>Road tolls</th>
<th>Transportation services can be provided freely</th>
<th>Heavy national guidance</th>
<th>HRT breaks down, responsibilities fall upon smaller operators</th>
<th>Public transportation is free</th>
<th>Public transportation chargeable</th>
</tr>
</thead>
</table>

5.1.2 Economic development

There is a theory about the economical waves or cycles of innovation, the so-called Kondratiev’s waves. The theory is based on the assumption that the economy flows in waves that last 40-60 years. Each wave has its own elements that characterize the era or cycle. The waves began at the end of the 18th century with the wave of the steam engine. The next wave took place in 1830-1880 with steel production and railways. The third wave was characterized by electrification and chemicals and it ended at the beginning of the fourth wave in 1930. The fourth wave was the era of the automobiles and petrochemicals. The fifth wave was the time for information and computer technology to become a part of everyday life and it ended with the financial crisis of 2007-2009. We are now thought to be at the beginning of the sixth wave, which is believed to be characterized by intelligent technologies and resource efficiency. If the sixth wave were to last for 40 years, we would be at the end of it by 2050. (Wilenius & Kurki 2012, 9.)

A regressing economy is a possible future scenario for the year 2050. In the theory about the waves of innovation, there has always been an economical downfall in between the waves. A regression in economy influences most functions of a society, including public transportation. Regression can bring along large-scale unemployment, which influences
the need to travel and the amounts of passengers. Regression might impact on the foundational funding of public transportation, making the circumstances challenging to operate.

We could also be on the road of a growing economy. A closer look at the Kondratiev's waves shows that the timespan of a single wave has become shorter in the recent decades, and that the waves have grown clearer as well. By the year 2050 we could be at the start of a new, seventh wave. A growing economy gives room to innovation and technological development. In public transportation in the year 2050 this could mean innovative energy sources, resource efficiency or completely new forms of traveling. In the times of growing economy employment status is often high and authorities have funding possibilities.

The economic development might also have led to a growth of differences in income among citizens. Major differences in income is a large societal challenge and it is a source of confrontation in many issues. In the urban structural context, it could lead to segregation within population areas and centers. Public transportation might become the privilege of the wealthy or the poor man's option.

In regards to public transportation, small differences in income level among people could result in a better overall social acceptance of public transportation. Today one might hear phrases about bus travelling being for those who cannot afford to own their own car. In the correct economic state and the general social atmosphere public transportation might even become a megatrend in the suitable circumstances.

In the year 2050 we might be experiencing challenges with unemployment. Unemployment on a general level indirectly impacts public transportation as people have less need to travel or commute. A service that does not have enough end users is unable to operate, unless the future brings us new funding possibilities.

A steady-state economy is a term of ecological economics and it would essentially mean a stabilized population and consumption. It would be an economy where the birth rate approximately equals the death rate and consumption meets production. Currently, the global economy is built on economic growth, but it is not considered a sustainable form of economics. (Center for the advancement of the steady state economy 2018.) A steady-state economy could possibly mean a more efficient public transportation system. However, if Finland were to aim for a steady state economy, the distances would remain a challenge in organizing public transportation. The efficiency of travelling in a steady state economy does require other additional measures, such as urbanization to continue, in order for it to be achieved.
TABLE 3. The PESTE table filled with future scenarios on economic development.

<table>
<thead>
<tr>
<th>Economic development</th>
<th>Regressing economy</th>
<th>Growing economy</th>
<th>Differences in income grow</th>
<th>Differences in income diminish</th>
<th>Unemployment</th>
<th>Steady economy</th>
</tr>
</thead>
</table>

5.1.3 Social situation and population development

Social circumstances within a municipality can have a major impact on the use of public transportation.

In the future, Vihti might experience a vast growing in population. Studies show, that a population growth of less than 2 per cent is ideal for a municipality. A larger growth level puts a strain on the infrastructure and pressure on making large-scale investments, such as new schools or daycare centers.

The population in Vihti could also be decreasing. Vihti has recently, in the year 2015, experienced a population reduction. In regards to the population growth estimates for the entire Helsinki region, this scenario seems unlikely. However, as population grows in the region and if traffic jams continue to exist on a regular basis, Vihti might not appeal to a commuter if other transportation options are not opened.

The young and the working generation in the year 2050 in Vihti might prefer to travel by private car. This scenario would be a logical historic continuum, as the share of commuters using public transportation is small even today. Private cars are likely to be based on a different technology than the cars of today, and car emissions will presumably be on a completely different level. However, in a future scenario like this, public transportation is not likely to have developed and the service level might have decreased.

By the year 2050 Vihti could also be experiencing a generation of environmental awareness. This could be due to other changes in our society, such as a significant growth in ecological technologies inspiring environmental choices or changes made in professional lives that reduce the daily need to travel.

A steady population growth is something Vihti pursues in the strategies and master planning of today. It is also a logical continuum of the present-day situation in Vihti and in the region. In order for the public transportation system in Vihti to develop, the steady population growth should be directed to the areas by a current bus route.
TABLE 4. The PESTE table filled with scenarios about social situation and population development.

<table>
<thead>
<tr>
<th>Social situation and population development</th>
<th>Vast population growth (over 2 %)</th>
<th>Regressing population development</th>
<th>A driving generation</th>
<th>A generation of environmental awareness</th>
<th>Steady population growth</th>
</tr>
</thead>
</table>

5.1.4 Technological achievements

By the year 2050, technical development will most likely have been immense in many sectors of society. If the sixth wave of innovation is indeed going to be characterized by intelligent technologies and resource efficiency, it will presumably bring changes to the means of public transportation as well.

In 2050 the new railway from Espoo to Turku might run through Vihti. A station by this railway would be significant, not only in the sense of public transportation opportunities but also in regards of the entire development of the municipality. The railway connection would result in a possibility of a large-scale operational area in terms of business as it connects the capital city to Turku. This could also benefit the municipalities between the two city regions. A person living in Vihti would have a vast area within a reasonable commuting distance and timespan.

The need for a faster connection between Helsinki and Turku has already been recognized. Despite the ongoing plans for a new railway, the connection might be an appealing opening for an innovational project. There have already been thoughts about a hyperloop connection for this route. A hyperloop is a vehicle designed to move passengers or cargo in a low-pressure tube. The tube would be built either on columns or underground to avoid for example challenges with wildlife. The benefits of a hyperloop in comparison to a train revolve around the travel time as the hyperloop could have a top speed of 1080 km/h. (Hyperloop One 2018.) Hyperloop in the context of future research could be a term describing all the technical improvements regarding travelling that are not a part of our day-to-day life yet. These are innovations that will change our lifestyle: weak signals of today, megatrends of the future.

A railway connection between Helsinki and Tallinn as well as the fast connection between Helsinki and Turku are a part of the Trans-European Transport Network, also known as Ten-T. The Ten-T policy is an implementation and a development project of a Europe-wide connection network. The objective is to close gaps and eliminate bottlenecks within the European Union in order to strengthen a wide cohesive transport area. (European Commission 2018.) If a railway would exist between Helsinki and Tallinn in the year 2050,
it would benefit Vihti as well in terms of a larger operating area within a reasonable travel time. In addition, it could bring pressure on creating the faster connection between Helsinki and Turku.

New technologies also change societies through the change in work they bring along. Many traditional occupations have already been replaced by a technological innovation. For example, train tickets are bought from a machine instead of a cashier. Computers are already able to create news articles by themselves. If this trend continues in the future, the nature of the work we do is going to change. Many occupations or parts of them can be replaced by a machine. This trend is going to significantly change work, or people might even be able to work less. This has a direct impact on the need to commute or travel daily.

A few years ago, 3D-printers seemed like science fiction. Now we have these printers available in stores. However, the impact 3D-printers could have in public transport in the future seems insignificant.

Energy solutions in private car manufacturing especially have taken large steps ahead in developing resource efficient engines and sustainable forms of fuel. If energy efficiency in private cars improves and the use of sustainable energy sources becomes the future megatrend, it might decrease the need for public transportation in the sense of emission reduction. If the emissions of private cars are cut significantly, the traffic emissions in total are reduced as well. However, this alone does not solve all issues around transportation, for example congestion remains or increases on the main routes.

TABLE 5. The PESTE table filled with technological achievements.

<table>
<thead>
<tr>
<th>Technological achievements</th>
<th>ESA-rail and station</th>
<th>Hyperloop</th>
<th>A rail connection between Tallinn - Helsinki</th>
<th>A change in work, less need to commute</th>
<th>3D-printers</th>
<th>Energy solutions</th>
<th>Technology does not develop</th>
</tr>
</thead>
</table>

5.1.5 Environment

Environmentally one possible future scenario is the population of Vihti growing but the share of public transportation users remaining the same. If technological improvements in private car performance are not achieved, this will result in traffic emission increases. This however, would be the scenario where Vihti has failed on achieving the aims set on different levels regarding emission reduction.

In the future Vihti might have been able to strengthen its population centers through consistent land-use. In a central-focused urban structure, large areas of forests and fields remain unplanned and unbuilt. This benefits, for example, wildlife as habitats remain intact.
Furthermore, large rural areas benefit agriculture if fields or forests are not fragmented into smaller areas. In a centralized urban structure population density is high and work places are integrated in centers. This structure enables an efficient public transportation system as distances are short many live within a reasonable travel time to a stop or a station. In addition, the attractiveness of public transportation might increase as the urban structure enables rapid connections from one population center to another.

In the future, Vihti might also have characterized itself as the rural municipality of the Helsinki region. Vihti has long traditions in agriculture and rural villages. It is possible that promoting country life will become a main strategic alignment for the municipality. A structure with longer distances and fewer passengers along routes creates a challenge in regards to the profitability of organizing public transportation.

One way to significantly reduce the need to commute is for a municipality to increase the number of places of employment within its borders. If people living in Vihti also work in Vihti, the daily travel distances are shorter and more appealing to other forms of travel than a private car. This in turn highlights the significance of a functioning internal public transportation system.

Finally, Vihti might be experiencing a decrease in greenhouse gas emissions. This could be due to for example a centralized urban structure, a decrease in population or an increase in places of employment in Vihti. Or it could be due to something else. Reduction in emissions is a goal set to all municipalities on a global, continental, national and regional level. Often also on a municipal level. This would be a scenario, where Vihti has been able to achieve all goals.

**TABLE 6. The PESTE table filled with environmental scenarios.**

<table>
<thead>
<tr>
<th>Environment</th>
<th>Traffic emissions grow</th>
<th>Central-focused development</th>
<th>Scattered settlement-based development</th>
<th>Municipal self-sufficiency in work opportunities</th>
<th>Traffic emissions diminish</th>
</tr>
</thead>
</table>
5.2 FAR future table

TABLE 7. The PESTE table filled completely (Appendix 2).

Vihti public transportation 2050

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Ns</th>
</tr>
</thead>
<tbody>
<tr>
<td>political situation</td>
<td>Road tolls</td>
<td>Transportation</td>
<td>Heavy national</td>
<td>HRT breaks down,</td>
<td>Public transportation</td>
<td>Public transportation</td>
<td></td>
</tr>
<tr>
<td>and decision making</td>
<td></td>
<td>services can be</td>
<td>guidance</td>
<td>responsibilities</td>
<td>is free</td>
<td>is chargeable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>provided freely</td>
<td></td>
<td>fall upon smaller</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>economic development</td>
<td>Regressing economy</td>
<td>Growing economy</td>
<td>Differences in</td>
<td>Differences in</td>
<td>Unemployment</td>
<td>Steady economy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>income grow</td>
<td>income diminish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>social situation and</td>
<td>Vast population</td>
<td>Regressing</td>
<td>A driving generation</td>
<td>A generation of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>population development</td>
<td>growth (over 2%)</td>
<td>population</td>
<td></td>
<td>environmental</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>development</td>
<td></td>
<td>awareness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>technological</td>
<td>ESA-rail and station</td>
<td>Hyperloop</td>
<td>A rail connection</td>
<td>Steady population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>achievements</td>
<td></td>
<td></td>
<td>between Tallinn</td>
<td>growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Helsinki</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>environment</td>
<td>Traffic emissions</td>
<td>Central-focused</td>
<td>Scattered settlement</td>
<td>Municipal self-</td>
<td>Traffic emissions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>grow</td>
<td>development</td>
<td>based development</td>
<td>sufficiency in work</td>
<td>diminish</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>opportunities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When the PESTE table was fully filled, creating of the FAR future table began. If all scenarios the filled PESTE table provides would be taken into account, 6300 scenarios in total would need examining \((6*6*5*7*5)\). However, the PESTE table includes fields that likely cannot coexist. For example, if population decreases, the likelihood of the establishment of a railway station is small. Or if public transportation is free of charge, a driving generation is an unlikely scenario. These are anomalies that need not to be included in the creation of the scenarios. However, public transportation and its impacts on different sectors in society is a complex matter. Therefore, the elimination of anomalies does not significantly decrease the number of scenarios. In other words, most of the fields can coexist with each other. This can be clarified by creating a matrix of the PESTE table and comparing all fields with each other. 31 fields in total are fields that cannot coexist.

TABLE 8. A pairwise comparison matrix data of the PESTE table. Y meaning the two fields can coexist, N meaning the two fields form an anomaly.
The workshop took on the approach of creating plausible future scenarios from the PESTE table by creating tree-like structures from different fields of one driver to another. These structural links were given explanations during the workshop, clarifying the possibility of these fields coexisting in the future. The structures were initially drawn up during the workshop and digitalized later on.

The next phase of the workshop was to align the structures to clarify the scenarios created. The scenarios are further narrated into the form of small stories about the future.
5.2.1 Vihti beating the odds, AABAB

In 2050, road tolls have become a reality in largest urban regions in Finland, including Helsinki, Tampere and Turku regions. Toll lines have been placed along the main roads leading to the central city areas and also along main roads within the cities. An extra payment has proven to be an effective way to change people’s choices in travel forms, as Finland has succeeded in decreasing the total number of private cars in central city areas. Public transportation has increased its attractiveness and contributions are made constantly in developing sustainable travel forms.

The decrease in car numbers is not only due to changes in travel forms. The system of payment for road use has also affected people’s decision-making on places to reside in. In a time when most employment opportunities lie within central city areas, the expenses of daily commuting weigh heavily when comparing the pros and cons of urban living versus living in a smaller municipality.

Furthermore, resource efficiency and green technologies have changed the core functionalities of societies. It has become clear that a societal system built on economic growth has come to its end. The world has seen extensive droughts causing famine, massive heat waves, flooding and destructive storms. The change in societies does not come easily or without expense. Many companies have failed to achieve their economic goals in their constant pursue of growth, and have been forced out of business. Extensive unemployment has followed and the nation is experiencing an economic recession.

People choose to reside close to likely employment opportunities. The population of Vihti municipality has begun to decrease, which is a phenomenon shared with other municipalities close to the capital region and other city regions in Finland.
However, Vihti is alert and creates a strategy responding to the regressing development. A decision is made to concentrate all land-use development resources in the southern parts of Vihti, the area closest to the capital region. In addition, this is the area that has been most interesting in terms of developing regional or national transportation routes over the years and it is an interesting location regarding traditional industrial work as well.

Vihti is successful in achieving a train station by the Espoo-Salo rail link. The municipality of Vihti in this scenario proves to be resilient to any hardship and focuses on key aspects. By making the best of a bad situation, Vihti achieves a significant contribution regarding public transportation. This will work in Vihti’s favor as the seventh wave of innovation begins to formulate.

5.2.2 Regressing Vihti, AABDD

The existence of road tolls along the main highways has indirectly brought on regression in a smaller scale, affecting municipalities that have traditionally been dependent on commuters to the capital region. Buses are still the means of public transportation in Vihti, but buses have developed significantly in engine efficiency. Buses are driven automatically and the vehicles are unmanned. The road toll system concerns public transportation as well, which has led to an increase in travel fares. This in turn has led to a decrease in the number of passengers and therefore, a decrease in the service level.

Vihti is experiencing a decrease in population due partly to the expenses of travelling. This phenomenon is shared with other municipalities of the so-called KUUMA region and by 2050, the decade of vast population growth in the beginning of the 21st century is merely regarded as an anomaly of history. The so-called Nurmijärvi phenomenon will not return.

Additionally, the general use of time has changed by 2050. Many professions of today are gone by 2050: cars drive themselves, cashiers are automated, planning processes are more computerized and news articles are made by robots. Resource efficiency and green technologies have brought on new businesses. However, these businesses tend to be located mostly in central city areas, adding challenges to the problematic circumstances of the surrounding municipalities. Work does not take as much time as it did in the past and people have more spare time on their hands now. Coffee shops, restaurants, activities and spas are popular. The increase in spare time has brought on a phenomenon that was a weak signal before: the quality of leisure time is a megatrend now. People choose not to spend their spare time commuting between home and the workplace. Furthermore, work life has changed dramatically and work places are no longer as meaningful in a social sense as they were before. Social interaction takes place elsewhere, in theaters, coffee
shops or in exhibitions. This has been a dramatic change for a nation of people traditionally described as introverts.

The changes in social structures have led to a situation where Vihti is more self-sufficient when it comes to vocational opportunities. However, this has not occurred through developments in the business sector, rather through population decrease. Vihti in this scenario is struggling to survive as it has not been able to strategize properly in the changing environment.

5.2.3 Appealing Vihti, BBAAB

Vihti has taken a pioneer’s role in mobility services ever since transportation services became open for all competition. This has been a premeditated strategic move that has been ahead of its time and it was originally made to improve the use of public transportation. The realization of the strategic aim begun with a project of creating mobility as a service platform suitable for Vihti. A mobile application was created with real-time information about bus services. The information included location tracking of the buses and information on how many seats were available on particular vehicles. In addition, the application included information on park & ride facilities as to how many parking places were available at any given time. Furthermore, commuters were able to inform others about carpool possibilities.

The mobile application was a success and it was developed further into an overall travel service. By 2050, the application is in regular use all around Finland. It was also used to improve public transportation services further, because the application gathered data on regular travel routes.

The contributions Vihti made concerning green infrastructure and sustainable travel forms were in correlation with the 6th wave of innovation and by 2050 the economy is growing. Vihti has been open-minded and bold in other strategic decisions as well, which has resulted in a lot of publicity in the region. Vihti has been able to create a positive public image as the youthful municipality of Helsinki region that focuses on developing services to benefit its inhabitants. This has resulted in a population growth of over 2 per cent annually. A growth of these volumes requires large-scale investments in the municipal infrastructure, in the form of new schools, daycare centers and new residential areas.

Vihti has focused on a long-term development of Nummela population center, which has also become a home for the majority of Vihti inhabitants. Other areas have been developed as well, but not in the volumes of Nummela. Consistent planning, development and
the efforts made in sustainable transportation have resulted in a station along the rapid rail link between Helsinki and Turku.

Vihti in this scenario is bold in its aspirations. Vihti has succeeded in making the municipality a desirable place to live in and, in addition, has increased the use of public transportation.

5.2.4 The countryside of Helsinki region, BDDnC

At the time all transport services became open for competition, Vihti decided to focus on improving the connections within the municipality. Smaller operators with mini-buses were introduced on routes with smaller passenger volumes. Even Hanko-Hyvinkää railway was opened for public transportation in Vihti, allowing travel from the rural village of Selki to Otalampi and onwards to Ojakkala and Nummela. Along with the improvements in inner connections, the land-use planning resources were divided more equally within the municipality, resulting in more contributions in rural localities and rural villages.

The economic equality has improved nationally due to change in work. Many tasks of 2018 are automated by 2050 and the overall need for work has reduced dramatically. Furthermore, many items and services have decreased in value because of the automatization.

Along with the improvements made on public transportation in Vihti, a generation of environmentally aware people has emerged. People utilize the services provided. In addition, the energy solutions of private cars have improved massively. Cars running on petrol are considered a thing of the past. In 2050 there are plenty of sustainable options in terms of the energy source for private cars.

This Vihti has made a strategic choice of being the rural municipality of Helsinki region. It is considered an asset for the municipality as it provides a different type of living option within the most densely populated area of the nation. Vihti has accepted the fact that some services are likely to never be established in the municipality due to the scattered urban structure. Nevertheless, the municipality is thriving representing the countryside of the Helsinki region.

5.2.5 “Business as usual” Vihti, CnECA

Drastic changes have not taken place regarding social structures and public transportation services. In fact, the operating responsibility for passenger rail transport has returned to the government. Public transportation in its entirety is heavily regulated by the Finnish
government. The guidance involves minimum service levels for population centers and rural localities depending on population density. There are strict regulations on funding of the system. The biggest changes have taken place in regional transport systems, as the role of regional or local authorities has decreased significantly. These authorities have become government organizations. Travel fares are also regulated by the government, which keeps them on a reasonable level.

The economic circumstances have remained steady for a period of time. The steady situation has increased trust in the societal foundation and a certain foundational stability in everyday life reflects this era. People’s choices in investments, consumption and travelling are strongly premeditated.

The population of Vihti has increased at a steady pace. This has been a development predicted by Statistics Finland as well. There is heavy guidance from the government level regarding municipal land-use planning, in addition to the guidance on public transportation. Previously, legislation allowed municipalities to operate independently in terms of local land-use. Experience has shown, however, that a government authority is necessary to ensure that the decisions on land-use are in fact validated by law. These circumstances have made it difficult for Vihti to expand its population center areas as it intended. Nummela has remained the largest population center, with other areas of the municipality developing more slowly.

With the moderate population growth and the national restrictions on expanding existing population centers, Vihti has not been able to achieve new public transportation investments. Investments on transportation systems are traditionally a result of a long-lasting and wide-spread political debate and this is still the case. By 2050, the only large-scale investment the government has accepted regarding public transportation, is the heavily lobbied underground rail link between Helsinki and Tallinn. The new connection has combined Helsinki region and Tallinn into the most significant commercial center in Eastern Europe.

The rail link has provided new career opportunities for Vihti residents as well. However, when investments and efforts are not carried out in order to improve public transportation systems, people are not enticed to give up their private cars. This has resulted in a growth in traffic emissions on Vihti’s part.

The Vihti of this scenario is repeating the old patterns. Innovation and creative thinking are not in the strategic focus.
5.2.6 Green thinking Vihti, EBDnE

Vihti has made a bold strategic decision and it offers free public transportation to all its residents. This has required changes in legislation and Vihti is now able to subsidize 100 per cent of the ticket fares, regardless of the fact that the system operates on a market basis. The decision has resulted in a dramatic increase in the number of public transportation users.

Plenty of smaller operators emerge to offer public transportation services. Property value around bus stations and bus stops increase significantly, because these areas become the most desirable areas to live in. Furthermore, coffee houses, restaurants, grocery stores and other small businesses flourish nearby public transportation terminals. The economy is booming, despite and because of the massive investment made by the municipality.

The decision has several effects, both direct and indirect. Indirectly, the contribution creates an entire generation of environmentally aware Vihti citizens. The choice to begin using public transportation has initially been based on the economic benefits. However, the environmental aspects of it have soon followed. Additionally, the commuter buses have become places for social interaction. Buses have also undergone major improvements regarding energy sources and energy efficiency. All these contributions have resulted in a significant reduction in greenhouse gas emissions.

This scenario presents a green-thinking municipality that is able to go to great lengths to achieve the goals on sustainability.
6 THE RESULTS

The workgroup was able to formulate six very different types of future scenarios regarding public transportation in Vihti. The aim of this phase of the process was to recognize societal relations between issues and how decisions might impact other parts of society. The process also showed that even though we cannot know the future, we can acknowledge possibilities. Furthermore, the results already showed that in order to pursue some named scenarios, measures should be made today.

It was now clear that some future scenarios seemed more attractive to a present-day municipal expert than others. The next phase of the workshop was to choose a scenario Vihti would be keen on pursuing.

The choice of the desired future scenario was unanimous. With a major investment regarding public transportation and the positive development in population and urban structure, the Appealing Vihti (BBAAB) was perceived by the participants as the scenario that Vihti should aim for. According to the participants, the positive aspects of this scenario exceed the negative aspects of it, such as the municipal investment pressure it is likely to bring.

6.1 SWOT analysis

The next phase of the workshop was to closer analyze the desired scenario. The SWOT analysis tool was used for this phase. The SWOT analysis method was familiar with all participants and they analyzed the scenario of appealing Vihti thoroughly. The strengths and weaknesses of the scenario were assessed from the viewpoint of the current circumstances. The opportunities and threats aimed further into the future.
6.1.1 Strengths

The strengths listed include the fact that Vihti is already prepared for the realization of the rail link between Helsinki and Turku. A sub-area master plan has been accepted by the municipal council for southern parts of Nummela including the railway alignment. This resolution, however, was revoked by the Supreme Administrative Court of Finland. Nevertheless, the municipal land-use planning takes the rail link into account in all decisions.

Decision-makers in Vihti agree that efforts need to be carried out in developing the public transportation system. This includes pursuing the Helsinki-Turku rail link and its station in Nummela. A common ground in an issue of this size works in the municipality’s favor as public discussion surrounding the topic is coherent.

The changes in Finnish legislation give a good basis for appealing Vihti. The Act on Transport Services gives municipalities plenty of opportunities to develop their public transportation as they see fit. The Land Use and Building Act has experienced several changes in recent years. These changes have empowered municipalities in decision-making regarding land use even more so than before. This could allow municipalities to make
strategic alignments in order to benefit its own infrastructure, whether a regional authority finds it a suitable development or not.

Nummela is already a strong and growing population center with versatile services. It should be developed consistently with the aim being the future train station. The circumstances are favorable, because the location of Nummela is interesting to both people and businesses. In addition, this development benefits most other areas in Vihti.

Vihti, and Nummela especially, is located at a crossroads. Three main highways run through Vihti. This should be turned into a strength, rather than a limitation.

In a national and regional scale, Vihti is located reasonably close to Helsinki. It has a strong premise to develop its public transportation and to make efforts on achieving the train station in the future.

6.1.2 Weaknesses

Vihti is not currently a part of a regional transport system. This means that the possibilities for regional investments regarding improvements in public transportation are low. Therefore, the fact that Vihti is not a part of a regional transport system is considered a weakness in public transportation. Furthermore, the ticket system, travel fares and route information are not coherent with the prevailing regional transport system in the area. This results in public transportation being less appealing to commuters.

In addition, government funding on large-scale infrastructural investments focuses on larger population centers with high population density. From the national viewpoint, the population of Vihti and the population density of the strategic areas in Vihti are yet to be of an investment interest.

Vihti has a vast surface area with four population centers and many rural villages. In a situation, where public transportation is organized on a market-basis, the service level in low population density areas has a tendency to decrease. Nummela has a good level of service, while service is inadequate in other areas.

Vihti has strong traditions in rural development. Despite the mutual aim of developing the municipality as a whole, the need to develop the strongest municipal center and the need to sustain rural vitality are often controversial with one another. This positioning escalates in times of tight resources. An ongoing inner debate concerning development prioritizing could hinder or significantly delay the realization of a railway station in Nummela.
Currently, there are approximately 8000 employment positions in Vihti. If population growth would be 2 per cent annually, appealing Vihti would need to increase its employment opportunities. Without adequate job opportunities, Vihti will not achieve the attraction of the masses. Despite the realization of the rapid Helsinki-Turku rail link, an annual population growth of 2 per cent would likely lead to increase in private car numbers on main roads, if self-sufficiency in career opportunities remains at current level.

Vihti already has a railway, but it is not open for public transportation. Hanko-Hyvinkää - railway runs through many municipalities and population centers, but it is merely utilized in the public transportation service between Hanko and Karjaa. The planning process of electrification of the railway is underway, but an increase in public transportation service level on the railway is not considered.

6.1.3 Opportunities

The appealing Vihti scenario brings many opportunities. If Vihti were to achieve a significant population growth, Vihti has the opportunity to develop Nummela into a vibrant small town with multiple choices in housing. Population growth partly enables the realization of the railway station. In addition, Vihti has the opportunity to significantly increase transport service level, both in quality and quantity. The service level can also be increased by ruthlessly exploiting the opportunity to freely provide public transportation services as the municipality sees fit.

In addition, services include career opportunities of different natures, for example commercial, public or social. Furthermore, new circumstances allow Vihti to be an interesting location for offices of different businesses, as it is no longer considered mainly for traditional industrial operators.

A rise in population can bring on a topic of increasing educational opportunities within the municipality. As it stands, Vihti has an upper secondary school and a vocational school, which is organized in co-operation with Lohja. There are no academic institutions in Vihti. A population growth enables faculties of academic institutions to locate in Vihti in the future.

The appealing Vihti has a more positive public image and a stronger position in a regional context. Vihti has the potential of using a louder voice in regional planning and development processes.
6.1.4 Threats

A municipality could become blinded by success and a rapid pace of development. An extensive growth in population and in business sector demands large-scale investments in infrastructure and in public facilities. A municipality must be able to remain ahead of the development in order to have sufficient resources for future needs. An appealing Vihti requires consistent effort in all municipal sectors to keep the image appealing.

The vitality of the municipality could result in a general increase in values. Properties will be more valuable when demand increases. This in turn puts pressure on increasing prices on services and products, as property value increase transforms into higher rental expenses. The allure of Vihti could have a negative economic outcome in the longer perspective.

Environmentally, a centralized urban structure enables a preservation of larger areas, forests or crop fields. It is generally considered to be a sustainable form of urban structure, despite the fact that locally valuable areas or objects in a densely built center are at risk of vanishing.

6.2 Vision for low-emission traffic in Vihti 2050

After selecting a desirable future scenario and analyzing the scenario thoroughly, the workshop portion of the study was finished. The outcome of the workshop then needed to be crystallized into a vision for low-emission traffic in Vihti in the year 2050. The vision aims at describing the future goal clearly and powerfully. A good vision is simple enough, believable and consistent.

Creation of this vision focuses on the scenario chosen and its factors. It focuses also on the strengths and opportunities described in the workshop. The future Vihti is courageous enough to pilot applications and other services in the aims of developing its public transportation systems. It is responsible, both towards the climate and Vihti residents, in its attempts to reduce the number of private cars. It is successful in pursuing large-scale infrastructural investments. It is consistent in its urban planning, resourcing and investments. It acknowledges its different types of areas, despite the rapid development of Nummela.

Vihti is known for its open-minded steps towards a user-friendly, sustainable urban structure. In a successful Vihti - through consistent planning - everybody is able to choose a low-emission form of transport.
6.3 A roadmap to the vision

According to the concept of aligning the future, the formulated vision needs to be aligned with the present day. This gives the opportunity to observe current strategies, actions, priorities and investments and whether or not they are in accordance with the chosen scenario and the vision derived from it.

Detailed urban planning in Vihti is already strongly focused on Nummela population center. This is aligned with the chosen scenario and the vision created. Nummela is currently the biggest population center in Vihti and the public transportation possibilities are versatile. In the sense of maintaining and developing the municipal services in total, it is essential to develop Nummela in the future as well.

In regards to the new rail link between Helsinki and Turku, Vihti needs to focus more on land-use planning in the southern parts of Nummela, or rather on combining the current Nummela center with the future center around the railway station. The plan could be strategic in nature or more of a plan frame, that is transport-oriented and strongly based on the future main routes of public transportation. If a station in Nummela is going to be a stop for the fastest trains on the railway, the overall public transportation system must be planned from a region-wide viewpoint. In this case, express buses from Pori or Turku are likely to make a stop at the railway station. What are the routes these buses are going to use? Which roads need to be planned as main roads, along which the inner public transportation is going to travel? With plans ready Vihti is more prepared for the impacts a
railway station produces. Furthermore, a realization of a railway station is often a result of co-operation between consistent land-use planning and transport system planning, one cannot exist without the other.

The current ongoing masterplan process concerns Vihti entirely. The draft presents the new rail link as a necessity. Two stations along the railway are presented, both in southern parts of Nummela, even though it is likely that there will only be one station in Vihti. Terminals of public transportation are placed in the center of Nummela and next to one of the future railway stations. A public transportation development corridor is presented along the road Tervalammentie. (Vihti 2018.) The plan focuses on developing Nummela population center, which is in accordance with the scenario of appealing Vihti. The outset of the plan is the new rail link and the urban structure developing around it. Public transportation could take on an even larger role in the future stages of the masterplan process. Are there other new public transportation routes necessary? Are there more routes within the municipality in need of improvement or acknowledgement?

Vihti could pursue a more transit-oriented planning procedure in all of its municipal urban planning processes. Naturally, transportation is always taken into account in planning processes. However, it could be more of a focal point of development than it is today.

This results in another development challenge within the municipality’s organization. There should be more co-operation between urban planning and route planning. This could allow Vihti to transform its urban planning into being more transport-oriented than it is today. Additionally, structural development could be aligned better with existing and future main transportation routes. Furthermore, a deeper co-operation could benefit planning of the rural villages.

A membership in HRT would have positive and negative impacts on public transportation. As a member Vihti could receive a better recognition regionally for investments and development projects it requires. If development of a mobility as a service platform or an application were to begin, a regional system would be an organization of a reasonable size to pilot the service. The clear benefits of HRT membership for an end-user would be the regional ticketing system, real-time tracking of transportation vehicles and simpler route planning. The negative impacts would include the increase in overall costs of the system. Being a member of a joint authority means that decision-making is also shared with the region. Vihti would lose power to independently decide on public transportation arrangements within the municipality. Furthermore, a membership in a regional authority could mean a decrease in service level on routes excluding the route between Helsinki and Nummela. (Vihdin joukkoliikenneselvitys 2018, 14.)
While strengthening the co-operation between urban planning and route planning, the rural villages in Vihti could also be planned on a transit-oriented basis. It could result in a cost-efficient string-like rural structure leaving large surface areas unbuilt.

Population growth can take place through migration and natural population increase. Migration includes both people moving from abroad and residing in Vihti and also people moving from other municipalities in Finland. Natural population growth means that the birth rate within certain areas exceeds the mortality rate. Natural population growth has been a wicked problem in itself for the Finnish nation. In the last seven years, the birth rate has decreased by 20 per cent, and in 2017 the total fertility rate was at its lowest in the history of Finland (Statistics Finland 2018). A population growth rate of over 2 per cent in Vihti would require the trend of migration to larger city regions to continue. It would also require the realization of the rapid rail link. Furthermore, a change in birth rate is essential, not only for Vihti but for the entire country of Finland.
7 DISCUSSION

This study has been an in-depth analysis of public transportation in Vihti and future prospects for it. Aligning future scenarios, strategies or visions with the current operative level is an imperative phase of strategic planning. It is a way of recognizing the operations that need changing, operations that might in fact be unnecessary and new operations needed. It is also a way of demonstrating how visions or strategies that might seem abstract, actually are achieved. This study has shed light on some aspects of current procedures in the municipality that could be further examined.

Futures studies and future research give people a possibility to assess different scenarios and ponder on the impacts of new phenomena on our society. It is a tool for understanding causal connections of wicked problems, issues that influence many layers of the society. Scenario comparison should be present in decision-making on a global, national, regional and municipal scale.

Land-use planning as a professional field could be summarized into a continuing pursue of compromises. In most cases, land-use planning processes all have multiple stakeholders, each with its own agenda. These agendas have a tendency to contradict one another. A future scenario analysis could be adapted into land-use planning processes as a way to explain the resolutions made in the planning process. It could also be developed into a workshop method for participatory events. The nature of the research methodology is interdisciplinary, which is in correlation to the profession of land-use planning.

Public transportation was an interesting subject for a futures research as it is a versatile topic concerning many stakeholders. In fact, public transportation, population growth and career opportunities form a triangle that is a wicked problem in itself. Without population and a reasonably high population density, public transportation systems usually do not evolve. Especially, new openings for public transportation are highly unlikely before a certain urban structure already exists and land-use plans give a good potential for population growth. The current trend for businesses of many fields is to locate in the proximity of population centers and near good transportation opportunities. However, people preferably wait for the realization of public transportation systems before choosing to reside close by to a planned route. Additionally, builders need to be certain of a public transportation project before investing in a housing construction. When it comes to major infrastructural investments the question seems to be: “Which comes first, the people or the train?” The answer is somewhere between “neither” and “both”, because of the nature of the problem. It is indeed a wicked issue and it needs to be addressed as a combination rather than two separate development projects.
The topic of the future of public transportation in Vihti is a topic of a large scale. Generally examining public transportation touches various different themes from urban planning to population and user preferences. Many of these interfaces could be formulated into a thesis study of their own. The challenges of carrying out this study revolved around the issue of keeping the study in focus.

History studies tell us where we have come from. History shows us the error of ways of the humankind and hopefully, we learn from those mistakes. It tells us how we have evolved. But how do we see time? Is it linear or circular? There are some elements in time that can be seen as repetitive, such as the waves of innovation. Even though we probably do not repeat the same steps we have taken, some wave-like development is still notable, especially in the field of economics. So why not include future studies in curricula? Perhaps it is time to end studying history and begin studying time.
REFERENCES


FIGURES

Figure 1. Helsingin seudun aluesarjat. Helsingin seutu. [Accessed 28.11.2018]. Available at: http://www.aluesarjat.fi/


Figure 3. Helsinki Regional Transport. HSL:n maksuvyöhykkeet. [Accessed 4.11.2018]. Available at: https://hslhrt.maps.arcgis.com/apps/View/index.html?appid=90726344e15546529c80a11701c3f710


Figure 7. Vihdin kunta. Vihdin kartta. [Accessed 7.11.2018]. Available at: https://www.vihti.fi/asuminen-ja-ymparisto/tontit/


Figure 10. Statistics Finland. The percentage of population over 64-years-of-age in Vihti and in entire Finland from year 1987 to 2017. [Accessed 26.11.2018]. Available at:
APPENDICES

Appendix 1: The empty PESTE table.

Appendix 2: The filled PESTE table.

Appendix 3: The scenarios created in the workshop.

Appendix 4: Scenario alignment.
## Vihti public transportation 2050

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