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Towards a Geographic Information Systems and Data-Driven Integration Management.

Studying holistic integration through spatial accessibility of services in Tampere, Finland.

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Towards Geographic Information Systems and Data-Driven Integration Management. Studying holistic integration through spatial accessibility of services in Tampere, Finland.

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Abstract

Integration management in Finland and Tampere is broad task including multiple actors and departments. To manage integration, is to coordinate the cross organizational cooperation of multiple service structures that support migrants with different kinds of services. Although integration work has traditionally been provided through the Employment & growth services, the other relevant services for integration are, amongst others, education, health & wellbeing as well as social and civic services. This work adds to the body of research that investigates spatial accessibility to services necessary for integration and the integration levels of migrants. In this study migrant integration is measured using employment, education- and skills as well as well-being indicators. This study produced composite indexes for these dimensions, a holistic integration index as well as integration performance gap indexes comparing the performance between migrants and the native population in the key indicators. The study uses a GIS model that includes information on the bus route system, integration services as well as bus stops and traffic lights to assess and quantify the accessibility of integration initiation services to the integration outcomes of migrants in Hervanta, Tampere's City Centre and in Koillinen. Accessibility is measured in terms of travel time to integration services. Data for the GIS model was downloaded from public network databases and integration data was accessed from Statistics Finland through the City of Tampere's Department for International Talent Attraction and Migration. The selection of indicators was informed by experts at Statistics Finland and through questionnaires to integration experts.

The process of using a holistic, data driven, and GIS supported approach to studying migration and integration related phenomena was fruitful. When all data was gathered and processed a network model was built and analyzed using the network analyst tool in ArcGIS. A service area analysis and an OD Cost matrix analysis were conducted. It was found that most, over 17 000 migrants in Tampere have good to intermediate access (access within and around about 30 minutes) to integration services and 7% of the migrant population had poor access. The results show that in the study group, migrants who live further away from integration services and who consequently have poorer accessibility, had better integration performance than those living in Hervanta and Tampere's City Centre. There is a correlation between access to integration services and integration performance, however a causal relationship between the two variables is not established.

Key words: Migrant Integration, Geography, Physical Geography, GIS, Network Analysis, Tampere, Accessibility, Data-driven decision making, Holistic Integration Index.

Preface

This study was conducted in collaboration with the City of Tampere under Employment and Growth Services, specifically for the department for International Talent Attraction and Migration.

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To my family, thank you for your support, patience and understanding. To The City of Tampere, International Services, leadership, and colleagues. Thank you for your trust and guidance.

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Chapter 1: Introduction

1.1 Accessibility and Integration

Having access to services for integration is essential for migrants who have arrived in a new country. The physical accessibility to integration services in Tampere is central in this case because it is mandatory for newly arrived migrants to physically present themselves at an unemployment office and register as unemployed job seekers, so that they can trigger the integration process, and they must be physically in the country to attend language and other training courses. Beyond having access to official services to trigger the integration process, it is also essential that service providers contracted to provide language training as well as other supporting services such as healthcare, further training and education, housing, social services, and other services are also physically accessible. These tend to be measured in terms of cost to reach the service (Guagliardo, 2004)

Accessibility is a broad term, encompassing a broad spectrum of elements in the context of integration.

- Physical accessibility to services – This can be measured in distance, frequency of the public transport, travel time or even cost to travel.
- Structural accessibility – used here to denote intentional or unintentional institutional rules, routines, norms, or patterns of behaviour and attitudes that become obstacles to accessing the ability to exercise rights or access opportunities as smoothly as most of the population. (e.g., the language of services or access to translation, access to online banking, housing in certain neighbourhoods or even mortgages, and jobs.)
- Digital accessibility – the availability of services over the internet and their ease of use.

In this research, physical accessibility measured in travel time and its relation to the level of integration of migrants is the main focus. The research studies the structural barrier, defined as the uneven distribution of services and institutions across space far from migrant communities making them inaccessible using public transportation which causes a barrier in the usability of that service (Heidinger, 2022).

The European Union published a report on accessibility and the digitization of migrant integration services due to the Covid-19 pandemic where it noted the challenges migrants faced during the pandemic to physically access integration services and how this could affect integration and increase loneliness and isolation. It also pointed out the need to increase the digital accessibility of integration services siting challenges such as lack of internet connection, lack of technology, language barriers, lack of e-IDs, lack of digital skills, and lack of time and space at home (European Commission - EWSI Editorial Team, 2022). Another post-pandemic research questions the accessibility of, and the long-term impacts of the digital integration services for migrants. In the results, some respondents reported an improved accessibility to traditionally physical services because of their digitization (McMullin, 2021).

Social sciences have also embarked on the task of mapping the movement of different groups including migrants in different environmental settings such as urban areas. Theories driving this work include studies of the diaspora and transnationalism and how these phenomena affect the composition and shaping of urban spaces through the movement of people, goods, culture as well as money. The manner in which migrants learn how to use urban spaces has an impact on how they access resources, and this consequently affects their integration (Buhr, 2018b). One such study proposes that migrants who live in neighborhoods with high levels of ethnic diversity and low socio-economic disadvantages tend to have better integration outcomes (Ziller & Spörlein, 2020).

The flexibility and hybridity of work has pushed some researchers to question the validity of self-constituting spaces and encourage an alternative approach to studying segregation and its impact on migrant integration. It has been proposed that neighborhoods should not be a unit of analysis but rather an object of study, and researchers must not presuppose that the experiences migrants have within their neighborhood are the only ones that affect their integration, but rather investigate how they use their neighborhood and also study how their experiences outside of them impact their integration (Buhr, 2018a).

According to Geyer et al., (2013), when immigration is handled well, it should supplement the deficiencies in the local labor force and maximize migrant's economic integration into the mainstream economy. However, the data seems to suggest that immigration policies are not being well managed in Scandinavian countries, especially for non-European migrants. One report states that in 2015 48% of working age migrants in Sweden were unemployed and this situation only

improved slightly after 15 years of living in the country possibly owing to the kinds of migrants moving to Sweden i.e., low skilled individuals instead of the highly skilled migrants that suit the labor market needs of Sweden (Evans, 2015).

As a phenomenon widely researched in the social sciences, migrant integration is not immune to the data driven evolution of the social sciences. As smart cities move towards Big Data, the discussions around the benefits, risks and applications of technologies and the use of data continue, and protections are being put in place for example with the adoption of the General Data Protection Regulation (GDPR, 2016). Top of mind in the social sciences and for governments dealing with, in this case, migrant integration are the benefits data driven integration management could bring to this historically, trend-based and task driven sector. Some reports propose that the GDPR, in fact, enhances the data driven social sciences through Recital 157 which states that "… Within social science, research on the basis of registries enables researchers to obtain essential knowledge about the long-term correlation of a number of social conditions such as unemployment and education with other life conditions..." (Vestoso, 2018).

Since state and municipal governments collect a lot of data about their citizens during routine service provision, coupled with the information private companies collect through services and devices, there is a new opportunity through big data analytics, artificial intelligence, the Internet of things, blockchain and other technologies, to not only monitor and manage urban infrastructure and service use, in real-time but also to understand, inform decisions and guide strategies simultaneously (Engin et al., 2020).

Ethical challenges about the use of data, especially data that narrows in on identifying the subject, are however incredibly important to keep in mind. As public institutions explore the efficient use of data for all kinds of purposes and to increase public value it is important to remember emerging migrant communities and their needs as well (Toots et al., 2017).

Data-driven migrant integration management is all about the use of data and analytics to inform and guide the integration of migrants into a new society. Data integration can help policymakers and other stakeholders to understand the needs and challenges faced by migrants, identify areas where support is needed, and design and implement targeted interventions to facilitate the successful integration of migrants into their new communities. By using data to inform decision-making, policymakers, and other stakeholders can better understand the needs of migrants and

design interventions that are more effective in promoting their successful integration into their new societies (Beyan et al., 2016).

1.2 Study Area - Finland and migration

According to Castles et al., (2005), migration is suitable for multi- and interdisciplinary analysis. It is driven by a myriad of factors, but often where goods and money move, people tend to follow suit. Technology and easier access to good transportation networks facilitate this movement ever more increasingly and the evolving need of the marketplace places its demands on skilled and general labor.

On the other hand, increasing wealth gaps, environmental factors, job opportunities in aging societies, as well as war and conflict, are also driving people to migrate to different places. Government policies in receiving countries also drive different types of migration. They shape migrants understanding of the costs and benefits of migrating. As regular channels of migration are increasingly tightened, irregular, and exploitative migration increases to meet demand (Castles et al., 2005).

The reasons why people migrate today are more diverse and motivated by different factors and goals, such as war, work, business, and personal dreams. In Finland, however, the main reasons why people migrate to Finland are for work, family ties and to study according to Finnish Immigration Service Statistics (Finnish Immigration Services, 2021).

Tampere was selected for this study because, although small, the city has played an impactful role in migration and integration issues in the Nordics and the European Union over time. Tampere's influences on the European Union stem from the so-called Tampere conclusions" that were adopted by the European Council in 1999. This plan was centered on the following four pillars to create an area of freedom, security, and justice in the European Union.

(i) Partnerships with countries of origin
(ii) A Common European Asylum System,
(iii) Fair Treatment of Third-Country Nationals, and
(iv) Management of Migration Flows – "deeply influenced the EU's migration and asylum policies"(European Policy Centre, 2019).

Statistical evidence shows that migration to Tampere began to increase noticeably starting in the 1980s and 1990s. This was mainly due to refugees from different parts of the world and partially due to the fall of the Soviet Union (Rapo, 2016). In 1989 Tampere received its first group of quota refugees from Vietnam and they were housed in the Hervanta neighborhood due to its proximity and availability of services. As part of the yearly quota, at the beginning of the 1990s, refugees from Yugoslavia and Somalia also began to arrive. Their planned reception received a lot of attention from the public and media and some negative articles were written about them, especially related to the costs of their reception.

In the 1990s services to support the reception of refugees began to be organized by the City of Tampere. In the beginning, services for reception and integration were organized as part of municipal social services but, with time and an increased understanding of the diversity of needs that migrants have, towards integrating and settling, other municipal organizations began to take part in organizing services for migrants. Such services include cultural services, employment services as well as educational services at different levels (Nylund-Oja, 1995)

The 1999 Finnish law on migrant integration and the reception of asylum seekers, created a legal framework and targets in the field of migration and integration work. It made it a requirement for municipalities to create and implement integration programs to access funding for the costs related to the integration of immigrants. Because this first law was enacted mainly in response to humanitarian migration, many amendments were made in the early 2000s until the new, and current, law on integration came into force in 2011. The current act on the promotion of integration covers all migrants regardless of their reason for moving to Finland and its target is to ensure that all migrants receive information about Finnish society, work-life, and access to integration services (Finlex (Finnish Ministry of Justice), 2010)

There are currently about 21 000 people of migrant background living in Tampere, and they represent about 8% of the population and are responsible for 33% of population growth in 2020. The most common migrant groups in Tampere are people from Estonia, Russia, Iraq, and Afghanistan (City of Tampere, 2022b). Most of the population, including that of migrants, is concentrated in the Southern part of the Tampere region closer to the city's center as can be seen in Figure 1 below, with the highest concentration in Hervanta (33720) which is considered a 'ghetto' and has an area of about 820 acres or the size of Rosengård in Malmö, Sweden or slightly bigger than SoHo, in New York which is 512 acres.

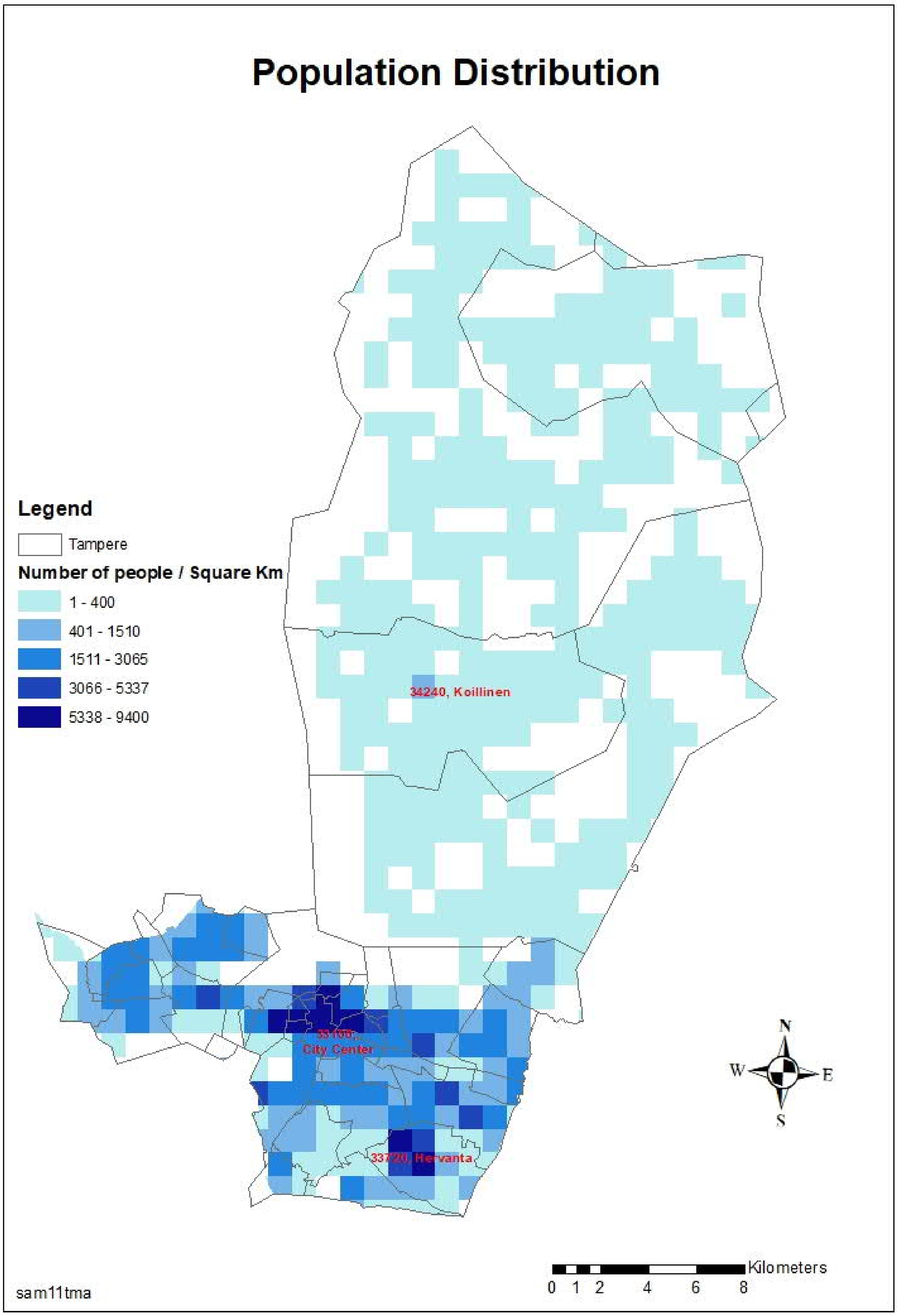


Figure 1: Population Distribution in the Tampere Region

Three main locations in Tampere provide important integration services:

1. International Tampere Skills Center (OSKE)
2. Maahanmuuttajien alkuvaiheen palvelut or (M.A.P Social Services)
3. TE Employment Services (TE-services)

Integration services are organized mainly through the Employment and Economic Development Office (TE-office) in collaboration with other basic services through the municipality. Integration services for refugees are organized through the city's social work for refugees as part of the "immigrants' first phase services". Currently integration services are also being provided by the city's Employment and Growth services at the International Tampere Skills Centre.

Finnish as a second language courses for migrants are provided by multiple service providers in Tampere. Most courses are located in and around the city center not too far from the three main services listed above. Tampere has been divided into 5 regional service areas namely Koillinen, Eteläinen, Keskustan, Kaakkoinen, and Läntinen. Each service area was designed to have local markets and well-being centers to bring services strategically closer and improve the efficiency of service provision (Marika Eromäki, 2020).

The service areas that were created by regional planners from a legal and general service provision point of view. In creating service areas regional planners take into consideration convenience, general accessibility, and the frequency of use of certain essential services by people in that region (Marja Uusivuori, 2012). For this reason, some postal codes can be found in multiple service areas because the demarcation can split a neighborhood in half and neighbors could potentially be referred to different healthcare centers.

Hervanta is a densely populated neighborhood with a high concentration of low-cost housing. Hervanta has good representative samples of migrant populations that allows this study to access data without being able to identify individuals and by so doing protect individuals' privacy. The threshold agreed upon while purchasing this data from Statistics Finland was that data could be accessed where the target group population was no less than 10 people. This was done to reduce the probability that individuals could be identified using the data and in line with Statistics Finland's professional ethics guidelines (Statistics Finland, n.d.-a).

Migrant populations in some postcodes or service areas in Tampere are very low, therefore analysis could not be done for all areas. Therefore, densely populated areas were selected for this study, except for Koillinen which was selected specifically because it is located further from the integration services and is part of the service area region.

Employment levels among migrants in Tampere are significantly lower than in the general population. The current employment bulletin reports that the total number of jobseekers amongst migrants in September 2021 stood at 5 160 out of a total of 13 705 jobseekers for the whole city (Ministry of Economic Affairs and Employment Finland, n.d.). This means that almost 38% of all job seekers are migrants even though they represent only 8% of the city's total population. The unemployment rate in Tampere currently stands at 11.4%. According to the Tampere City statistics department, general unemployment comprises of registered job seekers and those receiving services through the state's employment services. The general unemployment amongst immigrants in Tampere has remained above 50% over the past 5 years (see Figure 3 below), whereas that number for the whole city has been about 18-22% (see Figure 4 below).

There is not much written about the history of the neighborhoods in this study, however, Hervanta is considered a large suburb of Tampere. It covers an area of about 13.8 square km and is located about 10 km south of Tampere's city center and has a population of about 26 000 people according to the city of Tampere's website(The City of Tampere, n.d.). According to the Aamulehti publication from February 2022, almost 22 % of Hervanta's population have an immigrant background (Virpi Ekholm, 2022).

However, integration in Finland, according to the Centre of Expertise in Immigrant Integration should be measured using 5 dimensions, namely: employment, education and skills, wellbeing, participation (specifically civic participation in organizations, political life, and access to citizenship), and two-way integration (migrants' experience of acceptance and safety within the community) (The Centre of Expertise in Immigrant Integration, n.d.). The overall success of integration in Tampere has until now, not been measured holistically using a combined index with these indicators, nor has there been a proper statistical study connecting integration to accessibility of integration services in Tampere thus far.

The aspect that this study will add, to the body of research that already exists, is to use a composite (holistic) indicator of integration, i.e., a composite indicator for the success of integration using

the dimensions to get a holistic and comparable measure for a migrant group against the local population, to produce a natives-vs-migrant performance gap index, and place it in space and time and compare whether integration outcomes can be attributed to the physical accessibility of services.

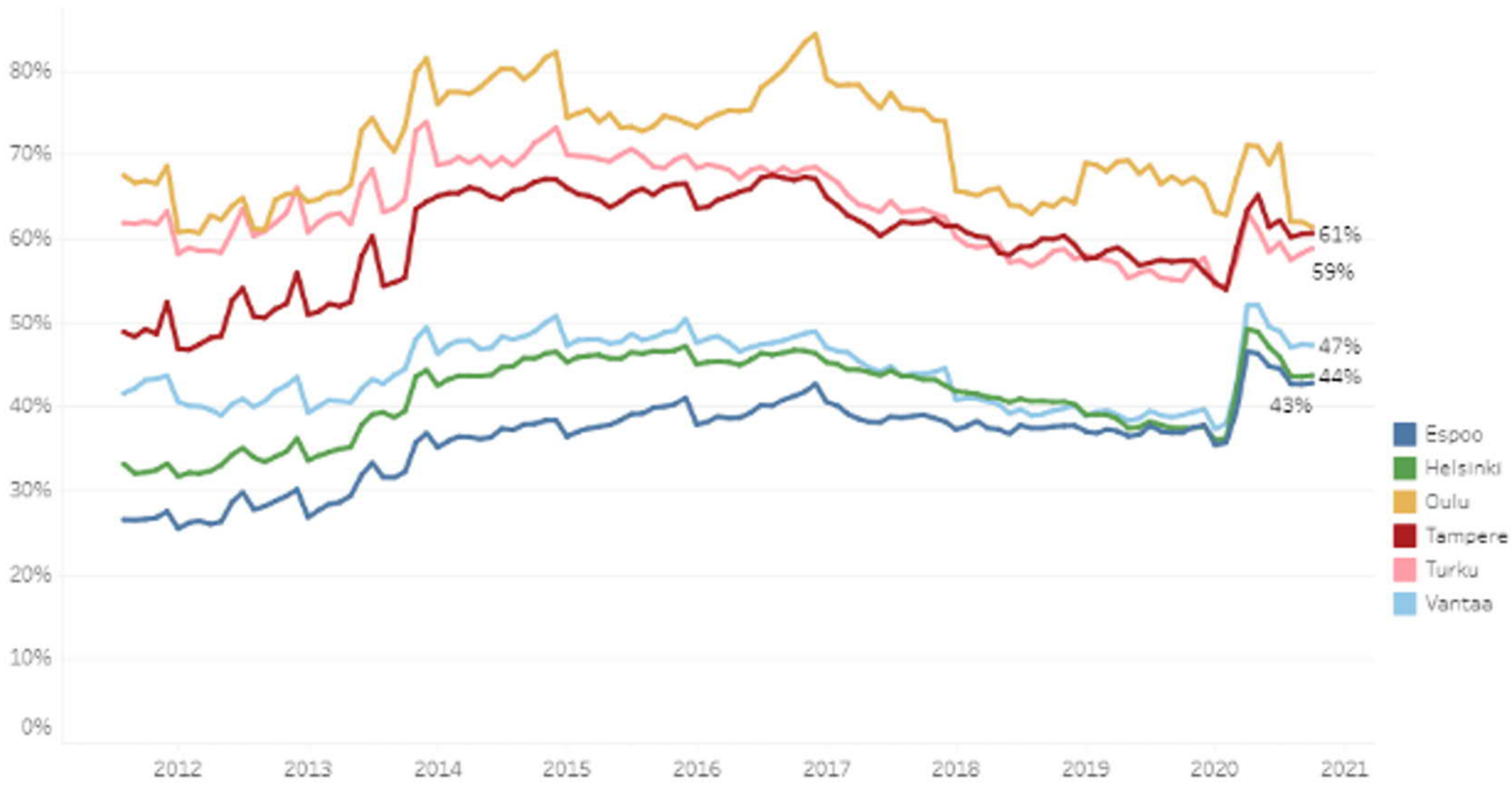


Figure 2: Picture of a table of General unemployment % amongst migrants in the big 6 cities in Finland: Source: City of Tampere Statistics. Permission to reproduce – City of Tampere TYKAS. 2021

Year	Tampere	Helsinki	Espoo	Vantaa	Oulu	Turku	Total
2006	14,9	10,6	7,3	9,3	15,5	14,1	**11,4**
2007	14,0	9,4	6,4	8,6	14,6	12,9	**10,3**
2008	13,4	8,5	5,9	8,1	14,4	12,1	**9,7**
2009	16,7	10,1	7,6	10,4	16,6	14,5	**11,8**
2010	17,6	10,9	8,1	11,4	17,3	16,5	**12,7**
2011	17,0	10,7	7,9	11,3	17,9	17,0	**12,6**
2012	17,4	11,2	8,4	11,4	18,6	17,4	**13,0**
2013	19,9	12,7	10,1	12,9	20,6	19,1	**14,8**
2014	22,0	14,8	12,1	14,6	22,2	21,2	**16,7**
2015	22,7	16,2	13,4	16,0	22,6	21,8	**17,9**
2016	23,2	16,5	13,8	16,5	21,5	21,4	**18,0**
2017	19,8	15,1	12,9	15,1	19,9	19,3	**16,3**
2018	18,4	13,7	11,9	13,6	17,3	17,5	**14,8**
2019	18,0	13,0	11,6	13,2	16,3	16,3	**14,1**
2020	22,6	17,9	15,9	19,0	18,8	20,1	**18,6**
2021	19,7	17,2	14,8	18,7	17,4	19,1	**17,6**
Total	**18,7**	**13,1**	**10,6**	**13,2**	**18,3**	**17,5**	**14,5**

Figure 3: Picture of table of general unemployment % (Includes migrants.) Source: City of Tampere Statistics. Permission to reproduce – City of Tampere TYKAS. 2021 (Year, City, and Totals)

1.3 Research Aim

The general aim of this report is twofold: it seeks to investigate what the spatial and temporal distribution of migrant integration is, amongst different groups in selected neighborhoods in Tampere. Secondly, to discuss the possible impact of accessibility to services on the success of integration in Tampere.

An acceptable accessibility threshold has been broadly agreed on for primary care services systems at 30 minutes (Bosanac et al., 1976). Although integration services are not primary care services such as hospitals, this study will adopt a similar time scale for this research in measuring accessibility.

The main objectives of this study are:

- To use a holistic integration index and visualize the success of integration in different regions and neighbourhoods in Tampere.
- To use a spatial GIS-based model of accessibility to essential integration services that considers the cost of accessibility in terms of time.
- To discuss the possible impact of accessibility to services on the success of integration.

The study will concentrate on the accessibility situation for migrants traveling by public transport, because migrants tend to use public transport more than the local population for different reasons (Mary Hanna, 2021b).

Main Research Question:

How does accessibility to services necessary for starting integration influence the rate of holistic integration for different migrant groups in different neighborhoods in Tampere?

Secondary research questions

1. What is the cost of traveling to integration-related services in Tampere from different areas?
2. What are the main factors limit migrants' access to services necessary for integration in Tampere?
3. What is the relationship between holistic integration and accessibility to services?
4. What are the differences between different neighbourhoods regarding accessibility to services necessary for integration in Tampere?

Chapter 2: Background

Finland is on the northern edge of Europe and shares borders with Sweden, Norway, and Russia, (see Figure 4 below). Even as a Nordic welfare state, with a stable economy and well-functioning services- Finland, has traditionally been a country of emigration. This has been attributed to poor employment opportunities and bleak prospects by some reports (Juho Korhonen, 2017). Although there has been a marked increase in migration to Europe, migration to Finland has been small and therefore the foreign-born population remains low in comparison to the other countries in the Nordics and E.U. (Koikkalainen, 2021). According to a report by the Organization for Economic Co-operation and Development - OECD, (2018), Finland had been experiencing an increase in the foreign-born population at a compound annual rate of 6.8% over 25 years, and the percentage of foreign-born people in Finland had experienced a jump from 1% in 1990, 6.5% in 2016 and the most recent statistics report 7.6% in 2020. According to official statistics by Statistics Finland, (2021), the current total population of the country is 5 546 487. 522 852 people live in the region of Pirkanmaa, in which Tampere, the city selected for this study, is located. Tampere is the most populous inland city in the Nordic countries with a population of 241 009 at the end of 2020 (City of Tampere, 2022a).

Historically, after the City's founding in 1779 by King Gustav III of Sweden, Tampere's industrialization accelerated due to special privileges awarded by the king in the charters of Tampere to newcomers, specifically to stimulate economic activity and growth. This Charter made 400 lots available for inhabitants and these inhabitants would enjoy a 20-year tax exemption which stimulated immigration to the city. Considering that provisions were made in this charter for complete freedom of religion and worship- and that the town plan included a town square with churches of four different denominations – it can be deduced that there was an international aspect to King Gustav III's plan to attract a skilled population to Tampere (Kostiainen & Sotarauta, 2003). One such example was the founding of the Finlayson company by James Finlayson, a Scottish migrant in Tampere. The Finlayson company had to import machinists from Britain to train Finnish workers to work on, build and repair machinery for his factory. This is some of the earliest recorded information regarding international labor migration to Tampere (Kowalski et al., 2020). The action taken by King Gustav III could also be one of the earliest recorded international talent attraction and retention strategies in Finland.

Figure 4: Location of the City of Tampere in Finland

2.1 Measuring Integration

Integration is a challenge that a lot of countries face in general. Successful integration has serious impacts on the host communities as well as the individuals going through that process, especially from the perspective of social cohesion and the realization of public value. Integration is a two-way process of mutual adaptation, between migrants and host societies(International Organization for Migration (IOM), 2017). With integration, the goal is to include migrants in the social, economic, cultural, and political life of the new country. This means that integration carries duties and obligations for both the individual and the new community and is a cross-cutting and multi-sectoral issue that affects both the lives of migrants as well as the citizens of the host countries.

So why measure integration? Measuring integration is about measuring impact and success. It is an effort to understand how well the time, effort, and resources provided to facilitate integration have been used, from the perspective of both the individual as well as the host community. The goal is to gain insights about the type of impact that the resources invested into the processes and services meant to drive integration are having, but also to try and understand migrants' experiences as well as their behaviors, to inform decisions, initiatives, and strategies. The necessity to understand integration and migrants better to be able to forecast resource allocation and improve services, is as core of a question in the Finnish service provision discourse, as it is for many other countries and their policymakers, service providers, and other actors (Corrie Macleod, 2021).

From a security perspective, the Finnish government commissioned a report on immigration, security, and foresight to provide a multidisciplinary and cross-sectoral situation awareness of migration and security and was done in collaboration with the Center for Statistics in Finland and the National Institute for Health and Welfare, led and coordinated by the Police University College (Laitinen Kari et al., 2016). This report outlines indicators for the follow-up of the links between migration and security and presents issues that need to be addressed regarding certain practices and processes. The report also makes a classification of phenomena related to peace and security that can be used to quantitatively follow up on matters affecting migration and security. (Saukkonen, 2020) points out that the local and international discussions around measuring integration and the different dimensions identified in the e.g., Zaragoza discussions are central to gaining a holistic understanding of integration. The European Union agreed on several indicators for integration analysis i.e., the Zaragoza integration indicators. Systems were put in place to report and follow up on these indicators in the EU and Finland. These indicators are employment, education, health, social inclusion, and active citizenship (Eurostat, 2010).

Finland has also, using the Zaragoza indicators as a reference point, created a localized set of indicators to measure integration in Finland. These indicators are employment, education and skills, wellbeing, participation, and two-way integration (The Centre of Expertise in Immigrant Integration, n.d.). For each of these dimensions, quantitative and qualitative indicators have been assigned and reports on these are updated yearly on the Finnish integration database.

To gain a holistic understanding of integration in Finland however these dimensions need to be combined and aggregated, and this has not been previously done in Finland. A study conducted by Anna Di Bartolomeo et al., (2015) was targeted at building composite indicators of integration that allow comparison for the level of integration of 'specific group of migrants residing in selected EU Member States' (migrant corridors). Towards this end, a Principal Component analysis technique was used in three dimensions of integration namely, labor market, education, and access to citizenship. The composite indicators developed in their study allowed for the ranking of the integration outcomes of migrant corridors by dimension. The study correctly points out that a major advantage of using composite indicators is that, by summarizing complex realities into a single number, they can be interpreted more easily, but conversely, oversimplification may send misleading policy recommendations, when poorly constructed or misinterpreted (OECD, 2018).

For each integration dimension in their study, the construction of composite indicators involved the following two steps:

1) the definition and construction of basic indicators measuring each dimension of interest (This has already been done in Finland at an integration policy level),

2) the aggregation of these basic indicators through the estimation of composite indicators assessing the level of integration of "a migrant community x in a destination country y" (migrant corridor) by dimension z.

Each principal component (of integration) is weighted according to its contribution to the overall variance in the data. In so doing, this technique groups together basic collinear indicators to form a composite indicator that captures the biggest amount of information common to basic indicators (OECD 2008). In this study however, only three dimensions of integration were used whereas Finland considers five.

2.2 Accessibility

Accessibility is a central aspect for all people to be able to arrive at destinations as well as to be able to use services not located within their homes. This study refers to the integration dimensions and analyses access to services that support the different aspects within the integration dimensions. In this sense accessibility has a socioeconomic, cultural, and integrative value that cannot be ignored.

Accessibility can be divided into multiple features (Litman, 2007) i.e.,

- availability of facilities
- availability of transportation
- affordability
- mobility (physical ability to move)
- convenience
- proximity

In addition, digital accessibility is becoming more important as well. The increased digitalization of services also adds new features to the list mentioned above. The features of virtual accessibility that we need to consider going forward, as information collection, transmission and consumption and the technologies used to facilitate this are also beginning to allow us to understand digital geographies and visualize virtual landscapes, may include the following:

- availability of user-friendly facilities online
- availability of internet connections and linked devices
- affordability of internet access
- digital mobility (the ability to navigate the virtual world)

This study will however focus on physical accessibility but make brief reference, where relevant, to virtual accessibility as well.

To measure accessibility, the cost to reach said service is often taken into consideration (Guagliardo, 2004). Euclidian distance is often used, when measuring accessibility by distance. This is however not a reliable method unless the distance between the two points is a straight line. Euclidian distance is measured from cell center to cell center in a straight line. Real world analysis

scenarios require that we attempt to recreate real world travel scenarios and consider the complexities of urban roads and networks. Advancements have been made regarding measuring accessibility by distance and time e.g., using trajectory data records for the travel origin location, the destination location, and the travel time, as well as considering the characteristics of traffic network dynamics and other factors (Sun et al., 2021).

Joyce & Dunn (2009) define public transport accessibility as "the quality of transit serving a particular location and the ease with which people can access that service". Mavoa et al., (2012) also group accessibility measure into three main groups namely: duration of public transport journey, access to transit stops and access to destinations using public transport. By these measures and definition, most areas in Tampere have good accessibility to integration services and this serves most of the population combined in the different service areas. Tampere has a well-functioning public transportation system, and many residents have easy access to transit stops to get to them to their integration services.

Other studies have used the PTAL (Public Transport Accessibility Levels) method which was developed in 1992 by the London Borough of Hammersmith and Fulham (Bell, 2015). This method takes into consideration:

a) Walking time from the point-of interest to public transportation access points.
b) The reliability of the service modes available.
c) The number of services available within the catchment; and
d) The level of service at the public transport access points - i.e., average waiting time.

It does not consider:

a) The speed or utility of accessible services.
b) Crowding, including the ability to board services; or,
c) Ease of interchange.

This study is concerned with accessibility for different groups living in different areas. Similar methods have been used to study methods of measuring accessibility to public services in the city of Aqaba by placing accessibility as an indicator of the efficiency of the spatial distribution of services in relation to residential neighborhoods in the city (AlFanatseh & Saqallah, 2021).

2.3 Integration services in Tampere

Integration services for the purpose of this study will be limited to services that support the integration process of adult migrants as defined by the Act on the Promotion of Immigrant Integration (1386/2010) and as enforced by the Finnish Employment services in the Integration Program.

The integration process as defined in the integration law of 2010 (Finlex - Finnish Ministry of Justice, 2010) contains the following steps:

a) Registration
b) Initial Assessments (Includes a skills assessment)
c) Service Needs Assessment, and
d) Integration Plan (Including Finnish language courses)

The registration for this integration process is triggered by registering as a job seeker and must happen in person, at a designated location for each area. To access integration services, one must:

- have lived less than three years in Finland.
- are at least 17 years old.
- unemployed or becoming unemployed soon.
- integration training is suited to your learning abilities.
- integration training supports your overall integration and employment targets.

The services listed in Table 1 below are services that provide different functions in Tampere as per the indicators listed under each dimension of the integration indicators.

Table 1: Integration Services in Tampere

	Integration Service Provider		
Integration Dimensions	City	Government	3rd Sector and other organizations
Employment	International Tampere Skills Centre, International House Tampere	TE-Services Tampere	Start-up hubs
Education and skills	Municipal vocational colleges with language courses, e.g., TAKK, TREDU	University of Tampere	Private schools providing language and other trainings.
Wellbeing	Social and Housing Services, Healthcare, Sports, Advisory services (MAINIO/KOTOTORI)	KELA (Finland's Social Security Institution)	NGOs and Cultural Services
Participation	Voting Stations, Decision making bodies	Finnish Immigration Services	
Two-way integration		Police[1]	Cultural/Migrant support services

[1] Integration indicator data in Finland includes recorded police responses to situations when migrants experience racially motivated crimes.

Chapter 3: Data and Methods.

3.1 Data

Both existing data and data collected through fieldwork were used in the analysis. The bulk of the data is quantitative data accessed through the city of Tampere regarding integration indicators, but some of the data is also qualitative collected through interviews and questionnaires.

Indicator data was accessed through the City of Tampere's International Service's IT development project: Digital Customer Service & Knowledge Management (D.A.T.E Tampere project). Although data for all indicators in all dimensions was initially requested from the Finnish Statistics Services, due to flaws and silos in data collection and publishing practices, not all data was available. Table 2 below outlines the data received for each dimension; this indicator list however does not match the integration statistics database (Kotoutumisen osaamiskeskus, 2021.).

Table 2: Integration indicators DATE Tampere Project: City of Tampere Kehittämistiimi. Permission to reproduce – City of Tampere TYKAS/International Services 2022 (See appendix for description of statistics)

Dimension	Indicator
Employment	A1 Employment rate
	A2 Unemployment rate
	A3 Proportion of the long-term unemployed
	A4 Labor force participation
	A5 Share of entrepreneurs in employment
	A6 Share of public sector employees of those in employment
	A7 Proportion of part-time employees
	A8 Proportion of employees in fixed-term work
Education and Skills [2]	B1 No post-primary degree or place of study
	B2 Completion rate of secondary education: Proportion of those who have completed vocational studies
	B2 Completion rate of secondary education: Proportion of high school graduates
	B3 Proportion of graduates with a tertiary degree
	B4 Highest level completed: primary or unknown
	B4 Highest level: second degree or special vocational education
	B4 Highest completed degree: higher degree
	B5 Proportion of NEET (not in education, employment, or training) youth

[2] Note: Official integration indicators also have a measure for Finnish language levels attained by migrants, but there is no national register with this data and so such data could not be provided by Statistics Finland for this study.

Wellbeing	C1 Premature mortality C2 Proportion of disability pensioners C3 Disposable income of the adult population: Average C3 Disposable income of the adult population: Median C4 Wage and entrepreneurial income of the adult population: Average C4 Wage and entrepreneurial income of the adult population: Median C5 Disposable income of households: Average C5 Disposable income of households: Median C6 At risk of poverty rate of households C7 At risk of poverty rate of employed persons C8 At risk of poverty rate of children C9 Proportion of people living in low-employment households C10 Housing: Proportion of the dwelling population living in owner-occupied dwellings C10 Type of housing: Proportion of the population living in rented dwellings C10 Type of housing: Proportion of the population living in an Ara rental dwelling C11 Proportion of cramped housing population C12 Proportion of cramped dwellings
Participation	D1 Acquired Finnish citizenship
Two-way integration	Unavailable

3.1.1 GIS-Data

GIS layers for the city of Tampere, its neighborhoods, and road networks were accessed as shapefiles from the National Land Survey of Finland's database (National Land Survey of Finland, n.d.). Location-encoded statistics of immigrants were purchased from Statistics Finland (Statistics Finland, 2021). Integration services were digitized in ArcMap and location coordinates were calculated as geometry in the attribute table. The calculate geometry was used to add x-, and y-coordinates to the point feature's attribute fields to show the location of each feature (ESRI, n.d.-b). These locations were then joined to the postcode shape file and the location attributes were enriched with the data from the shapefiles.

Shapefile data was acquired as open data from the National Land Survey of Finland and is licensed under a Creative Commons Attribution 4.0 International. Road lines, bus routes, and bust stop point data were accessed through DigiRoad which is the national database that contains the geometry of the Finnish road and street networks also under a Creative Commons Attribution 4.0. International (The Finnish Transport Infrastructure Agency, n.d.).

The geographical data used for the study is as follows:

- Tampere Administrative Boundaries
- Tampere Service Area administrative boundaries (City of Tampere GIS services, 2022)
- Tampere Post Code Areas
- Tampere Bus Routes
- Tampere Bus Stations
- Tampere roads and highways, with speeds (The Finnish Transport Infrastructure Agency, 2022)
- Population Grid Data

Integration Indicators were analyzed at 3 main administrative units i.e., city level, services areas, and postcode level.

3.1.2 Administrative Units and Data Types

Data were accessed from databases or digitized as shapefiles, lines, and points for the following layers as shown in Table 3 below.

Table 3:Location Data Levels acquired from the City of Tampere

Shapefiles	Lines	Points
City Level Data: Tampere.	Tampere region roads and highways.	Bus stops in the Tampere Region
Service Areas: Läntinen Area, Eteläinen Area, Keskustan Area, Kaakkoinen Area, Koillinen Area	Tampere region bus routes.	Integration service provider destinations (Digitized)
Post Code Areas: Tampere post codes - *High Population Neighborhoods:* Hervanta, Kaukajärvi, Tampere Keskusta, Atala-Linnainmaa, Härmälä-Rantaperkiö, Osmonmäki-Petsamo, Takahuhti		

3.1.3 Interviews and Questionnaires

Informal interviews were conducted to get information about the City of Tampere's decision makers' understanding of the state of integration in Tampere, services essential for integration, measuring integration, and their understanding of migrants' experiences with accessibility to integration services in Tampere. These interviews were conducted over the course of work over one month in the data collection phase.

A short ranking questionnaire was sent to 4 integration experts from the government and academia. Questionnaires resulted in responses recommending which integration dimensions and indicators to concentrate on from integration experts. A questionnaire was also posted in social media group for migrants in Tampere to get quantitative responses regarding two-way integration – specifically, migrants' own experiences of belonging and safety, but the questionnaire did not receive sufficient responses and therefore was disregarded for the study- since only 4 responses were received from the public.

3.1.4 Indicators and sample group data

Integration dimensions are derived from the Zaragoza declaration (Eurostat, 2010) but for this study specifically as defined by The Centre of Expertise in Immigrant Integration, (2021). Each dimension has a varying number of indicators some of which are also qualitative.

Integration Dimensions: Employment, Education and Skills, Wellbeing, Participation, Two-way integration.

The dimensions used in this study were selected based on ranking responses from a questionnaire sent to integration experts. These dimensions are employment, education and skills, and wellbeing. After careful consideration and consultations, participation was removed since only one indicator was provided by Statistics Finland and that was not considered sufficient to measure migrants' "participation" dimension. The participation dimension is more about civic and political participation and citizenship alone is not representative of that as can be deduced on the list of integration indicators defined by the Centre of Expertise in Immigrant Integration.

Through the City of Tampere's "Digital Customer Service and Knowledge Management" project, data was purchased from Statistics Finland. Statistics Finland is tasked with the production of reliable and up-to-date information for the benefit of customers and into social debate. Statistics Finland compiles statistics and reports concerning social conditions (Statistics Finland, n.d.-b). The data package from Statistics Finland included:

- Aggregated integration indicator data of all adults of foreign background in Tampere: at the time about 19 000 people
- Integration indicator data of migrants sorted at a continental level: Asians, Europeans, Former Soviet Union, Africans, Americans
- Integration indicator data of migrants based on the country of origin: Former Soviet Union, Iraq, Afghanistan, Estonia, Iran, China, India, Somalia, Vietnam, Former Yugoslavia, Turkey, Syria, Thailand

3.2 Methods

3.2.1 Calculating holistic integration.

To create indices, "goalposts" of the maximum and minimum limits on each indicator are set from the group level maximum and minimum values. Data for the indices were drawn from the period between 2010 and 2019. Indices under each dimension, were made for people with migrant background, Finns born in Finland and Finns born in Finland living in Tampere.

The method used is based on the formula for the Human Development Index (HDI) used by the United Nations Development Program (Max Roser, 2014). To create indices for each indicator the values were first normalized to a value between 0 and 1 using the formula:

1. Indicator Index (II) = (Actual Value – Minimum Value) / (Maximum value – Minimum Value)

Indicator Index = result of indicator value minus minimum indicator value divided by the result of subtracting the minimum indicator value from the maximum indicator value.

The indicator value for each year was used as actual value. Minimum indicator value and Maximum indicator values are selected from indicator results over the whole study period i.e., 2010 – 2019. The resulting indicator index runs between 0 and 1 where a value of 0 means minimum group performance in that indicator and an index value of 1 represents maximum performance.

After normalization the dimension indicators were averaged assuming that all indicators under each dimension carry equal weight. The following formula was used:

2. Dimension Index (DI) = (II*a* + II *b* + II *c*) / II *n*

Dimension Index = Sum of Indicators for each dimension divided by the number of indicators in that dimension

To create the holistic integration index, the averaged dimension indices were aggregated. This calculation is the geometric mean of the three dimensions of data accessed for this study, i.e., Employment, Education & Skills, and Wellbeing. The following formula was used:

3. Holistic Integration Index (HII) = (DI *employment* * DI *Education & Skills* * DI *Wellbeing*)1/DI *n*

Holistic integration index = Result of the multiplication of dimension indexes multiplied by 1 divided by the number of dimension indexes

Due to the high importance placed on the employment dimension in Finnish integration services, and also the opinions of integration experts in Finland weights were applied to the dimensions. The following formula was used:

b. Weighted holistic Integration Index = (((DI employment * weight X) * (DI Education & Skills * weight Y) * (DI Wellbeing * weight Y)))1/DI n

X being a weight of 1to represent the importance of the employment dimension and Y weight of 0.5 to make E&S and Wellbeing of equal importance.

Performance gaps, to show the difference in performance between migrant and native populations were acquired yearly using simple subtraction i.e.,

4. Integration Performance Gap =

(Integration performance gap at a dimension level)

Dimension Performance Gap = Migrant Dimension Index – Native Dimension Index

(Integration performance gap at a holistic level)

Holistic Performance Gap = Migrant Holistic Indicator Index – Native Holistic Indicator Index

Performance gap values are not indicators and range from -1 to 1. Values of 0 and below refer to none to negative performance in an indicator, dimension or holistically in comparison to the native population. Values greater than 0 represent positive performance in relation to the native population yearly. Performance gap values describe integrative impact in that instance. The trend

lines, however, describe the integration impact performance over time in a particular indicator, dimension or holistically.

3.2.2 Public transport in Tampere

This study will rely solely on the use of public transport routes to measure accessibility. Therefore, distance and time to access integration services will be measured through their routes and designated travelling speeds.

Tampere's public transport is comprehensive and includes bus networks and recently commissioned tram lines that are being expanded. According to Tiikkaja & Viri, (2021) Tampere reduced public transport frequencies in 2020 due to a decrease in ridership by 70% caused by the COVID-19 pandemic. They also point out that this reduction can most likely be attributed to better income and restrictions by authorities, i.e., those people with lower income might not have been able to reduce their amount of travelling because they were more likely to be essential workers with no ability to work remotely. According to Mary Hanna, (2021a) migrants tend to settle in large urban areas, and therefore they have a higher reliance on public transportation especially in the first few years of arrival. A study from Germany by Welsch et al., (2018) points out that migrants are also less likely than natives to own a driving license, a driving license that is valid in the country or a car.

The city of Tampere is also strategically focusing on the development of greener transport solutions by modernizing and increasing public transport accessibility to different areas (The of City of Tampere, 2021). Improved access to public transport and shorter travel times are considered to contribute positively to wellbeing according to Basso et al., (2020).

3.2.4 Road speeds

Road speed data was downloaded along with DigiRoad data. Different road segments have different speeds. This data was then joined to the line data for bus routes where different parts of the roads have different maximum speeds as is shown in Figure 5 below. The maximum driving speed for the buses was set at 80 km/hour in the analysis, which is the maximum permitted for public buses. The actual driving speed of the buses was determined by the speed limit of each road segment but limited to the maximum speed outlined above in case the route connected to a highway which may be 100 – 120 km / hour. Shape lengths were in meters, but were converted to

kilometers since the speed limits are based on km/hr. The travel time for each line segment was then calculated using the field calculator.

According to the National Association of City Transportation Officials, a light remains red for between 60 and 90 seconds, therefore an urban driver spends an average of 75 seconds waiting at each red light (National Association of City Transportation Officials, n.d.). According to results by Hawas, (2013) the average stop times at bus stops in their study was about 0.86 minutes or about 51 seconds. However, a more recent study by Hansson et al., (2022) states that each stop made by a bus at a stop in urban areas increases the travel time by 40 seconds, and 42 seconds in rural areas. Slopes and traffic density were not included in the calculations, because public transport and taxis have their own lanes or right of way, except on highways and Finland is quite flat with height differences of around 50 meters (Axel Christian Zetlitz Sømme, 1961).

The shortest two routes were selected from Koillinen and from Hervanta and the traffic lights as well as the bus stops within 5 meters of these routes were selected using a buffer analysis and resulted in 13 traffic lights on each route, 6 bus stops along the Hervanta Route and 18 bus stops along the Koillinen route. This information was used to compare the results of the service area analysis and travel time results according to Tampere's transport administration's travel times results.

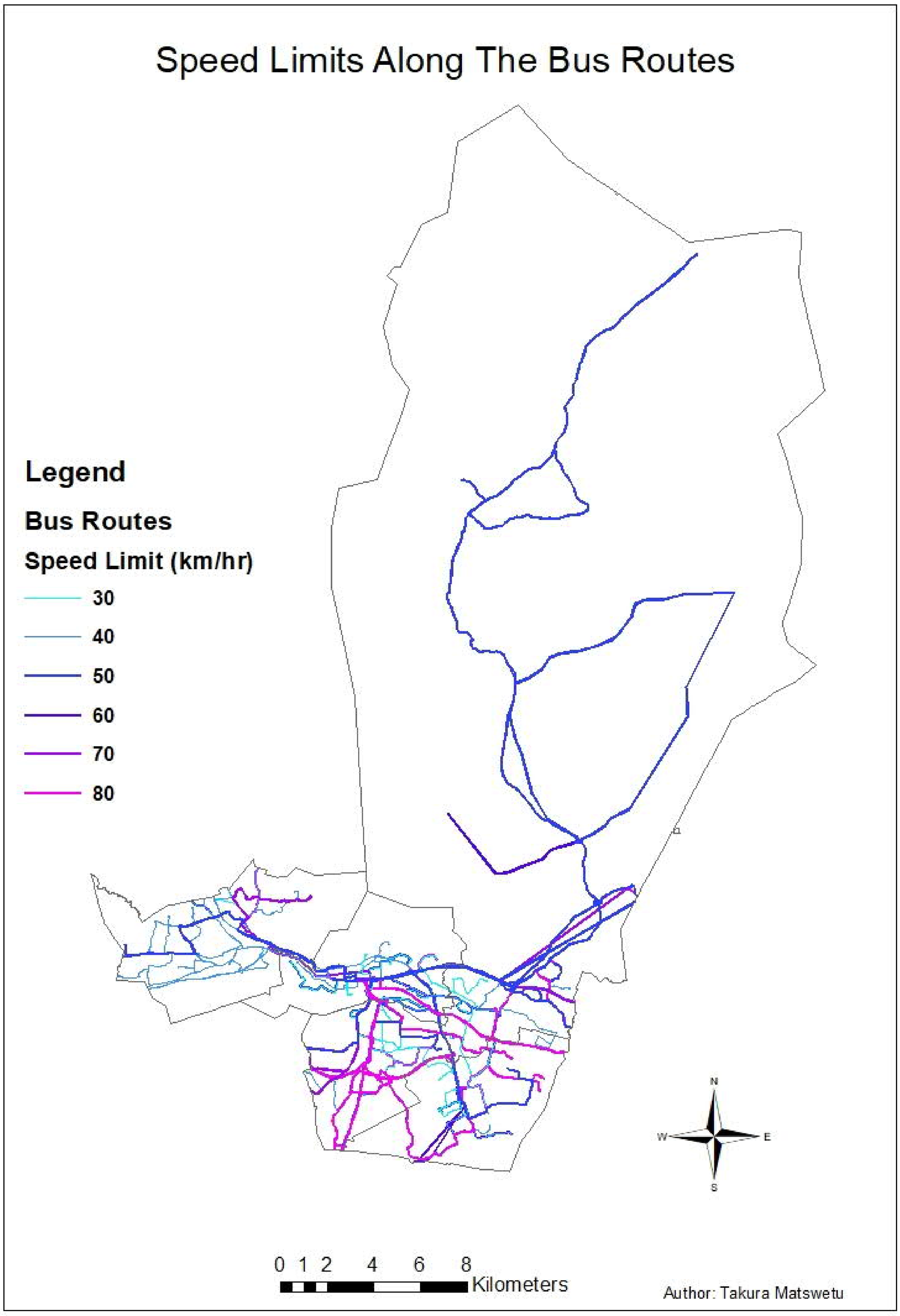


Figure 5:Speed limits along bus routes in Tampere

3.2.5 Bus stops departure selection

A threshold of 500 meters was set for good accessibility to bus stations. According to transit planners people tolerate walking around 400 meters for a local stop service and about 1000 meters for frequent transit, beyond these distances' ridership is said to fall -although the distances that people are willing to walk vary greatly (Jarrett Walker, 2010).

To select these bus stops the study assumed that all residents' journeys would begin from the centroids of their post code and service areas so as to average out the accessibility of the local bus stops at these levels and then buffers for the thresholds were created. This was done mainly to simplify the analysis and because the main bus station is located in the center of these areas along with a high concentration of residential and shopping buildings. Bus stops within those thresholds were selected as departure points for this study and were assigned appropriate identifiers. Figures 8 and 9 below show bus stations 500 meters from the centroids for post code area polygons and service area polygons. Some areas did not have bus stops within 500 meters of the centroid e.g., Koillinen, so for the purposes of this study the bus stop for Koillinen in the service area calculations was selected from the post code areas.

Table 4:Total bus stops to population distribution in different postcodes (Digiroad)

POSTCODE	POPULATION	BUSSTOPS	POSTCODE	POPULATION	BUSSTOPS
33100	*17738*	122	34270	*294*	27
33720	*25488*	98	33340	*5343*	26
33680	*1654*	89	33500	*11318*	25
33580	*15525*	86	33540	*9998*	24
33710	*18455*	78	33730	*2157*	24
33400	*9525*	74	33420	*2026*	24
33820	*9088*	74	33520	*961*	22
33560	*10159*	68	33870	*5480*	18
33900	*12477*	60	33700	*1743*	18
34260	*871*	55	33250	*2372*	17
34240	*1622*	53	33200	*6687*	16
33800	*5347*	50	33210	*5819*	16
33270	*7565*	46	33530	*5055*	16
33310	*7548*	42	33610	*3830*	16
33230	*6044*	38	33850	*2444*	12
33330	*3356*	38	33180	*2302*	12
33300	*5112*	33	33410	*5514*	11
33840	*3269*	29	33240	*1633*	7

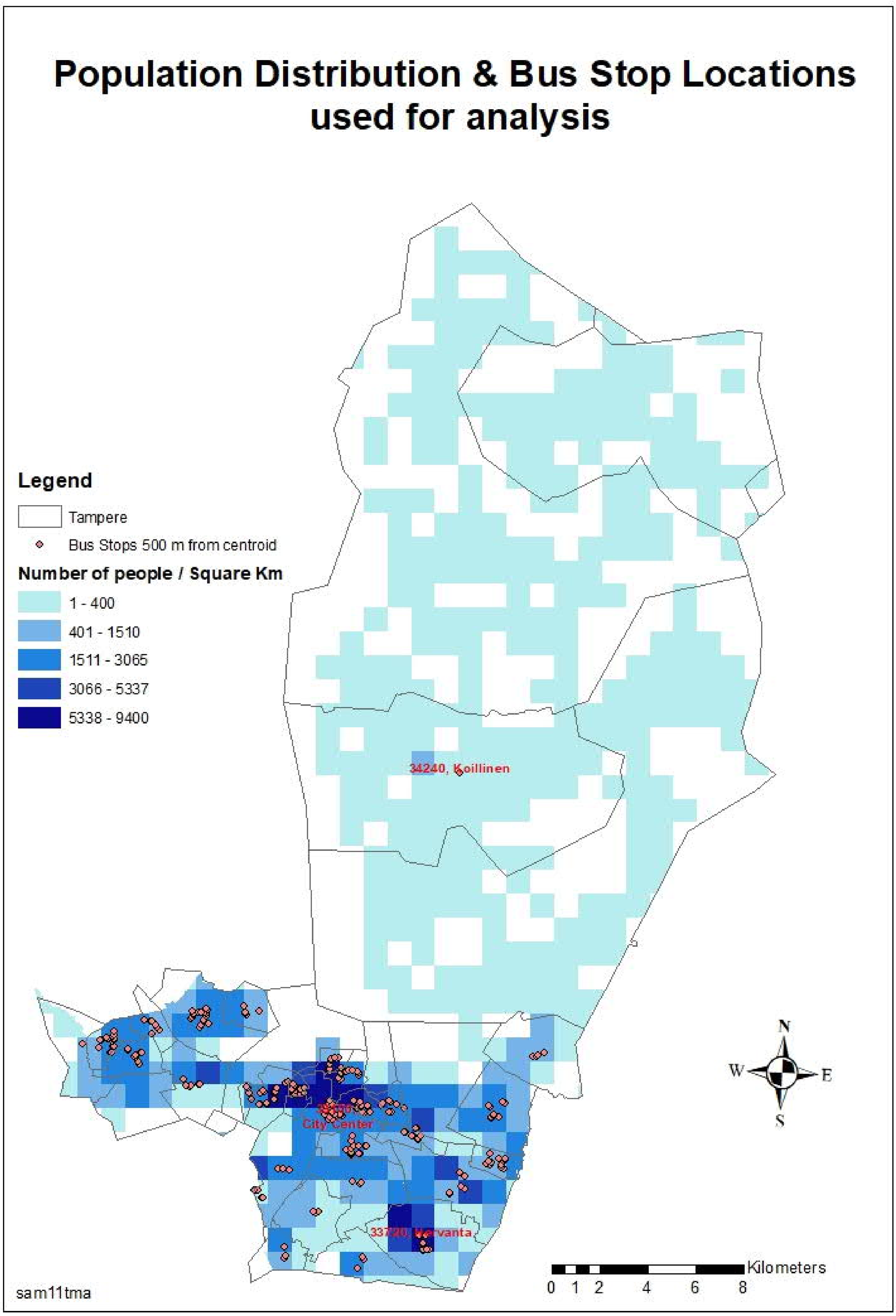


Figure 6:Population distribution and selected bus stops within 500 meters of post code centroid

3.2.6 Network analysis types

To study accessibility network analysis was chosen. The network analysis tool in ArcGIS can be used to solve network problems such as routes, closest facilities or identifying service areas around a particular location.

There are six types of analysis that are possible to conduct in ArcGIS namely (ESRI, n.d.-e):

- Route analysis

This analysis is used to find the best way to get from one location to another or to multiple other locations. In the case of multiple destinations, the user can define the order in which the locations are to be visited or then the software can output the best sequence to visit the locations. This is also referred to as solving the traveling salesman problem.

- Closest facility

This analysis is about identifying the closest location, service, or item of interest to a given starting point in general or within a given search radius. These interests can be multiple, and the user can define the direction of travel whether it is towards or away from them. When the facilities have been identified the user can display the best route to or from them, travel costs and directions to each facility.

- Service area analysis

This is used to find service areas around any location on a network and is essentially a region containing streets that that can be accessed within, for example, a specified time impedance.

- Vehicle routing problem analysis layer

Vehicle routing is best used for fleet management in dispatching vehicles and keeping to time constraints while simultaneously keeping the operation and investment costs as low as possible. The constraints include work shifts, delivery timetables, and driving speeds considering available resources to complete the tasks.

- Location-allocation

Location allocation is about identifying the ideal facilities for a given purpose from a group of facilities based on potential suitability to a set of demands. This type of analysis could be used to identify, for example, ideal locations to set up a hospital where it serves the highest population with least impediment or best places to set up refugee reception centers that provide the best access to most of the basic services that refugees may need.

- OD cost matrix

With the OD cost matrix one can create an origin/destination cost matrix from multiple origins to multiple destinations. It is a table containing network impedance from each origin to each destination and ranks the destinations each origin connects to in ascending order from least impedance. Although the output is straight lines the attribute table stores the network cost and not the straight-line distance.

Although the closest facility analysis and the OD cost matrix perform similar analysis, they differ in output and computation speeds. Since this study was not particularly concerned with the true shapes of the routes or the driving directions between the origins and destinations but rather the time of travel and the regions, the service area analysis and the OD cost matrix was chosen for this study. The service area analysis will allow us to visualize area cost of accessibility along the bus routes at 5-minute intervals up to 60 min. Due to the high number of origin-destination analysis that are necessary to get specific travel times from each area, the OD cost matrix will be used to complement the service area analysis. The OD Cost matrix analysis allows for multiple impediments to be input between origins and destinations as well as the ranking, which facilitates faster sorting based on minimum accepted values for the study.

3.2.7 Network construction

For the analysis to be accurate, the road network data used to generate the OD cost matrix must be topologically correct, meaning that all road segments are well-connected. If road segments are not well-connected, the analysis may produce incorrect results, such as incorrect distances, travel times, or routes between locations.

Topology was used to ensure that the network data used for accessibility network analysis was accurate and consistent. ArcGIS uses a set of predefined topology rules to validate the network data, such as:

- Each road feature must have a unique ID.
- Each road feature must have a beginning and an end.
- Every node must be connected to at least two edges.
- Edges must not overlap or cross each other.
- Dead-end edges must be properly connected to their end node.

When network topology is enabled in ArcGIS, the software automatically checks the network data against these rules and highlights any errors or inconsistencies that it finds. The topology rule "must not have dangles" was used in network analysis topology. It is used to ensure that all network features in a dataset are properly connected to other features and to identify and correct errors in the network data. Dangles are network features that do not have a valid connection to another feature. They can occur when a feature's endpoint does not connect to another feature, or when a feature's endpoint connects to another feature in an invalid way (ESRI, n.d.-c).

The network was built using ArcCatalog using two frictions i.e.

- Distance
- Time

In the network data set properties travel mode was set to "Truck" and minutes to closely resemble a bus. Truck uses the historical average speeds and the posted speed limits for trucks which is just like that of municipal buses in Tampere of 80 kilometers per hour. In ArcGIS it is also possible to create travel modes that have characteristics and properties more suitable to the specific study or organizational needs, but that is only possible as a portal administrator.

The following scenario was defined for the analysis namely:

Scenario I

Access to locations where integration services are organized, from a bus stop that is within 500 meters of the centroids of Hervanta, Koillinen and City Centre.

GIS methods were used to analyze accessibility to each service for the larger migrant corridors in Tampere from different neighborhoods (post code areas). Since there are multiple providers of integration services in Tampere serving different groups and the goal was to study accessibility to these services from multiple origins for several groups. A network dataset was created in ArcCatalog and in it were specified the origins, destinations, public transport network as well as the impediments in this case, which were the maximum travel speeds for public transport in the different road segments. Outputs were set to straight lines that represent the network distance and not the straight-line distance. A service area analysis was also conducted to understand the areas that are serviceable within specific time limitations at 10-minute intervals up to an hour.

3.2.8 Network analysis

OD Cost Matrix

For least cost routes in OD Cost Matrix from origin to destination the Dijkstra algorithm is used. According to the Esri website (ESRI, n.d.-a) "…Dijkstra's algorithm solves the single-source, shortest-path problem on a weighted graph. To find the shortest path from a starting location s to a destination location d, Dijkstra's algorithm maintains a set of junctions, S, whose final shortest path from s has already been computed. The algorithm repeatedly finds a junction in the set of junctions that has the minimum shortest-path estimate, adds it to the set of junctions S, and updates the shortest-path estimates of all neighbors of this junction that are not in S. The algorithm continues until the destination junction is added to S."

Essentially what the algorithm does is start from a source node and visits all neighboring nodes and, as it does so, it assigns a tentative distance value to each neighboring node and checks off the one that has been visited. It then selects an unvisited node with the lowest tentative distance value

and repeats the process of visiting all neighboring nodes and updating the tentative distance values. This is repeated until it reaches the destination node.

Besides GIS software (ESRI 2017. ArcGIS Desktop: Release 10.5.1. Redlands, CA: Environmental Systems Research Institute), I used other software such as SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) and Excel (Microsoft Corporation, 2018. Microsoft Excel, Available at: https://office.microsoft.com/excel.) to analyze, store, and visualize analysis results, statistical data and spatial data and produce tables and maps that show levels of integration in different areas and the accessibility of integration services from those areas. I calculated the centroids of the service and post code areas by calculating the geometry of the different polygons and then using the buffer tool, I identified bus stops within 500 meters of the centroids and then I used the extraction tool to isolate them and put them into a separate point layer.

To perform an accessibility analysis using the OD cost matrix it calculates the accessibility of each location by summing the costs of traveling from that location to all other locations. I mapped the resulting accessibility values to show the spatial distribution of accessibility across the study area, to the integration services.

Service Area Analysis

Service areas are a model of the movement of a subject or an object within a network given certain thresholds. Unlike a buffer, which assumes unimpeded movement in any direction within the threshold, service area analysis solves the analysis in the network and can take into consideration all of the impediments within that network as well as the mode of transport.

The service area solver has the following inputs and outputs:

1. Facilities as input
2. Polygons as output – showing zones of the output measures, in this case ‘time-zones’ of travel times in minutes, could also be distance or financial cost.
3. Lines as output – showing lines along the network as output measures. In this case it is minutes but can also be distance or actual cost.

The service area tool also uses Dijkstra's algorithm. It produces a subset of connected edge features within the defined distance or cost creating lines, polygons, or both. The service area analysis tool is a rich solver that can handle multiple breaks, facilitates multiple location inputs on the network and even allows for the specification of the direction a vehicle can approach the facility (ESRI, n.d.-d).

Calculations for travel time in the analysis include average time spent at bus stops along the travel route and waiting times at traffic lights. These delays were deduced from the studies done by Hansson et al., (2022) and the National Association of City Transportation Officials and added to the ArcMap analysis.

3.2.9 Correlation Analysis

One of the objectives of this study is to determine whether integration performance levels are associated to the cost of traveling (accessing) to integration services. Thus, this study is interested in how these two phenomena co-vary. The temporal study of integration from 2010 to 2019 provided integration data points for the 3 study groups, in the 3 neighborhoods over 10 years. Each integration sample was paired with the corresponding travel time variable based on the location of the study group where the index was calculated. These 90 holistic integration index samples and paired times were imported into SPSS. The index samples were tested for normal distribution in SPSS. After the test was done an appropriate correlation test was selected.

In the case where data is normally distributed correlation can be tested by looking at standardized covariance, which is represented with (r) and is called the Pearson's correlation coefficient. It provides a standardized measure of the strength of the association between any two variables (Rogerson, 2011). If the data is not normally distributed Spearman's rank correlation would be more appropriate. Spearman's rank correlation (rs) measures the tendency for a value to increase or decrease as another value increases of decreases. In the Pearson correlation positive figures are indicative of a positive correlation between the two variables, while negative values indicate a negative relationship. However, in the case of the Spearman's test, a positive value indicates a direct association between the variables and a negative value indicates an inverse association. Unlike the Pearson's correlation coefficient, a Spearman test can produce perfect values of -1 or 1 whether or not the data pairs are linearly related(Gauthier, 2001).

Correlation is affected by sample size. The larger the sample the more representative it is of the population, and the better it is to avoid the “crud factor”, which states that everything is somehow correlated to each other in social sciences (Meehl, 1990). This concept was redefined as “The epistemological concept that, in correlational research, all variables are connected through causal structures, which result in real nonzero correlations between all variables in any given data set”(Orben & Lakens, 2020). Rogerson (2011) also points out that spatial data tends to also show dependence.

Even though there may be a strong linear association between two variables, it does not necessarily mean that the relationship is causal. The fact that there may be a relation between two variables does not mean that one variable is causing the other to change in any way. So, we also want to be confident that the relationship did not occur by chance by employing a level of statistical significance, indicated by the probability or p - value, of the relationship. A t-test is used to ascertain whether the results differ significantly from 0. The t statistic, once calculated, can be referenced to the critical value from a standard t-table at the appropriate degrees of freedom and confidence level (Rogerson, 2011).

Chapter 4: Results

4.1 Integration indicators – findings from surveys

According to the four expert survey respondents the most important indicators for the employment dimension in integration were unemployment rate, employment rate, share of long-term unemployed persons of those that are unemployed and the labor force participation rate. These element received the support from 50% or more of the respondents as can be seen in Table 5 below.

Table 5:Survey responses Employment Dimension. Percentage of respondents that selected a particular indicator as important.

	Number of respondents in favor of indicator n=4
Employment	
Unemployment rate	4
Labor force participation rate	3
Employment rate	2
share of long-term unemployed persons of those that are unemployed	2
Education and skills	
Only basic education	4
Completion rate in upper secondary level education	2
Highest completed qualification	2
Discontinuation of education in upper secondary level education	2
Wellbeing	
At risk of poverty rate of the household-dwelling units	4
Share of population living in low employment household-dwelling units	2
Wage and salary income and entrepreneurial income of the adult population	2
Disposable monetary income of the adult population	2

For the education and skills dimension in integration, respondents expressed the importance of basic education, completion rate of upper secondary level education, the highest completed qualification, and the discontinuation rate of education in upper secondary level education. The

table also shows that all expert respondents considered basic education as central in this dimension. Under the dimension for wellbeing, the at risk of poverty rate of the household-dwelling units was considered very important by all respondents (see Table 5), share of population living in low employment household-dwelling units, wage and salary income and entrepreneurial income of the adult population and the disposable monetary income of the adult population were selected as the most important indicators.

As pertains to participation and two-way integration some challenges with the reliability and usability of the data were expressed earlier. As participation indicators were mainly related to political participation, their availability was limited to years when there were elections and could only be included in holistic calculations in those years. Two-way integration indicators were inaccessible because the qualitative responses were not assigned numeric values on a scale to determine the rate of migrant experiences on different issues.

4.2 Integration Indicators – Composite Index of selected dimensions.[3]

4.2.1 Employment

As can be seen in Figure 7 below the linear projection of the employment dimension performance for migrants in Tampere is on a slight downward trajectory. This is not unique to migrants only in Tampere, as the employment index for natives in Tampere is also showing a decline. On the national level however, the native employment performance is showing a positive rise reflecting an almost 0.2-point increase since 2010.

[3] For detailed results for all dimensions used including results for the weighted and unweighted composite indices see “Calculation results” in appendix.

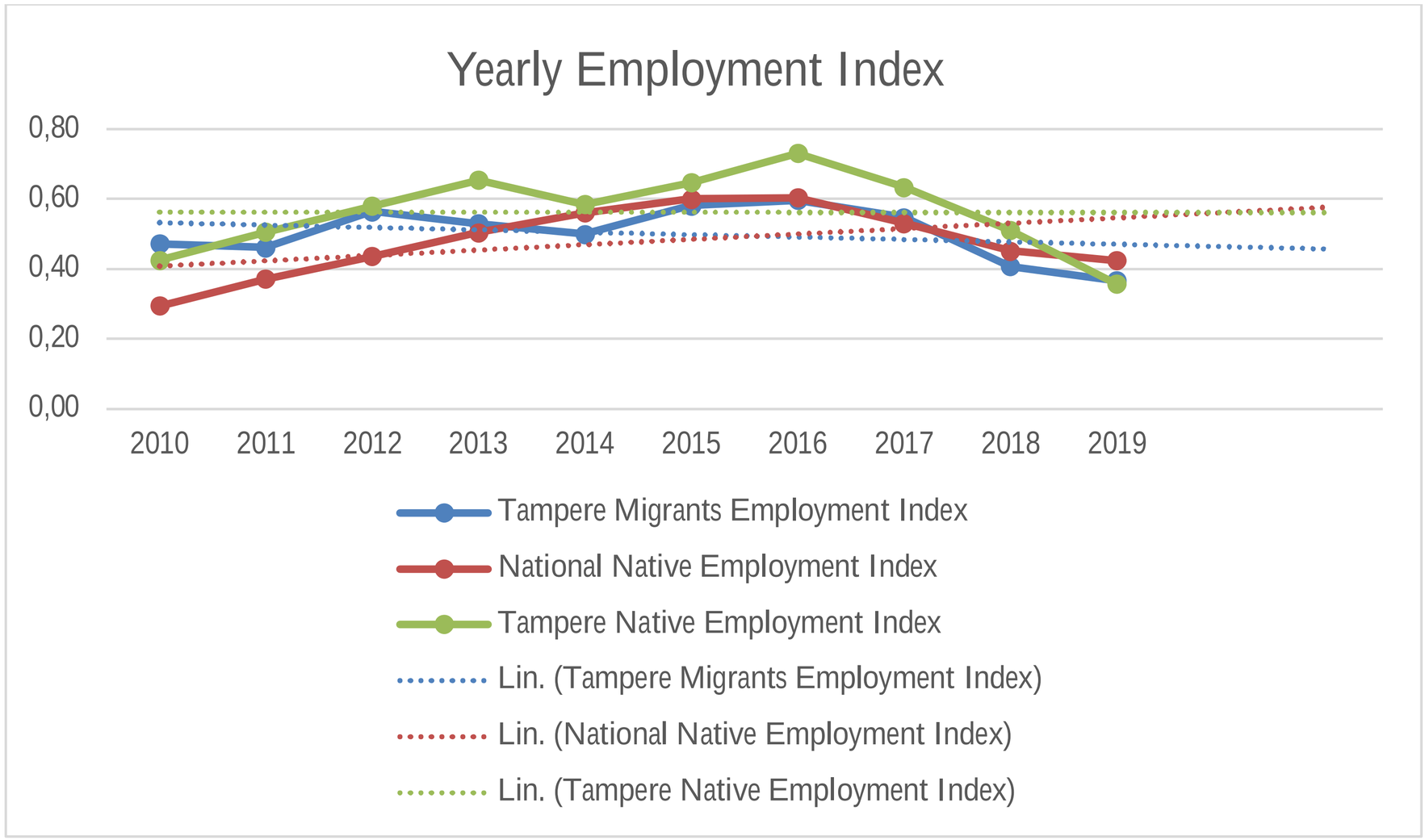


Figure 7:Yearly Employment Index

The employment performance gaps shown in Figure 8 below show that the integrative impact of employment services had gradually fallen since 2010 in Tampere, and nationally it slipped to negative integration impact in 2013. However, starting 2016 there has been a steady rise that coincides with the rise of food delivery services in Finland that hired a lot of migrants, the first municipal employment trials in Finland in 2017 and in Tampere the transfer of integration services from the Social Services Department to the Employment and Growth Services.

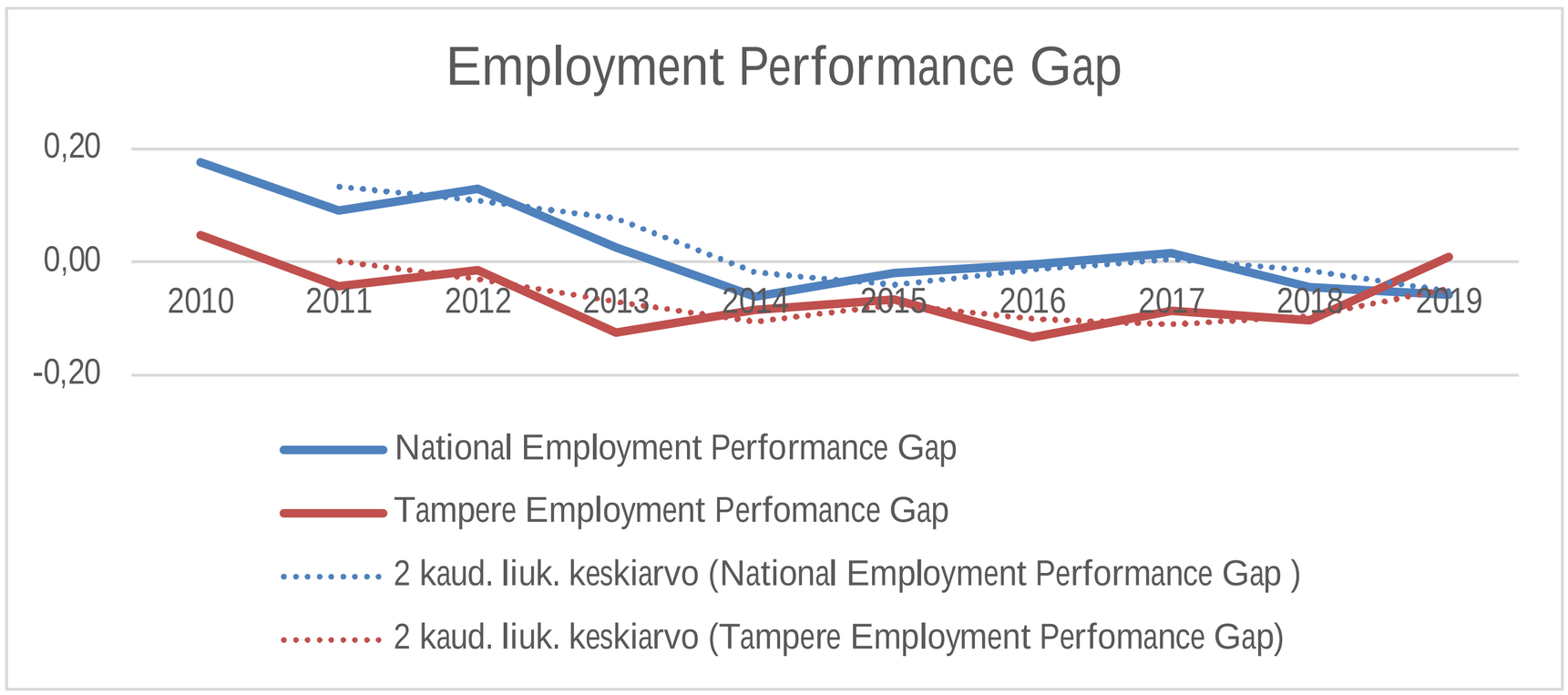


Figure 8:Employment Performance Gap

4.2.2 Education & Skills

Migrants' education and skills dimension index in Figure 9 below shows that around 2013 education and skills scores slipped below the native local and national levels.

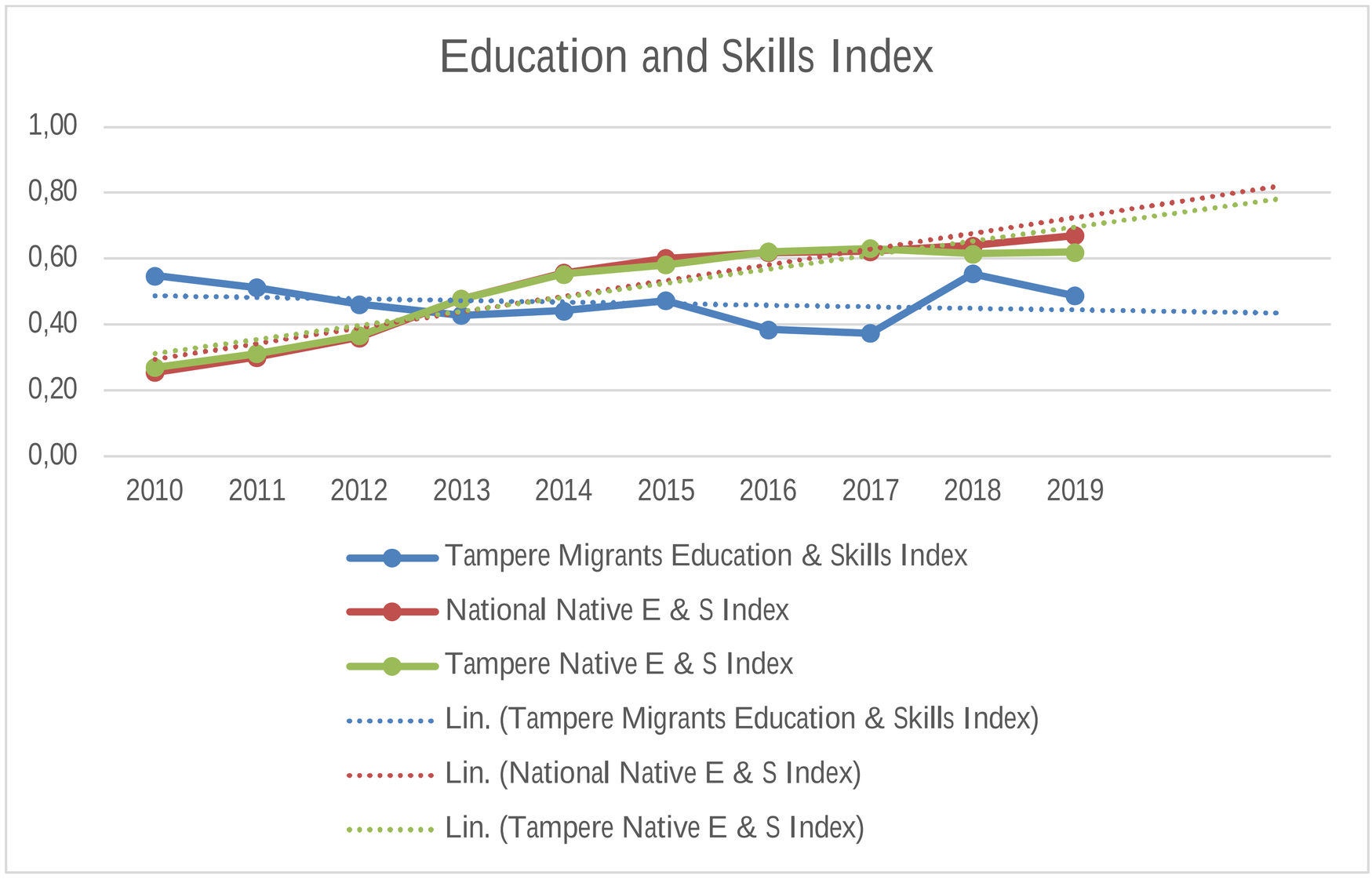


Figure 9:Yearly Education and Skills Index

In terms of integrative impact in Figure 10 below, we can see that both on a national and city level the performance was on a steady drop during the period up until the impacts of the access to education reform for refugees began to be realized around 2016-2017.

Figure 10:Education and Skills performance gaps

4.2.3 Wellbeing

Wellbeing index levels for migrants have steadily risen during the study period and have remained higher than natives, locally and nationally, since 2016 (see Figure 11). This is a very interesting trend produced from the indicators that were provided from the database. A careful analysis of

the individual indicators in the wellbeing dimension suggests that migrants had lower premature deaths in 7 out of the 10 years under study, and that although there is less disposable income amongst migrant groups low-income rates have been steadily reduced. Another point of note is that there has been a sharp decline in migrants living in social housing in Tampere (almost 25% reduction in (ARA) The Housing Finance and Development Centre of Finland Social housing) and the integrative impact over the study period is consistently one of the highest.

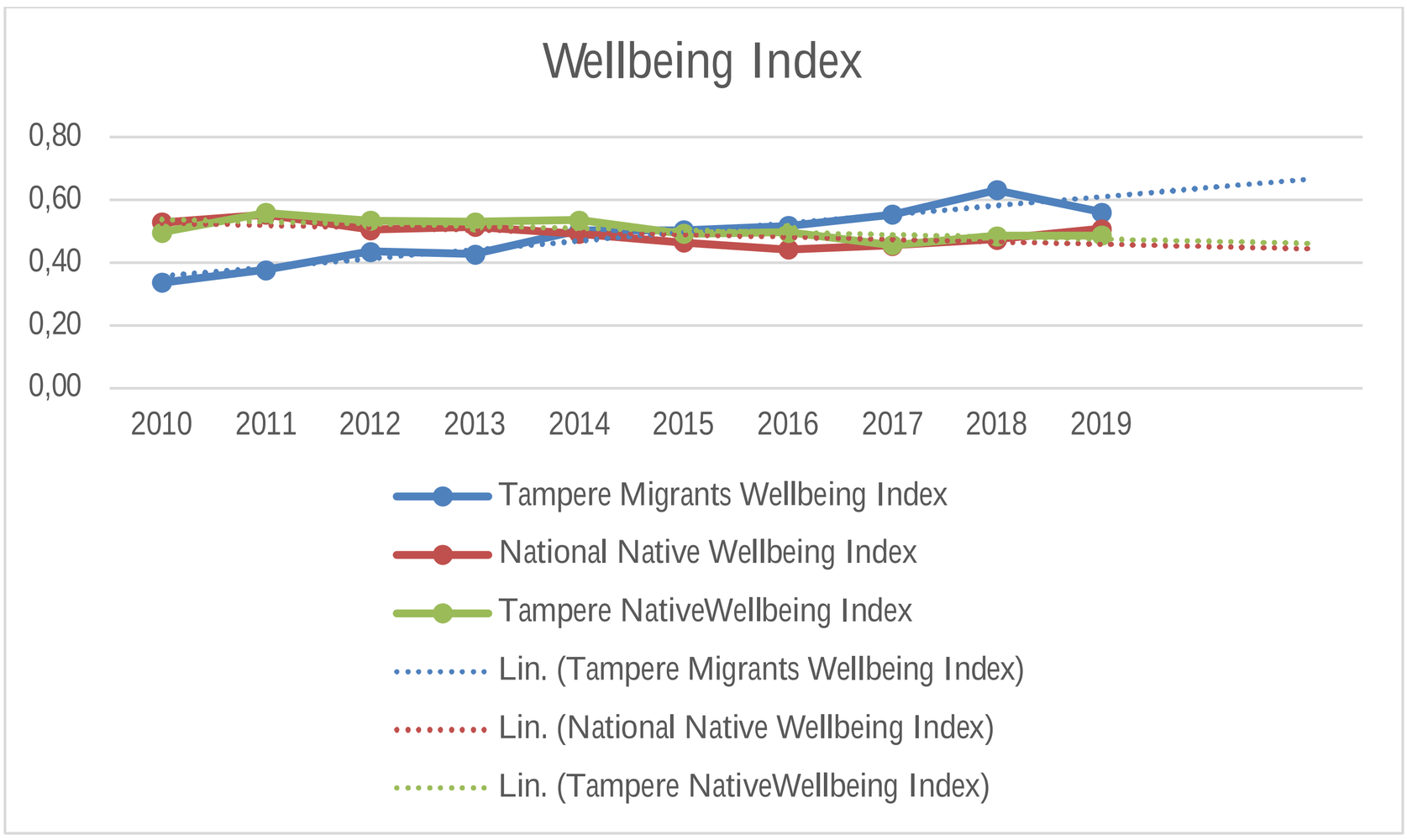


Figure 11: Yearly Wellbeing Index

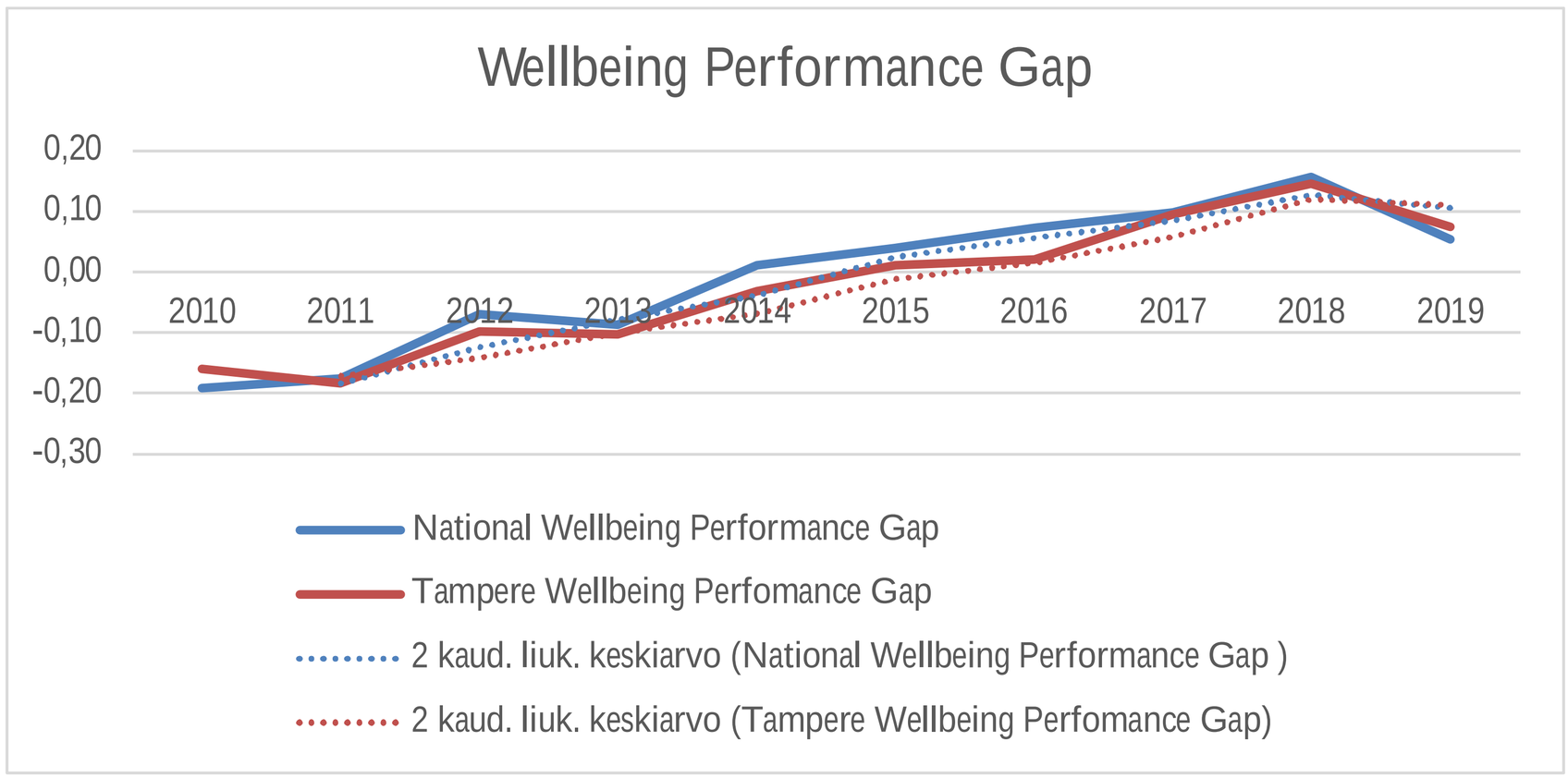


Figure 12:Wellbeing Performance Gap

Figure 12 above, suggests that in terms of integrative impact, natives in Tampere and nationally have been performing quite similarly to migrants in Tampere.

4.3 Holistic Integration Index (HII)

4.3.1 Weighted

Because of the central position placed on employment services in the integration of migrants in Finland, a weighted analysis was conducted to reflect this. The following manual weight values were used for the calculations to give more importance to the employment dimension, while education and skills are equal to each other.

Weighting:

- Employment 1
- Education and Skills 0.5
- Wellbeing 0.5

As can be seen in the index chart in Figure 13 below, holistically Tampere's native population has been outperforming natives nationally and migrants locally from a holistic perspective. The holistic integration index for migrants in Tampere remained closer to 0 value over the study period and performed at a similar scale as all natives nationally.

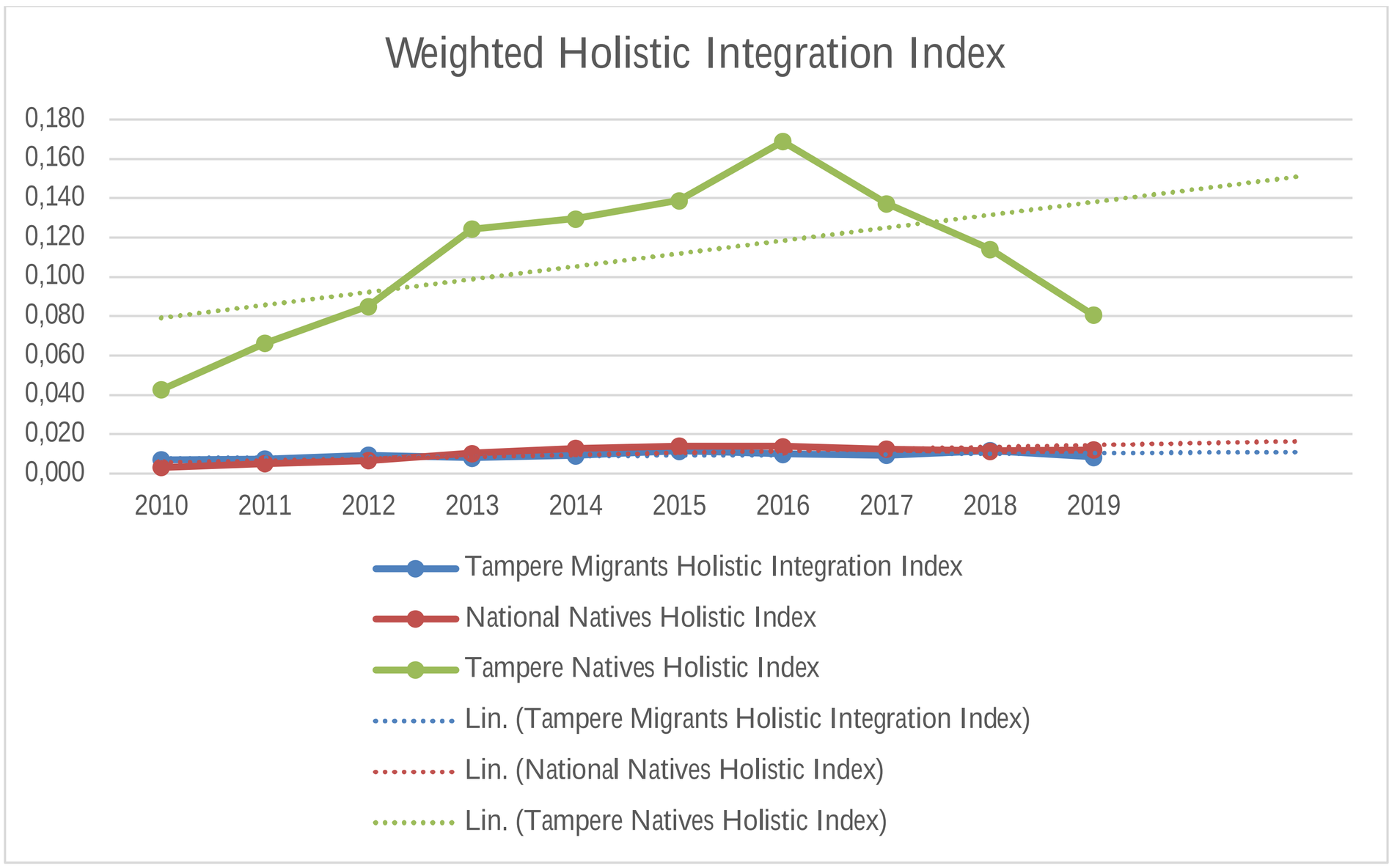


Figure 13:Weighted Holistic Integration Index between -migrants in Tampere (blue), Natives in Tampere (green) and Natives nationally (red)

Holistic integration performance according to the analysis remained largely flat and showed very little positive integration impact in the three dimensions and with little change. The results suggested that holistically, the mechanisms in place to further integration seem to be having minor impact in raising the holistic situation of migrants to the level of native Finns in Tampere. One must, however, bear in mind that these results include all migrants i.e., those who have arrived during the study period and those who possibly have gone through their integration processes already.

The moving average trendline in Figure 14 below also shows a slight rise in national holistic integration impact starting 2016 - 2017 as well as significant gains in Tampere's holistic integration impact beginning in the same period. The results however seem to suggest that the reduction of the gap in this instance can hardly be attributed to improved services holistically for migrants, but rather a holistic decline in the performance rates of Finnish natives in Tampere.

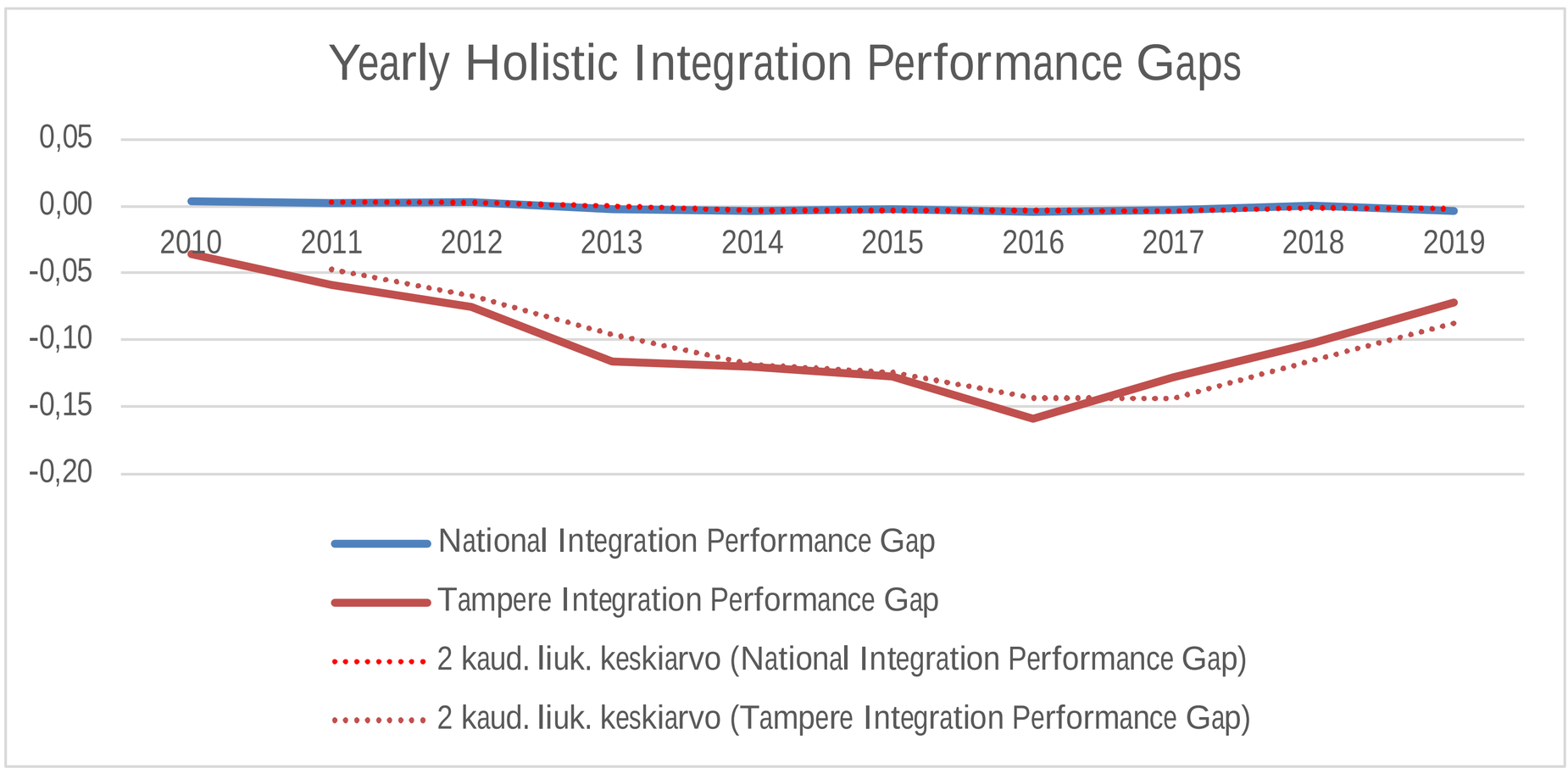


Figure 14:Weighted Holistic Integration Performance Gap

4.3.2 Unweighted

In Figure 15 below, it is clear to see that unweighted holistic integration still shows better performance for Finnish natives in Tampere in comparison to Finnish natives nationally or migrants in Tampere, but the indices are much closer to each other and show a positive linear trend for all groups. This also reflects the importance of employment, holistically, when looking at integration if we compare it to the figures above, the gaps are wide when employment is given more importance.

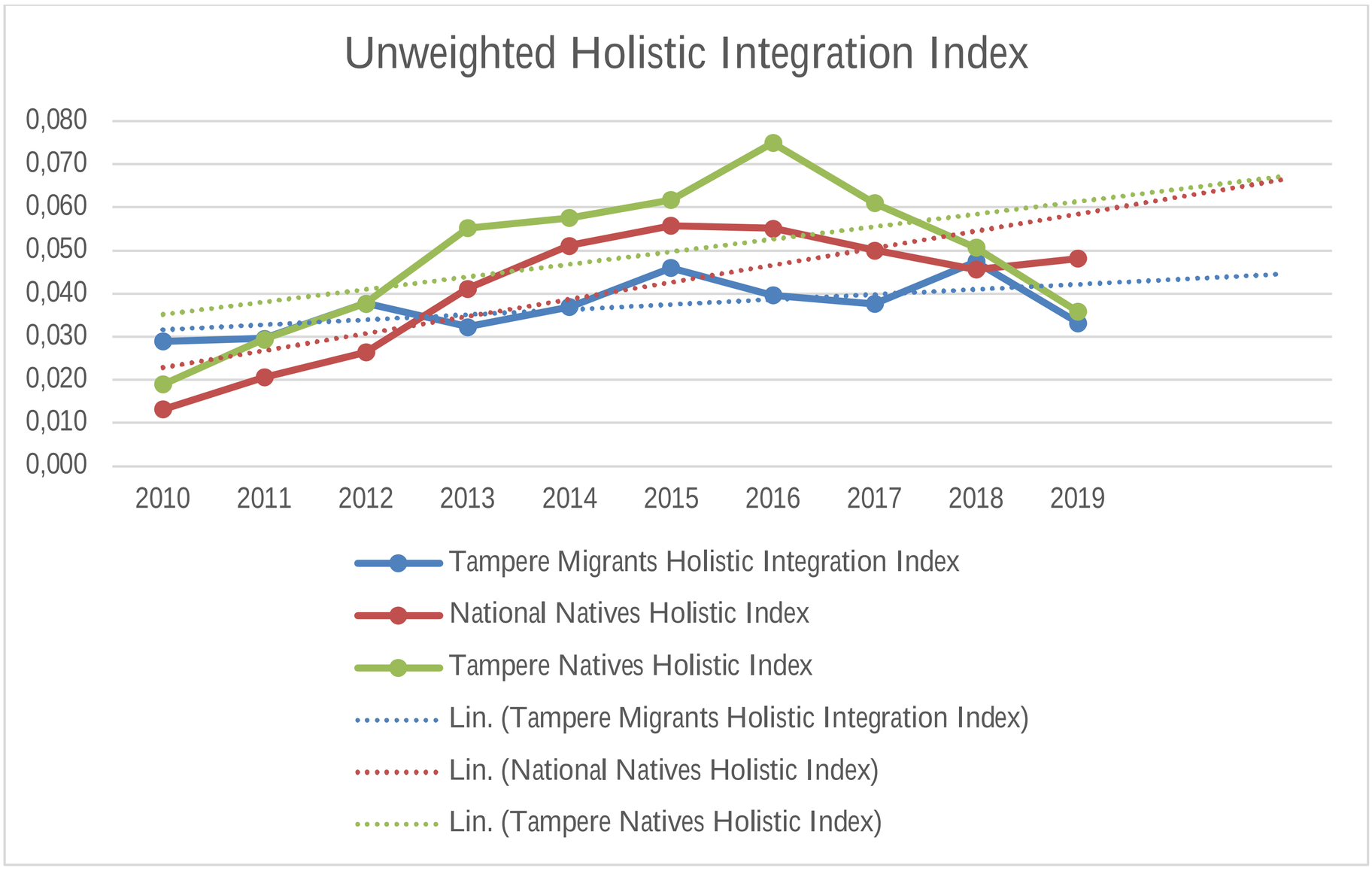


Figure 15:Unweighted Holistic Integration Index migrants in Tampere (blue), Natives in Tampere (green) and Natives nationally (red)

It is also interesting to note that the decline in holistic integration was for both natives and migrants in Tampere in 2018. This common decline is more visible in the unweighted chart than the weighted one. The performance gaps shown in Figure 16 below, however show negative holistic impact since 2012-2013. There has however been a steady rise in impact since 2016 locally but a national dip was experienced in 2019.

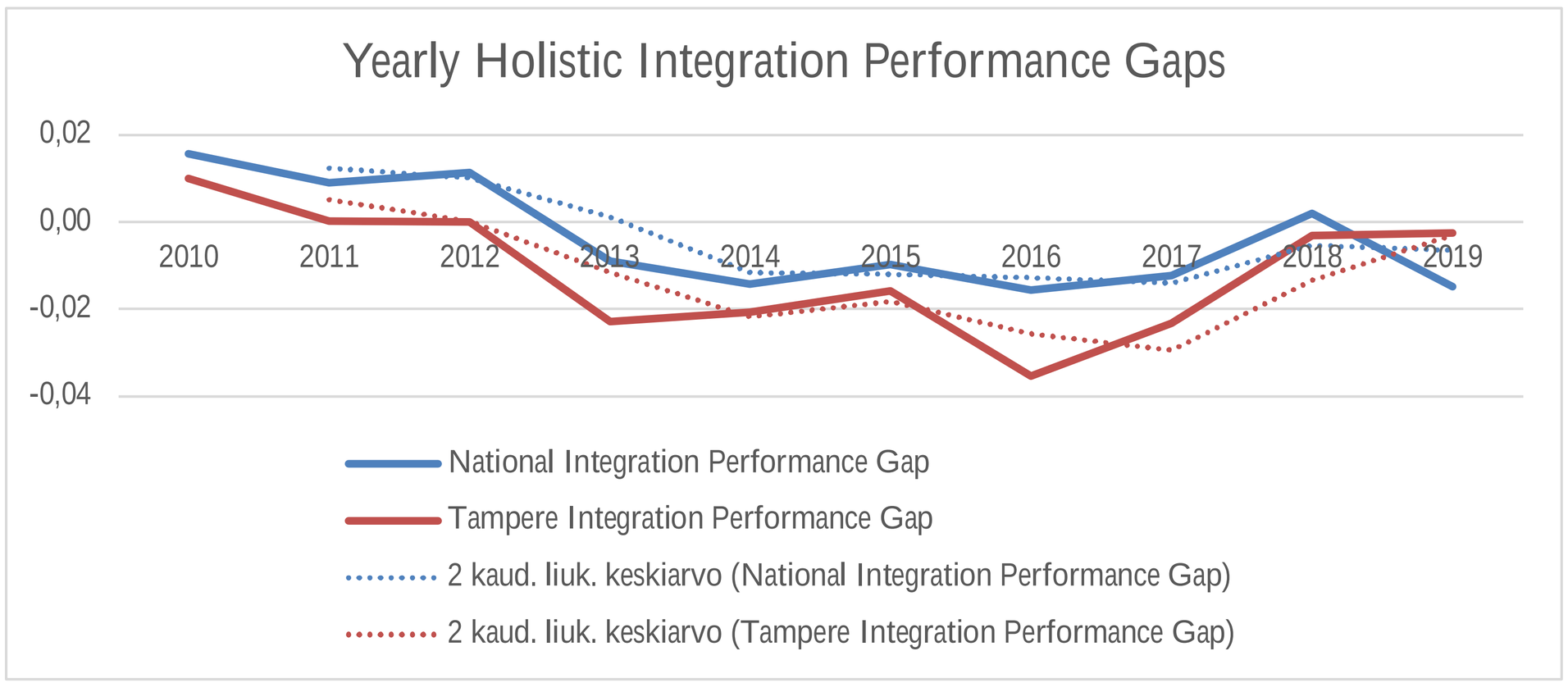
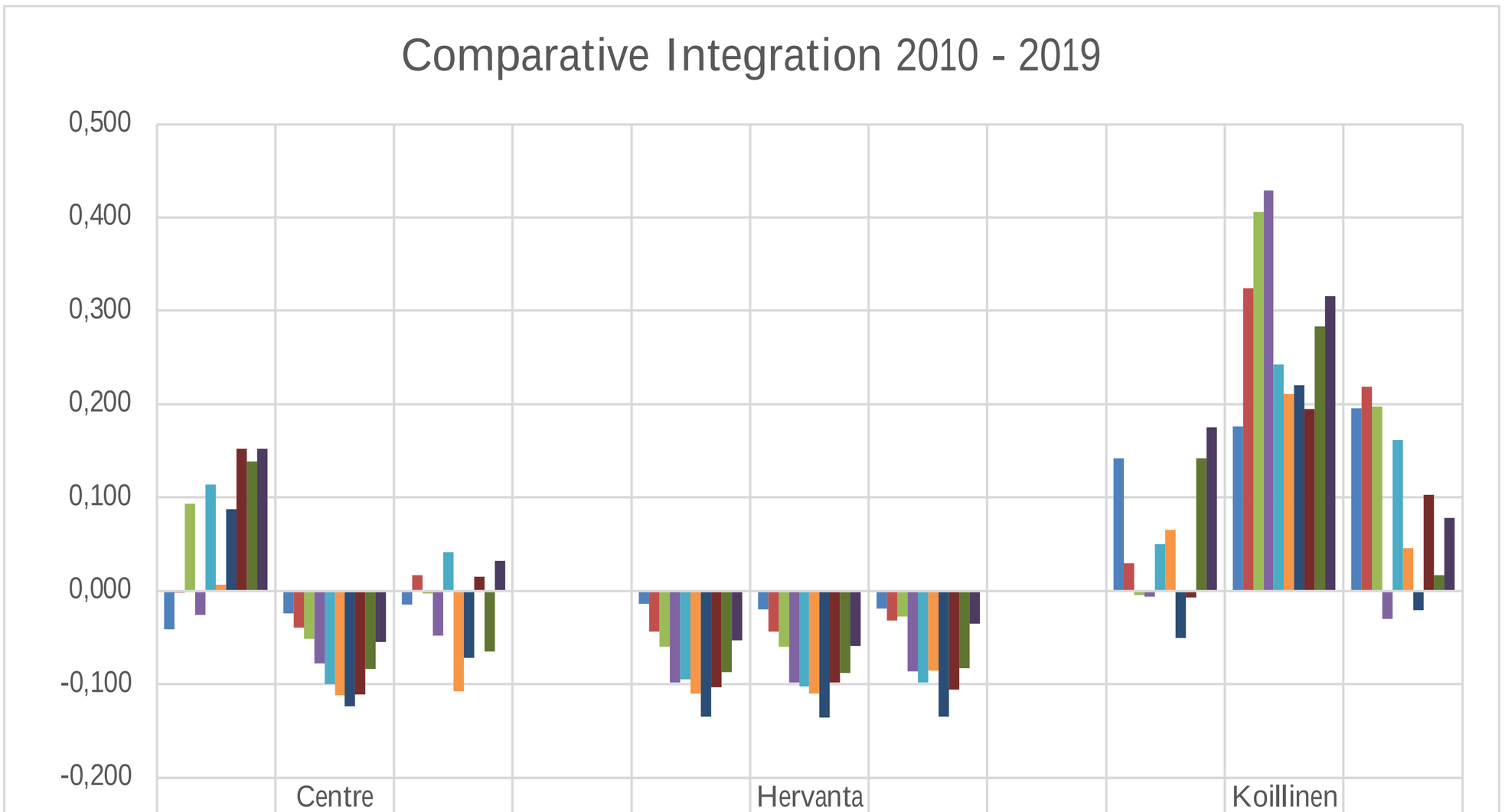


Figure 16:Unweighted Holistic Integration Performance Gap

4.3.3 Comparative Holistic Integration Performance

Using the above calculation method, the data for the selected target groups from Estonia, Iraq and the former Soviet Union living in the City Centre, Koillinen and Hervanta was combined for the time series shown in Figure 17 below.



	Centre Estonia	Centre Former Soviet Union	Centre Iraq		Hervanta Estonia	Hervanta Former Soviet Union	Hervanta Iraq		Koillinen Estonia	Koillinen Former Soviet Union	Koillinen Iraq
2010	-0,041	-0,024	-0,015		-0,014	-0,020	-0,019		0,142	0,175	0,195
2011	-0,002	-0,039	0,016		-0,043	-0,044	-0,032		0,029	0,324	0,218
2012	0,093	-0,051	-0,003		-0,060	-0,060	-0,027		-0,005	0,406	0,197
2013	-0,026	-0,078	-0,048		-0,098	-0,098	-0,086		-0,006	0,428	-0,030
2014	0,114	-0,100	0,041		-0,095	-0,102	-0,099		0,050	0,243	0,161
2015	0,006	-0,112	-0,108		-0,111	-0,110	-0,086		0,065	0,211	0,046
2016	0,088	-0,124	-0,072		-0,135	-0,136	-0,135		-0,051	0,220	-0,021
2017	0,152	-0,111	0,015		-0,103	-0,098	-0,106		-0,007	0,195	0,102
2018	0,139	-0,084	-0,065		-0,088	-0,088	-0,083		0,141	0,283	0,016
2019	0,152	-0,055	0,032		-0,053	-0,059	-0,035		0,175	0,316	0,078

Figure 17 Comparative Integration Performance Gap between Estonians, Iraqis and migrants from the Former Soviet Union living in The City Centre, Hervanta and Koillinen- Time Series 2010 – 2019. n = 90

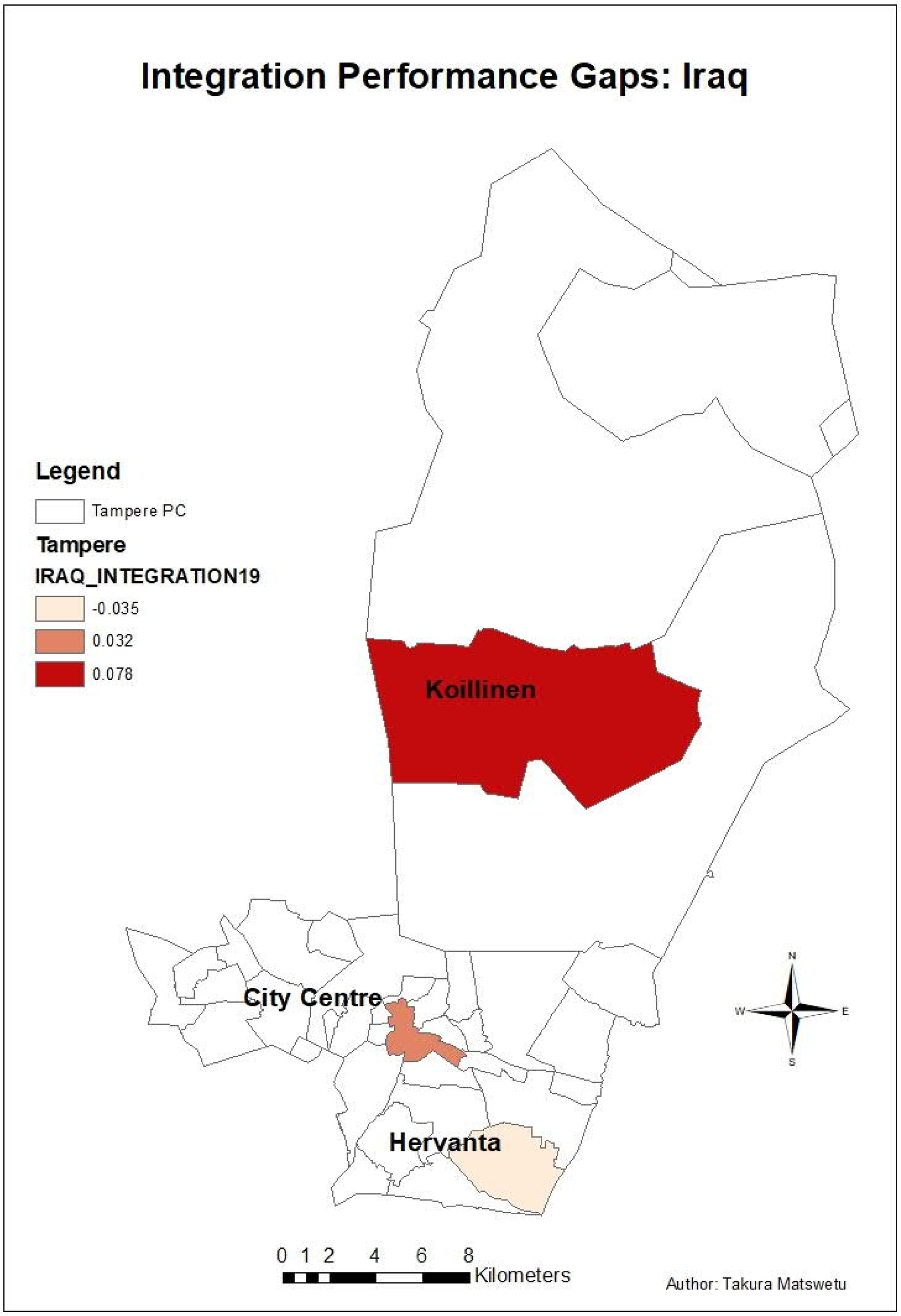


Figure 18: 2019 Integration Performance Gaps for migrants from Iraq

Figure 18 shows the integration performance gaps for migrants from Iraq in Hervanta, City Centre and Koillinen in 2019. Iraqis' integration performance is higher in Koillinen than in the other areas.

Figure 19 below shows the integration performance gaps for migrants from Estonia in Hervanta, City Centre and Koillinen in 2019. Similarly, to Iraqis, integration performance is higher in Koillinen than in the other areas.

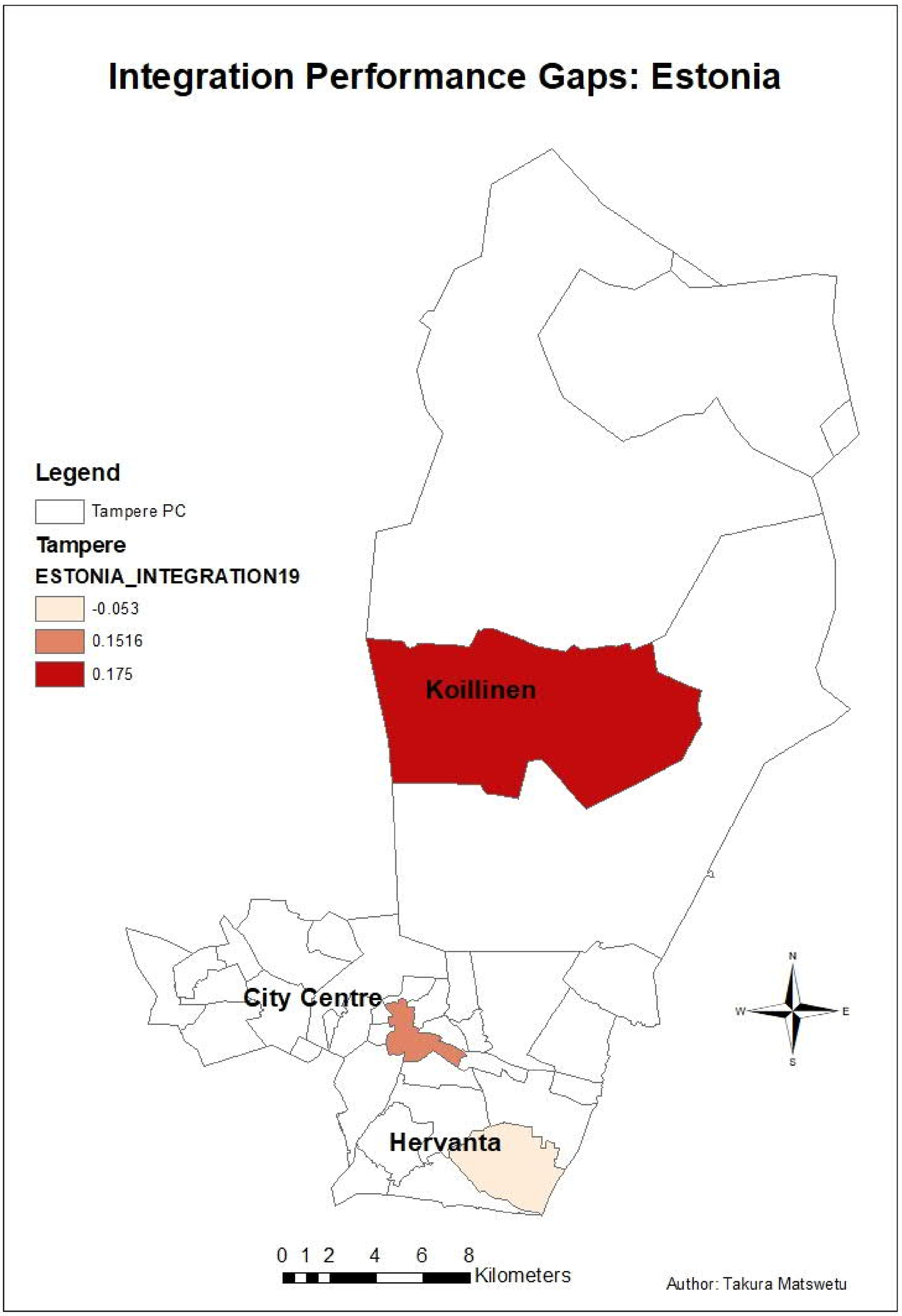


Figure 19: 2019 Integration Performance Gaps for migrants from Estonia

Figure 20 shows the integration performance gaps for migrants from the Former Soviet Union in Hervanta, City Centre and Koillinen in 2019. Integration performance is higher in Koillinen than in the other areas, similarly to migrants from Estonia and Iraq.

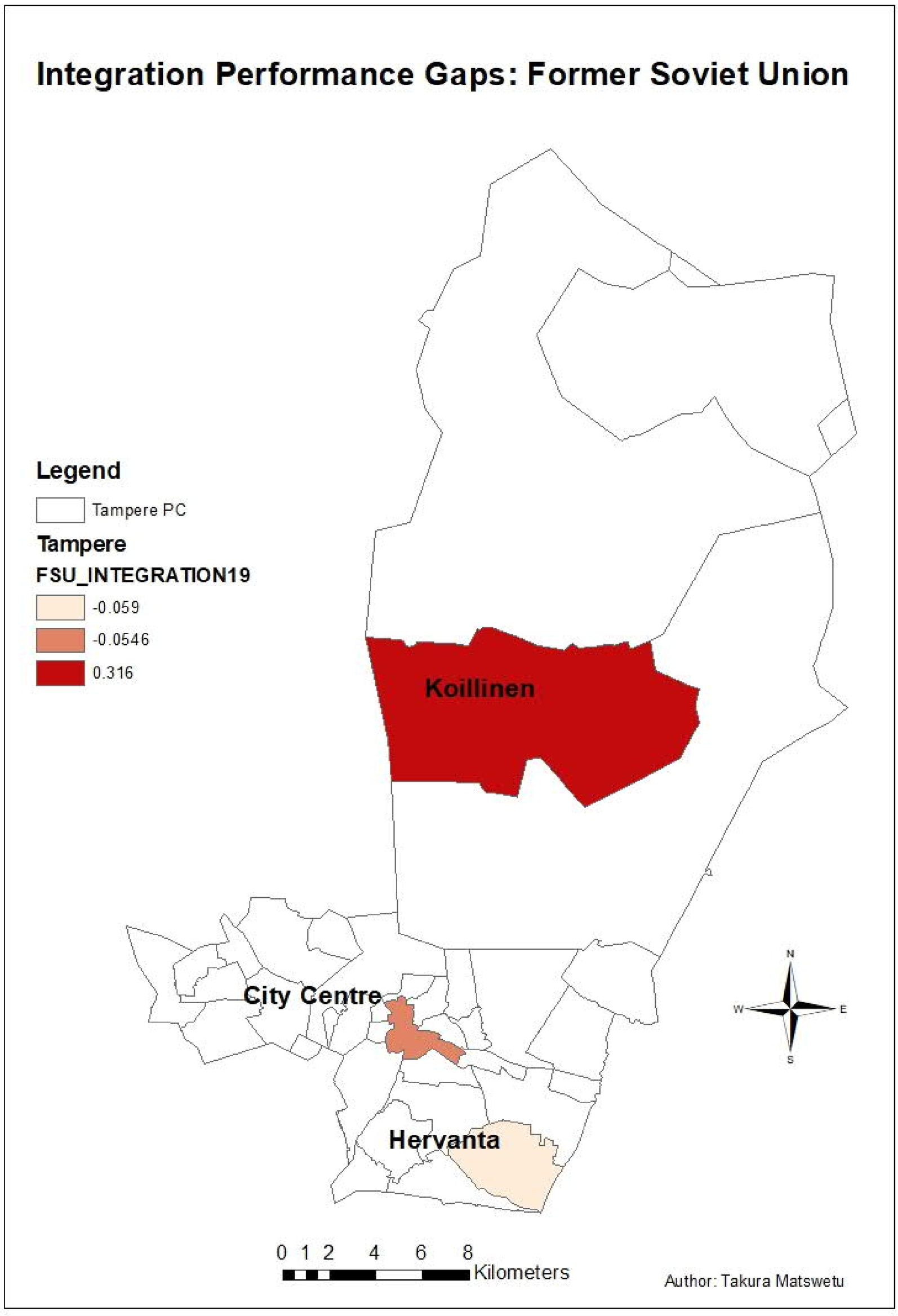


Figure 20: 2019 Integration Performance Gaps for migrants from the Former Soviet Union

In the case study, the post code areas 34240 (Koillinen Service Area), 33720 (Hervanta, Kaakkoinen Service Area) and 33100 (City Centre, Keskustan Service Area) where the areas selected to do comparisons between migrant groups because of their high population and their proximity or distance from the integration services. The groups studied here are the top 3 migrant groups in Tampere, i.e., Estonians, those from the former Soviet Union and Iraqis.

Figures 18, 19 and 20 show that migrants from all three groups that live in Koillinen outperform migrants living in the Center or in Hervanta. Migrants from the former Soviet Union outperform all other migrant groups in the study in Koillinen and those from Estonia outperform all other groups in the Center. Iraqis living in Koillinen have higher integration levels than in Hervanta or the City Centre.

4.4 Accessibility calculations

An analysis was done to find service areas around the locations in the bus route network. The areas were divided into 15-minute segments up to 60 minutes. The time scale in Table 6 below was adopted to define accessibility levels. A threshold value of 30 minutes was adopted according to (Bosanac et al., 1976).

Table 6: Accessibility Standards

Travel Time	Accessibility level
0 - 15 minutes	Good
15 - 30 minutes	Intermediate
> 30 minutes	Bad

The results from the field calculator in ArcMap are shown in Figure 21 below. According to the results traveling from Koillinen to reach integration services with no impediment takes about 33 minutes and to Hervanta about 10 minutes. However, when considering the 13 traffic lights on each route, each with a wait time of 75 seconds and the route from Hervanta has 6 bus stops, whilst the Koillinen route has 18 bus stops these travel times are below actual travel time values. Considering only traffic lights that would mean a more accurate representation of the travel times would be field result + (n Traffic lights x Wait Time 75 seconds) + (n Bus stops x Stop Time of 40 seconds).

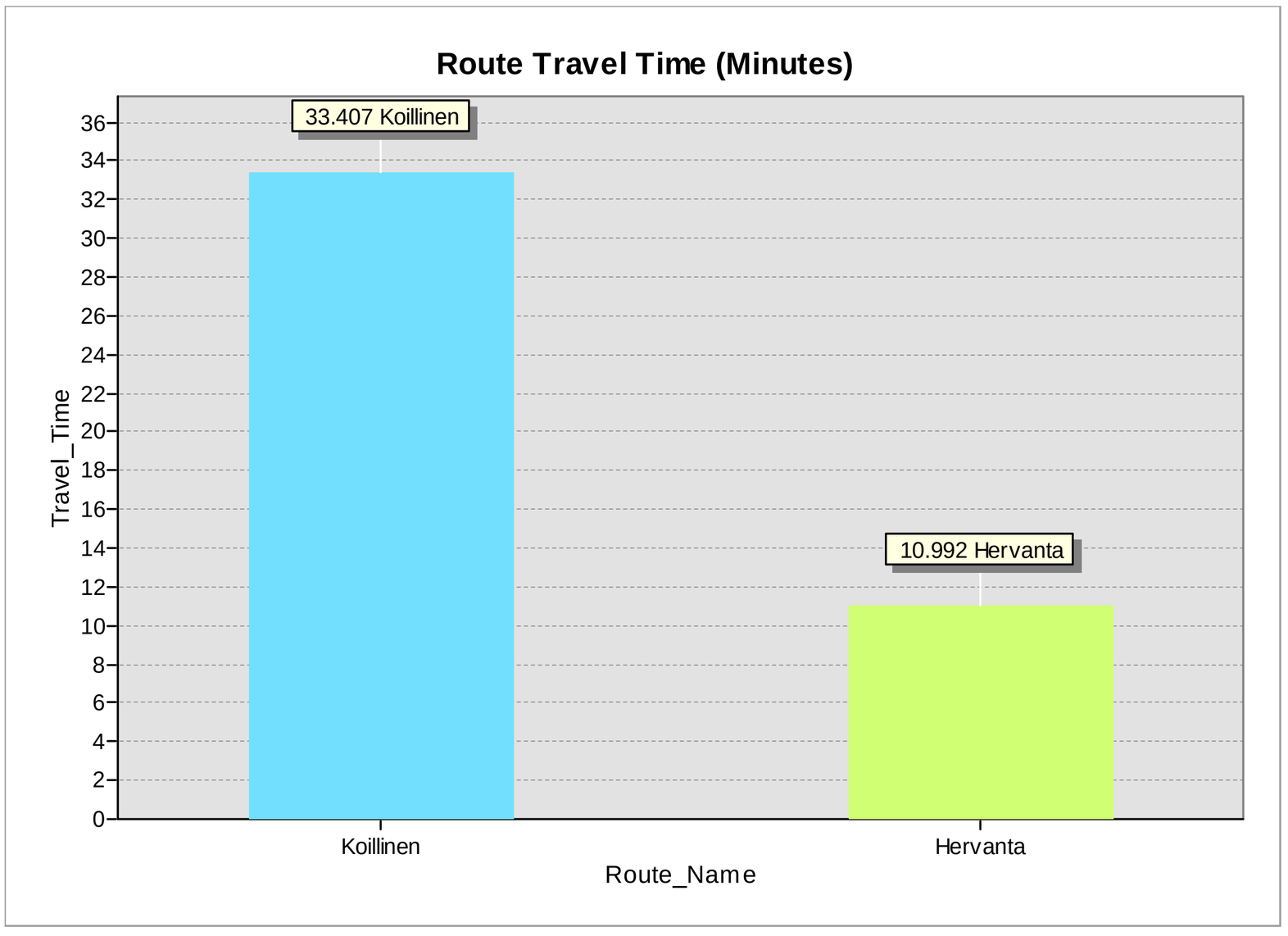


Figure 21: Field Calculator Travel Times (No impediments)

Using the above calculation, the results in Table 7 below were obtained for the two routes. This is assuming that the bus stops at every traffic light and bus stop, which is highly unlikely.

Table 7: Travel times considering impediments.

Route	Field Calculator	Traffic Light Stops (Minutes)	Bus Stops (Minutes)	Total Travel Times (Minutes)
Hervanta	10.9	16.25	4	30.25
Koillinen	33.4	16.25	12	61.65

According to Figure 22 below that shows the service area analysis, people who live in the city center area can reach integration services within around 10 minutes. People living in Hervanta, according to the results, can access integration services within 40 minutes and those living Koillinen must travel over 40 minutes to access integration services.

These results are quite close to the official travel time results from the Tampere Regional Transport Administration website of between 29 to 30 minutes, see Figure 30 in the appendix. The calculation results are however different for Koillinen, as seen in Figure 31 in the appendix, to similar results for the journey search from Koillinen on Tampere's official public transport website Nysse. These results are more in line with the results from the service area analysis in ArcMap shown in Figure 22 below.

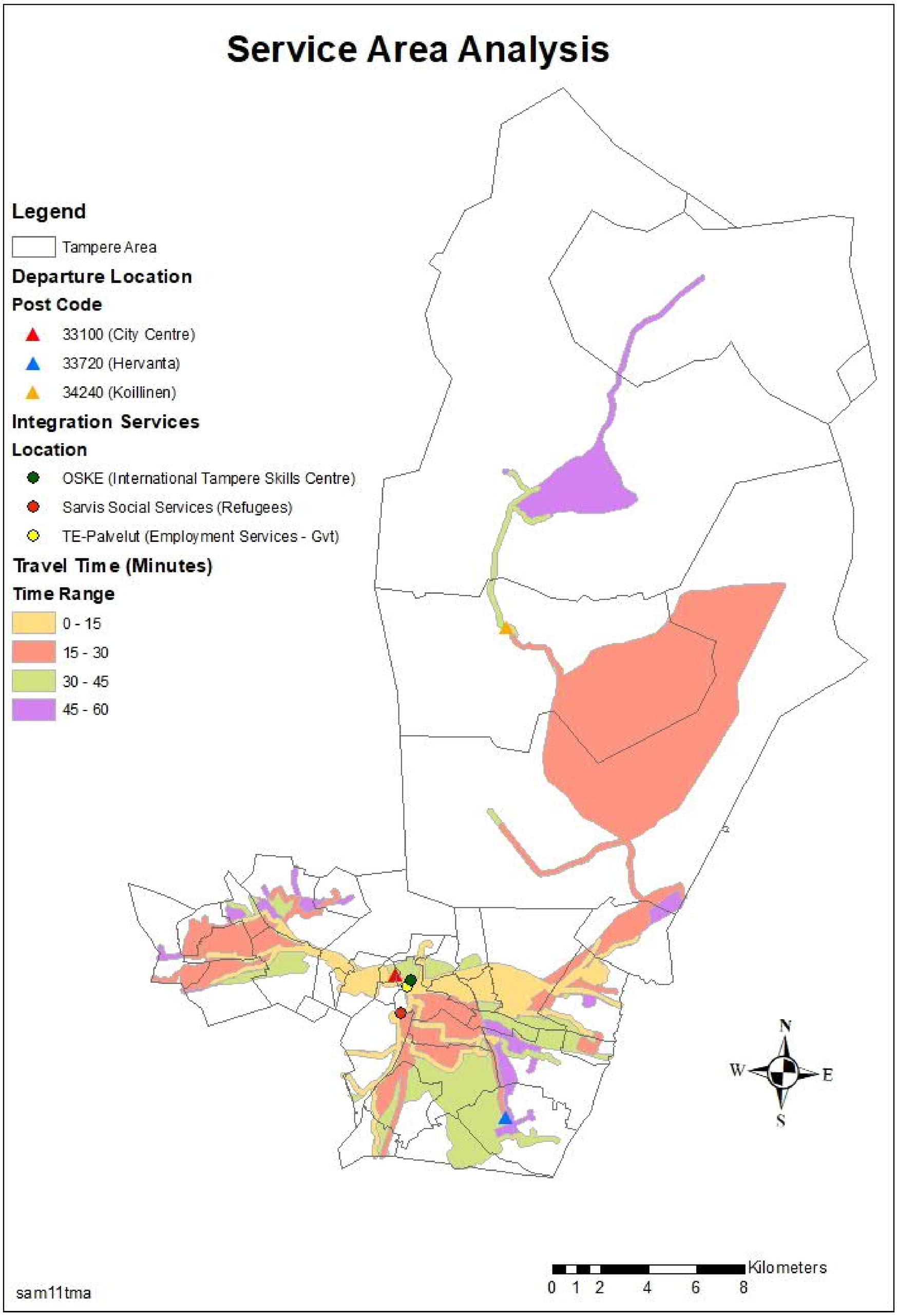


Figure 22: Service Area Analysis - Travel Times

With 29 bus stop departure points and 3 target destinations the OD cost matrix analysis produced 87 lines as output. As can be seen from Table 8 below, most post code areas have good accessibility to the integration service providers. Including all stops, most areas can access integration services in under or around 30 minutes. The furthest of all is Koillinen (34240) whose bad accessibility scores above 40 minutes when calculations for the stops are added to the OD cost matrix results.

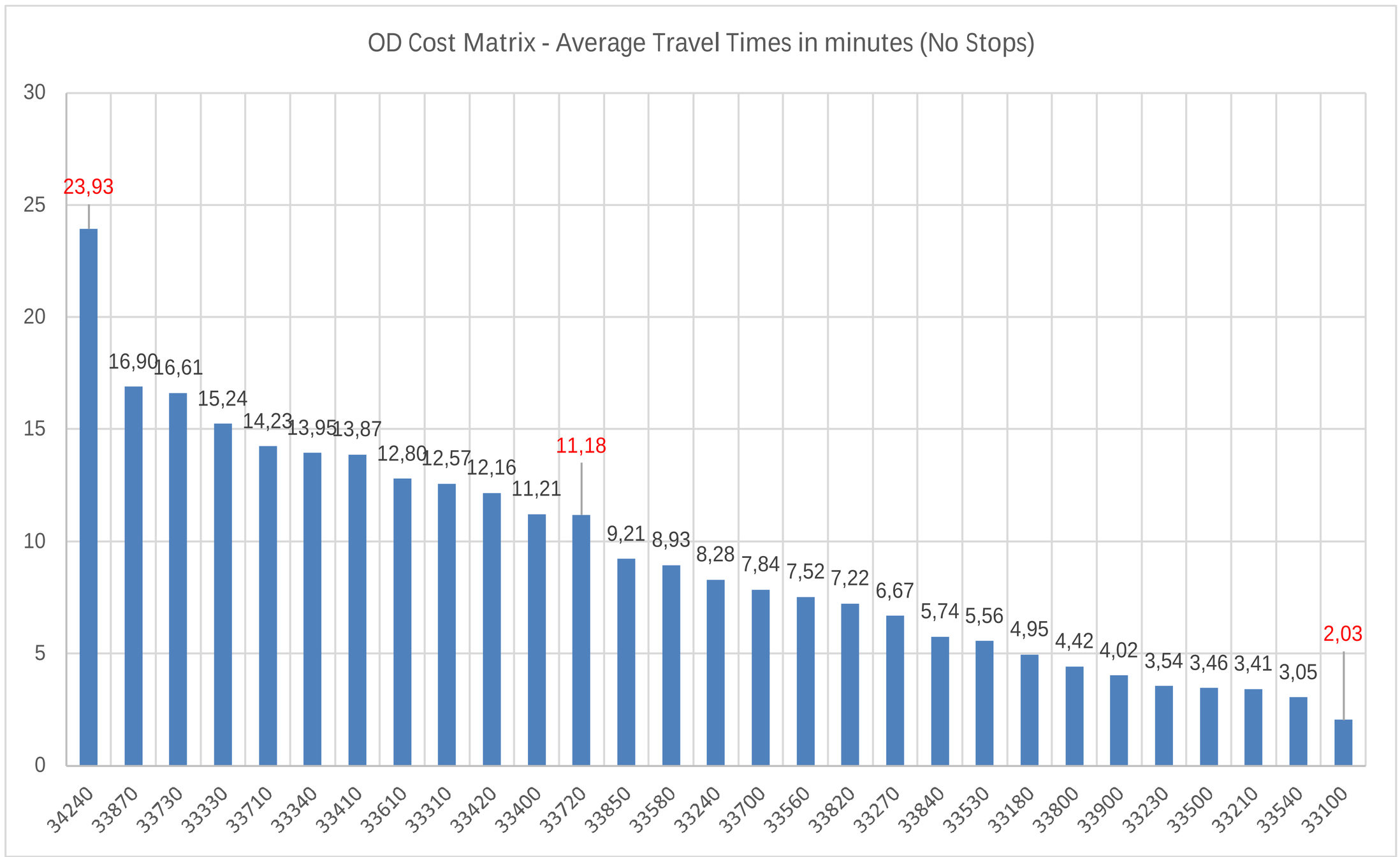


Figure 23: Accessibility to integration services from different post codes in Tampere (OD Cost Matrix Results)

After isolating the three main study areas from Figure 23 above, as seen below in Figure 24, the results from the OD cost matrix analysis with no stops show average travel times about 24 minutes for Koillinen (34240), 11 minutes for Hervanta (33270) and around 2 minutes for the City Centre (33100). Adding the stops calculated in Table 7 above, that would bring travel time from Hervanta to around 32 minutes, and Koillinen to around 52 minutes.

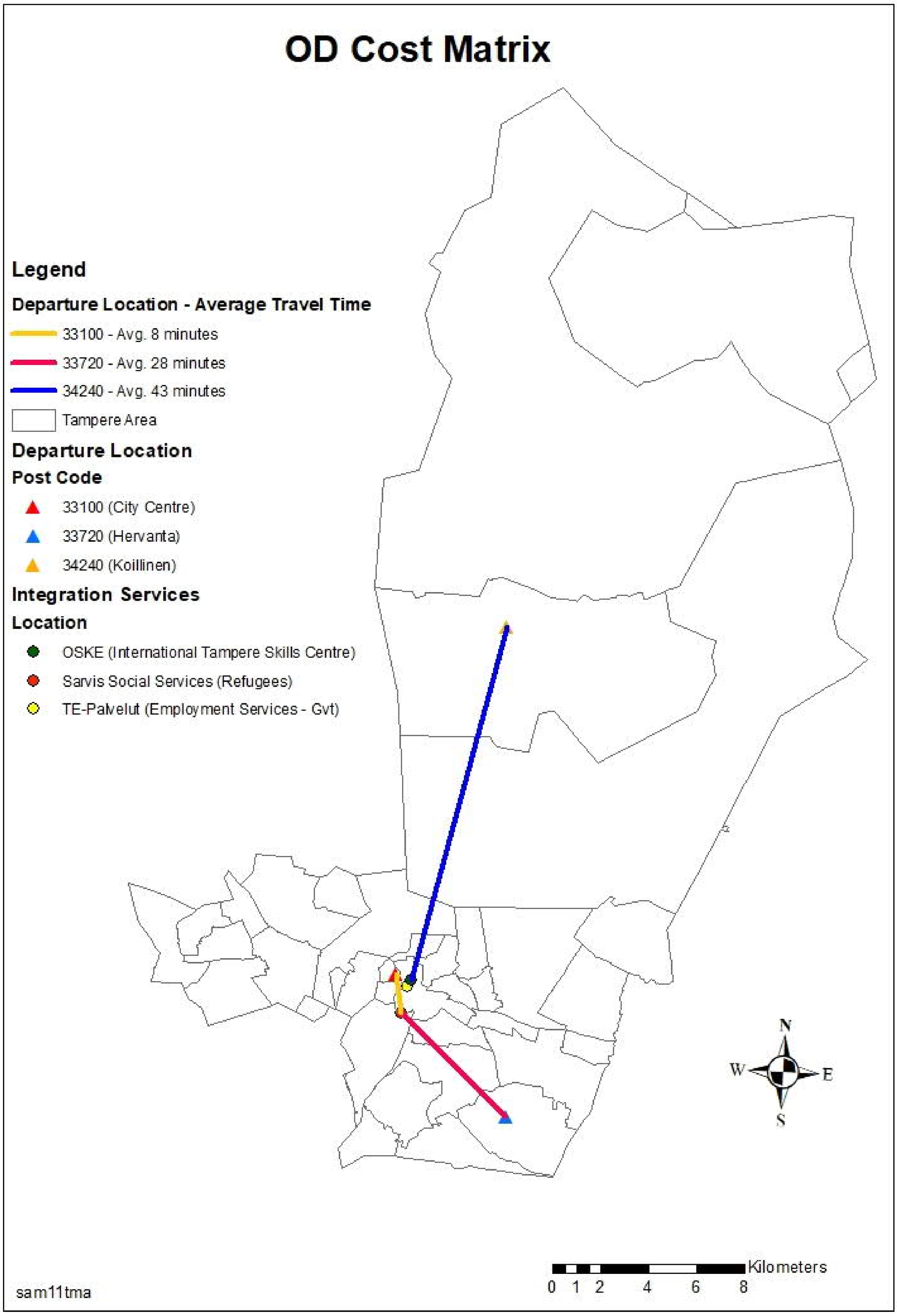
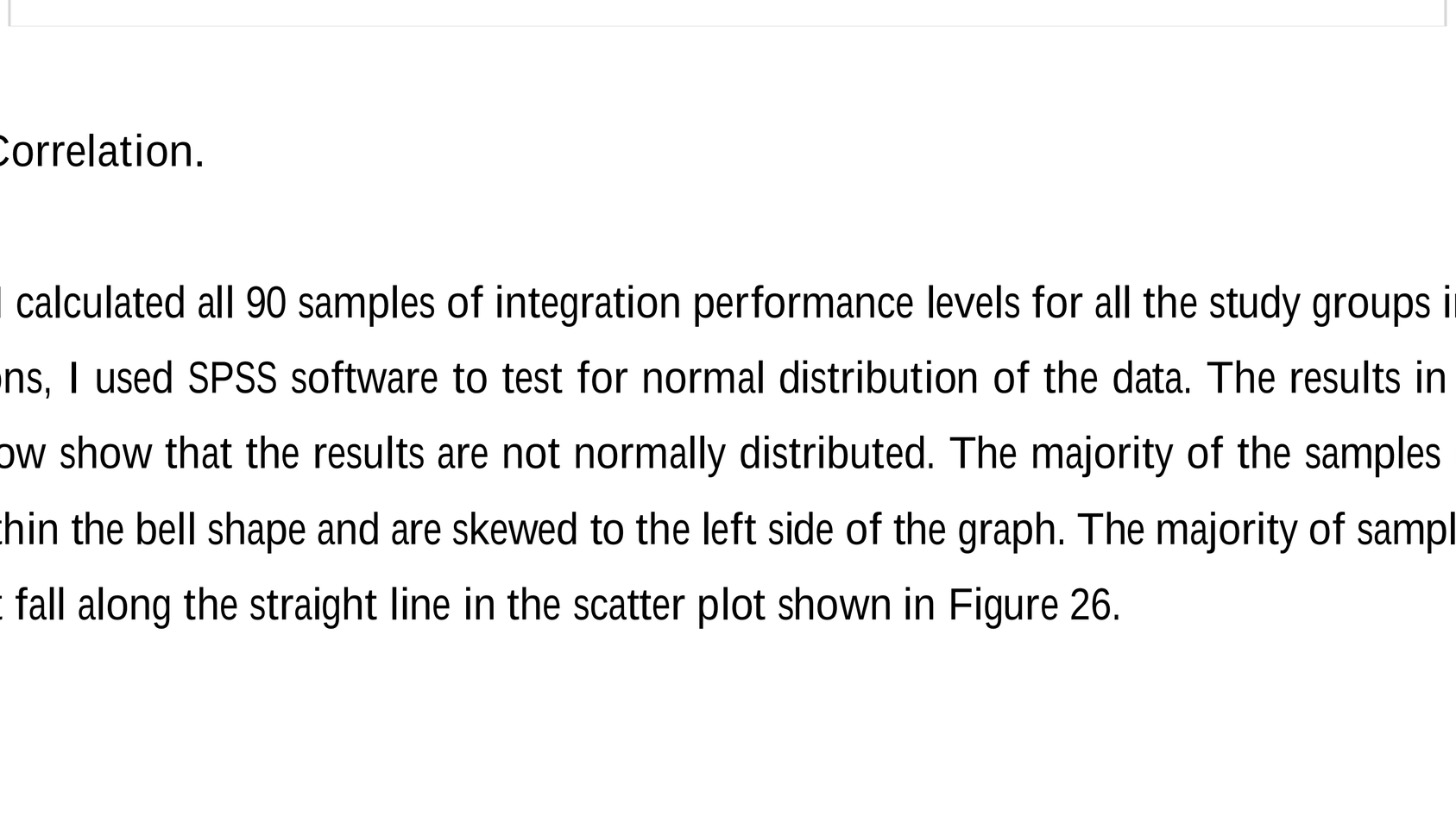


Figure 24: OD Cost Matrix Results (Network Distances) – Travel times in minutes

Similarly, Table 8 below shows that four of the five service areas have good average to intermediate accessibility to integration services and again the furthest Koillinen service area stands out as a remote location.

Table 8:Accessibility to integration services from different service areas in Tampere (OD Cost Matrix Results)



4.4.1 Correlation.

After I calculated all 90 samples of integration performance levels for all the study groups in the 3 locations, I used SPSS software to test for normal distribution of the data. The results in Figure 25 below show that the results are not normally distributed. The majority of the samples do not fall within the bell shape and are skewed to the left side of the graph. The majority of samples also do not fall along the straight line in the scatter plot shown in Figure 26.

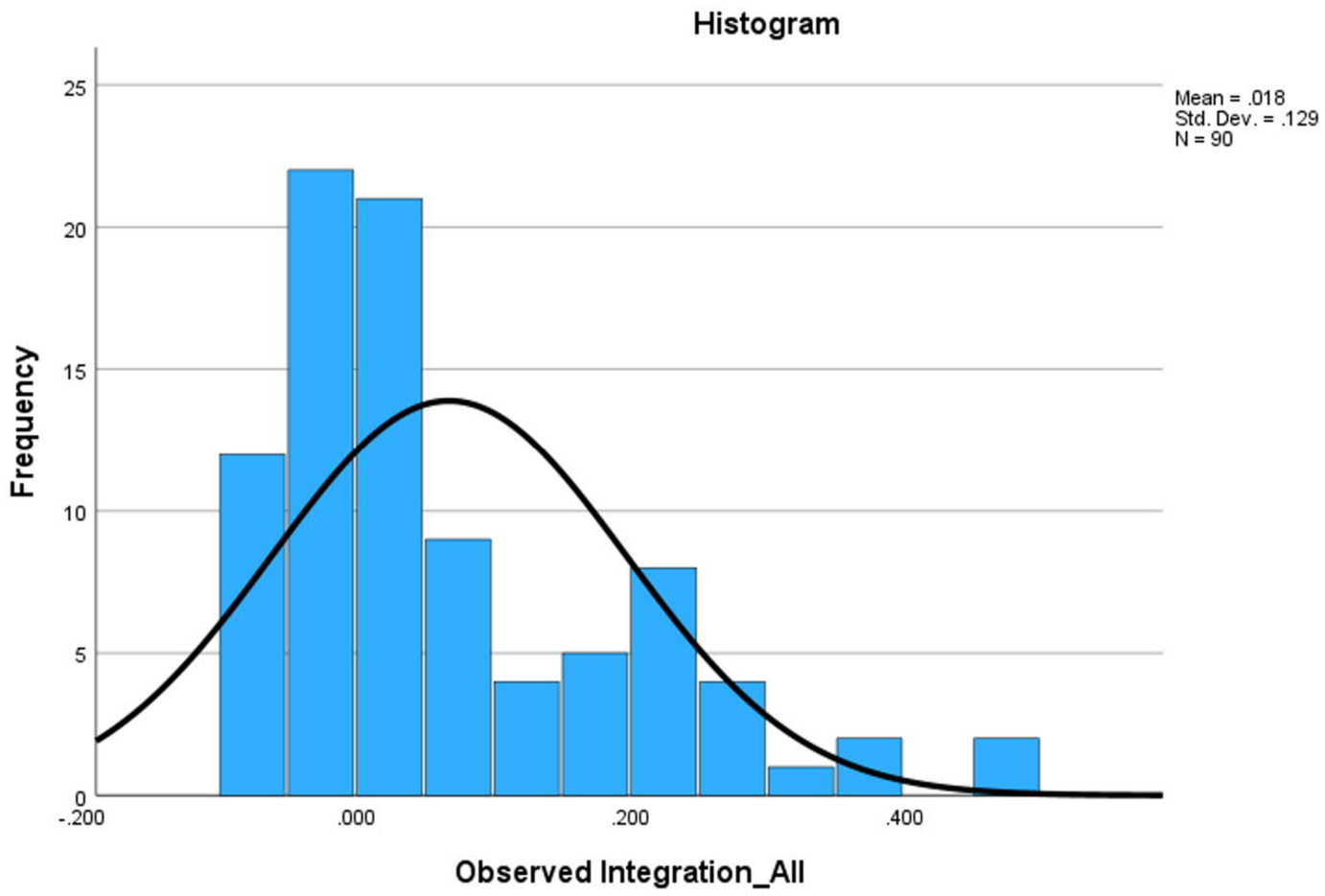


Figure 25: Histogram of calculated integration index samples 2010 -2019

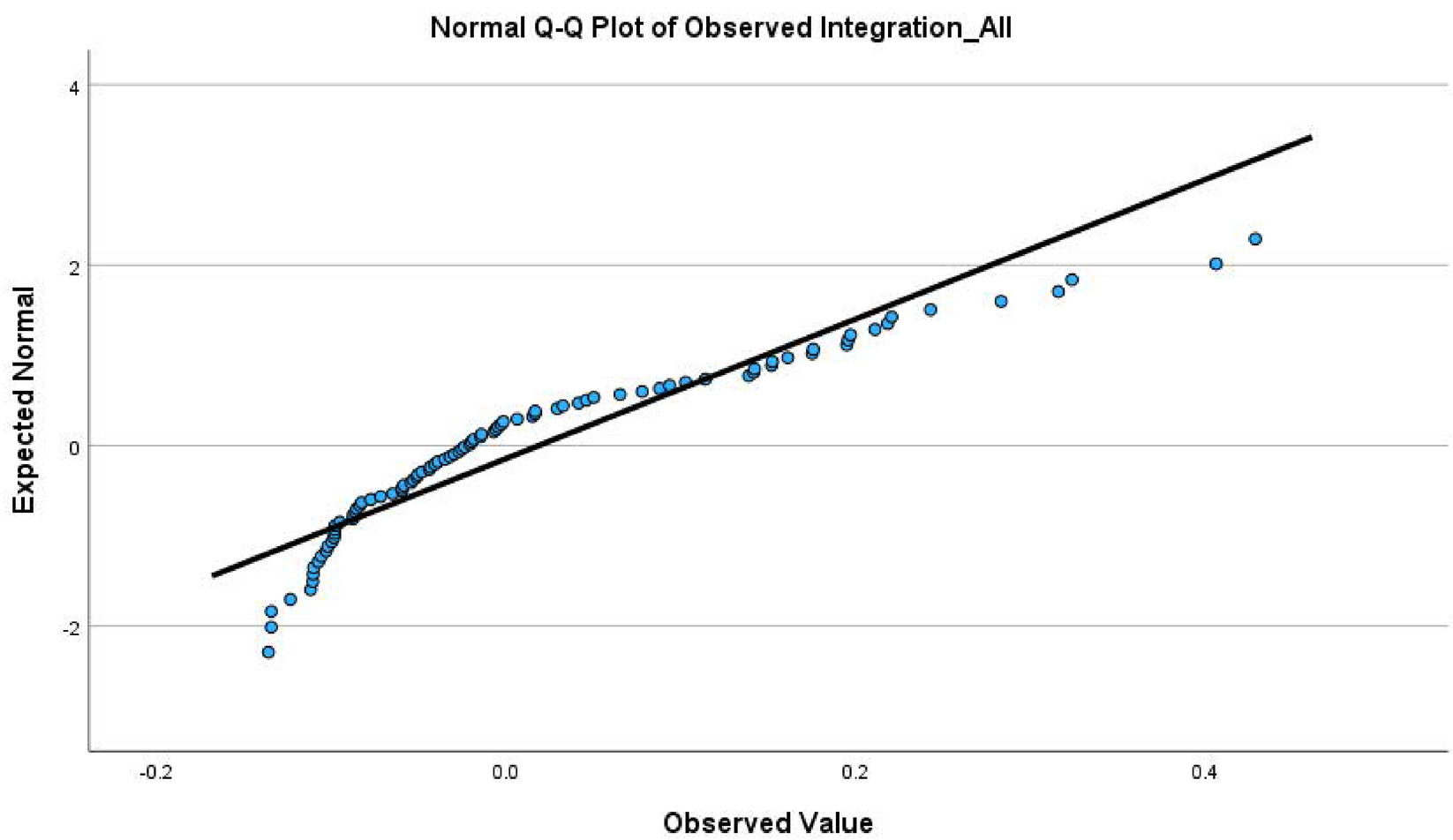


Figure 26: Scatter plot of integration index samples and normal expected index

The sig value of the of the Shapiro-Wilk test in this case is much lower than 0.05 leading to the conclusion, that the data deviates signicantly from a normal destribution as shown in Figure 27 below.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Observed Integration_All	.174	90	<.001	.880	90	<.001

a. Lilliefors Significance Correction

Figure 27: Test results of normal distribution if integration index samples

Since the data is not normally distributed, the test for corellation was done using the Spearmans rank test. I conducted the Spearmans test using the bivariate correlation analysis in SPSS and selected estimate confidence interval, which was estimated using the Fieller, Hartley and Pearson method.

The results in Figure 28 and 29 below show that there is a significant correlation between between time to travel and integration performance. In my two tail test the alternate hypothesis was only that there is a correlation, but I did not specify if the correlation is positive or negative. There is 99% confidence that the correllation did not occur by chance, as shown by the significance level.

Correlations

			Travel_Time	Observed Integration_All
Spearman's rho	Travel_Time	Correlation Coefficient	1.000	.436**
		Sig. (2-tailed)	.	<.001
		N	90	90
	Observed Integration_All	Correlation Coefficient	.436**	1.000
		Sig. (2-tailed)	<.001	.
		N	90	90

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 28: Spearman correlation results between travel time and integration index for all 3 study groups in Hervanta, City Centre and Koillinen 2010 - 2019

There is a correlation of 0.4 between travel time and integration and there is better integration in Koillinen than in other places. This means in this case that we have a positive moderate correlation between distance and integration i.e. the further one has to travel the higher their integration level. Although there were no assumptions when this study began, this was indeed a surprising result. However the travel time itself is not likely the cause of high levels of integration.

Confidence Intervals of Spearman's rho

	Spearman's rho	Significance(2-tailed)	95% Confidence Intervals (2-tailed)[a,b]	
			Lower	Upper
Travel_Time - Observed Integration_All	.436	<.001	.246	.594

a. Estimation is based on Fisher's r-to-z transformation.

b. Estimation of standard error is based on the formula proposed by Fieller, Hartley, and Pearson.

Figure 29: Confidence intervals of the Spearman test

4.4.2 Affected Population.

Public bus routes run through areas with high population densities which facilitates the smooth transit of a greater amount of people to the services that they need. The total population of migrants affected by poor accessibility (more than 30 minutes travel time) in Koillinen stood at 1396 (7% of migrant population or 0.6% of the total population in Tampere) in 2019 and those enjoying good to intermediate (up to 30 minutes travel time) accessibility are over 17000 in total.

Table 9 below shows how the total population of Tampere was affected by different travel times at the time of the completion of the service area study.

Table 9. The percentage of total Tampere population affected by different travel times.

Travel Time	Affected Population
0 - 15 minutes	5%
15 - 30 minutes	14%
30 - 45 Minutes	44%
45 - 60 minutes	37%

Chapter 5: Discussion & Limitations

5.1 Discussion

Holistic Integration & Accessibility

The method used to calculate holistic integration seems to produce a good model to understand how migrants are performing in multiple different spheres through a single value. It allows for correlation analysis to different variables that may affect integration which allows researchers to simplify complex studies to a degree of certainty. However, because the target group was not segmented to show integration levels of migrants shortly after the mandated three-year integration period, the results of the weighted and non-weighted holistic integration is general and broad. It would have also been interesting to see if a segment of migrants who have lived here for longer, e.g., 10 years or so, would have a different integration performance gap. This may have shed some light on the extent to which time has an impact on integration in comparison to accessibility.

The condensation of indicators from the different dimensions into a holistic indicator does, nonetheless, provide important insights on the integration of the migrant population in Tampere, which allows us to deduce group level, data driven, spatial and temporal holistic integration insights that could inform operational and strategic planning and implementation. Supporting migrants into integration using a more holistic approach may produce better results faster, rather than focusing on individual dimensions and not acting on, for example providing access to decent housing and making sure that issues related to mental- and other health and social are addressed. The negative impacts of segregation on the individual and the collective society can manifest in the form of socioeconomic gaps within society that lead to a lack of trust and a feeling of not belonging, which does not support integration (Granvik Saminathen et al., 2021) .

The results show that in 2019 Estonians, Iraqis and migrants from the former Soviet Union had higher integration performance in Koillinen than similar groups in The Centre and in Hervanta. And the highest score in Koillinen of 0.3 by migrants from the Former Soviet Union standing at 0.26 points better than the highest score in Hervanta and 0.15 points better than the highest score in the Centre. This is despite that migrants living in Koillinen travel further to access integration services in comparison to those living in Hervanta and the City Centre. Had, for example, the results shown that those who live further from the services have poorer integration, it would have been a good place to reconsider the distribution of integration services to the areas most affected

by poor accessibility. This was however not the case, suggesting that accessibility to integration services is good in Tampere for all migrants, or there are other factors that play a more central role in the integration of migrants.

Integration should, in my opinion, increasingly be looked at as the holistic act of supporting people to harness their different forms of capital and manage different life events so that they can feel part of and contribute positively to their new host communities, whilst reducing their differences in key performance indicators in comparison to native members of those communities. The issue of reducing differences is often left to the individual and to market forces, but for specific vulnerable groups within migrant and even native populations it may be worth investigating, in future studies, whether equal and not equitable access, will allow host communities to hit strategic development goals for all.

OD Cost matrix

The OD cost matrix settings were largely unaltered. Accumulation was set to travel time in minutes and output shape type was set to straight lines. No U-turns were allowed at junctions.

The post code OD cost matrix produced 87 lines from 29 origins to each of the 3 destinations. The results from the analysis similarly show good accessibility for most areas in Tampere, intermediate accessibility for Hervanta and bad accessibility for Koillinen.

The isolated shape lines showing the three study areas including the calculations for the stops bring the results closer to the travel times from the Tampere Transport administration shown in Figure 22 and 23 above.

Service Area

The service area analysis was broken into time scales of 10 minutes each. Figure 24 above shows that people who live in the city center area can reach integration services within around 10 minutes, which is good accessibility. For those living in Hervanta accessibility is intermediate to poor as they can access integration services within 30 to 40 minutes and those living Koillinen must travel over 40 minutes to access integration services, which is bad accessibility.

Both OD cost matrix and service area analysis results place the furthest area Koillinen as an area with bad accessibility while Hervanta ranges between intermediate and bad accessibility.

Location, travel cost and integration -the connection?

The results of this study show that the large population of migrants living in Hervanta integrate at varying levels, but the 3 groups under this study seem to consistently underperform in integration performance specifically in Hervanta. According to Ziller & Spörlein, (2020) neighborhoods with high levels of ethnic diversity and low socio-economic disadvantages tend to have better integration outcomes, unfortunately Hervanta's migrant residents, according to our statistics, have been plagued by low employment levels of below 50 % (around 21 % for the whole population in comparison) during the 10 years for which data was acquired. In 2020 Hervanta had the least percentage of people with good income 6.6%, almost 35% low-income households, 60% single occupant households, 47% of households with children were considered low income, and 40% of households with children had a single parent (City of Tampere, 2020).

A closer look at the results, however, shows that holistic integration levels have risen steadily in Tampere for all migrants collectively. There have been significant turns in the growth trend over the ten-year period that can be attributed to significant moments such as the rise of food delivery services that hired a lot of migrants in 2015, the effects of the refugee influx from Syria that started, the first Municipal trial in 2017, the educational reform of 2018. According to Geyer et al., (2013), when immigration is handled well, it should supplement the deficiencies in the local labor force and maximize migrant's economic integration into the mainstream economy. This is the goal in Finland as the demand for skilled labor increases, unfortunately since employment levels amongst migrants remain significantly low, we can deduce that Finland is facing some challenges with managing integration successfully.

The study groups perform moderately in the City Centre. Considering that the average integration performance in the City Centre for all 3 groups over the 10-year period was -0.01, -0.08 in Hervanta and, 0.03 in Koillinen, it does not immediately show the connection between level of integration and the cost of accessing them. The results of the service area analysis show in this case that there is a significant moderate relationship between living further from integration services and one's level of integration and general integration gap. The results of this study show that easier accessibility does not necessarily mean better integration levels per se. Instead, holistic, data driven,

human centric and multi-actor solutions need to be investigated to avoid the loss of trust in institutions, to increase safety, a sense of belonging and to develop conducive environments for migrant integration.

This GIS and data-driven example provides an insight into how a holistic approach to investigating possible grounds for a decision of whether investing in placing a particular service at a particular location, could have the desired outcome in the target group. Assuming that in this case the idea was to place integration services closer to migrants expecting improved integration levels, then the results of this study would show that only making the travel distance shorter would not be in itself be sufficient to improve migrant integration levels in Tampere.

5.2 Limitations

Factors affecting integration.

Integration is a process affected by multiple factors and occurs in different contexts at different phases in a migrant's life. According to Solano et al., (2022) integration is first a practical and tangible action for a migrant to secure a livelihood. This includes registering in the new community, accessing healthcare, and finding work. In their article Farrington & Farrington, (2005) point out that accessibility relates to the capacity to "engage with a reasonable range of activities…" (p. 5), pointing out that such reasonableness is relative to the community in question. In this case we are talking about the accessibility of the core services that are essential to the integration process. Although there are multiple other services that support integration, only designated actors can initiate the right to access integration services in Finland depending on the migrant's residence status. Integration can be understood as a tool to further social inclusion and should therefore be considered in accessibility auditing and planning.

The second part of integration is about the attitudes and perceptions of migrants and the receiving societies, particularly perceived and self-perceived belonging, and acceptance. As listed in the dimensions, the main factors affecting holistic integration in Finland include work, education and skills, wellbeing, participation as well as two-way integration which is mainly about self-perceived inclusion and acceptance according to the indicators. However, I found that these dimensions and their data is not collected uniformly nor are they published at similar intervals. This, as well as the feedback from the interviewees, is what motivated the limitation to three dimensions i.e., work, education, and wellbeing.

This limitation is also what informed the choice of services, limiting them to the organizers of integration services rather than the service providers themselves. The accessibility of education, healthcare and job locations could not be taken into this study because I found that access to them is not strictly limited to a specific population from a particular area. Whereas the selected services are the only ones in the whole of Tampere meant to service all migrants.

I found that public transport in Tampere does not hinder accessibility to integration services as the vast majority of the migrant population can access these primary integration services points within a good to intermediate time. Regardless of this good accessibility, the results show that migrants living further from the services experience more positive integration impact compared to those living closer to the services.

This suggests, in this case, that the low cost of physical accessibility of services, in itself, may not be the primary driver of positive integration impact and that there are other mechanisms at play that may have more of an impact. Weiner, (1996) lists these mechanisms as,

1. The willingness of the society to absorb immigrants.
2. The commitment of immigrants to their new society.
3. The structure of the labour market.

The results could also suggest that with time and as migrants experience more positive integration effects, they move closer into the city where the property prices are higher or further out to less densely populated areas where there are more family homes and bigger yards at decent prices. This has been described as spatial redistribution into non-traditional areas of first settlement that with time reduces the spatial segregation between migrants and the native population (Bocskor et al., 2017).

Interviews

The experts in strategic planning and provision of integration services provided good information to lead this study. The experts represented different municipal, government and third sector actors as well as a researcher. The questions presented were mainly directed to the strategical aspect of data use in service planning since during data collection Tampere was going through the Municipal

Employment Trials and integration service provision was transferred to the central management of the city of Tampere on behalf of smaller municipalities in the Pirkanmaa region.

As the accessibility of services came to the forefront, also due to Covid-19, the focus shifted towards virtual service provision and digital tools. It would have enriched the process even more had there been more access to commentary and input from the experts doing customer service as well as more responses from the target group. Especially the input of the target group in expressing their interpretation of good accessibility and sense of belonging. Unfortunately, the number of the respondents from the target group was not representative and could not be reliably used for the study.

Spatial Data

Although there is a broad database of spatial data in Finland, the ease of access to download up to date data is still quite low. Some of the administrative boundaries used by the City of Tampere do not match those that are publicly held in public government or opensource spatial databases. This meant that some of the boundaries had to be edited and reprojected otherwise some results, such as population distribution in services areas, might have produced some errors.

Ideally the study would have been enriched if the population of migrants in other areas would have allowed for the analysis to be done in more than these three areas. This also limited the number of samples taken from areas that are far, and also those that are near. This could have allowed for the study to gain more insights on the impact of distance on integration in the correlation analysis as well.

Travel Times

This study assumes that buses always travel at the speed limit of the road segment and never faster than the designated maximum speed for buses i.e., 80km/hr. Times for stops at traffic lights as well as bus stops were added for each departure location. These times were then compared to official bus timetables and google maps and they differed between produced results by a few minutes in some cases and this can be attributed to that the number of actual stops depends on the state of each traffic light as the bus moves or the need for customers to climb off or get on the bus.

It is also important to note, that the accessibility study in comparison to integration levels does not consider whether people that have achieved high or low integration levels may have moved between locations closer to integration services and those further away after the initial integration services period of 3 years. Therefore, their location at the time of the study might not be the original location from where they accessed integration services to begin with. Thus, it assumes that the study group has been statically located during the whole study period.

Integration Data

The unavailability of data around participation and two-way meant this study could not achieve a truly holistic indicator reflecting all five dimensions of integration. This was due to the fact that data collection is done by different organizations and its collection schedule or format is not standardized.

The indicator data that was received for the study did not match exactly the lists of the indicators defined at the national level. The data that was made available was what had been available for publishing at the time and therefore this study's complete initial data request was unsatisfied. A similar study done with the full set of indicators may produce varying integration levels.

Chapter 6: Conclusion

In conclusion, the study successfully shows that integration indicator data can be used to develop a holistic integration index that can inform gap indexes to show holistic comparative performance between migrants and native populations at different locations. The study has shown that the holistic integration growth trends for Tampere over the study period have remained relatively low, though the trend points to growth. Some groups are collectively performing well in particular locations, in relation to the native population in some indicators. Migrants are however not a homogenic monolith even as groups from similar home countries. Migrants may share traits based on, for example, education systems from home, that may affect their starting points to integration in Finland and ultimately may have a more causal effect on their integration outcomes.

The cost to access integration services from most postcode areas remains good to intermediate for most of Tampere. The availability of public transport in the central areas is also good and has been recently subsidized with a network of trams servicing the most populous areas. This network is also being expanded whilst satellite areas are being connected through the railroad network.

There aren't many barriers limiting the physical accessibility of integration services for migrants, besides the ban on non-essential travel that had been put in place during the Covid-19 pandemic and that have now been removed. Most limiting factors to integration services are systemic and legal rather than physical. All integration services are open during office hours and service requests can be made through multiple communication channels. Affordability is not in itself a factor as Tampere's regional public transport services are not priced beyond reach for low-income individuals.

Considering that most migrants in Tampere have good to intermediate access to integration services and physical accessibility to integration services is not a challenge for most of the migrant population, the low integration results suggest, as pointed out above, that other factors such as personal circumstances, motivation, learning capabilities, education, the receptiveness of the host community and the quality of its integration services play, in this case, a big role as well. Since the cost of accessing integration services from Hervanta is intermediate but integration levels are poor, while on the other hand, the cost of accessing integration services from Koillinen is poor but the integration levels are better, the relationship between physical accessibility and holistic integration does not seem to be causal.

The low levels of integration, especially in Hervanta, reflect the beginnings of a similar trend as in Malmö's Rosengård in Sweden. There is residential segregation, and the indicators show poorer integration to the local population in comparison to the other locations. Hervanta is in the group of neighborhoods that has a high number of low-income individuals, high unemployment rates and high single parent households whilst also having the highest population of migrants *(see supporting information in appendix)*.

Cities moving towards data driven decision making should increasingly include inclusion, integration, and migration in their strategies. The methods used in this study to use integration data to understand spatial and temporal integration levels, performance in different integration dimensions and the comparison to the local population can be adopted to assist cities in "planning for pluralism" and cross sectoral collaboration (Heino & Jauhiainen, 2020). To come closer to these targets there must be the development of frameworks and practices to standardize data collection, analysis and reporting as well as the development of smarter integration management systems that incorporate modern technologies such as artificial intelligence to assist in handling the data, service matching and geographic information systems to aid in location-based recommendations, data processing and visualizing spatial data related to integration.

Much like Guagliardo (2004) points out the field of spatial accessibility advances when we begin to understand how spatial accessibility impacts the phenomenon under study, in this case integration. GIS software can be used to study physical accessibility to integration services but, to realize the full power of this technology in studies like these, it is important to have access to steady stream of reliable local data about the study groups and to turn qualitative data representing their experiences of spheres of daily life events that also contribute to individuals' and group integration such as personal experiences of the communities' receptiveness or the impacts of specific life events such as illness or divorce on their integration into quantitative data.

Ultimately, the study shows an example of how integration and access to services can be studied using a geographic information systems and data driven approach. It is a step towards modelling quantitative methods to plan for spatially related decision-making in migrant integration services. This kind of study can be used to investigate not only if placing a service at a particular distance will have an impact on the desired result, but also to study what the content of the service should be, considering the target group.

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Appendix

Indicator Descriptions

Dimension	Indicator	Description (https://kototietokanta.stat.fi/
Employment	A1 Employment rate	Ratio of employed persons aged 18 to 64 (%) to the population of the same age.
	A2 Unemployment rate	Ratio of unemployed persons aged 18 to 64 (%) to the labour force of the same age
	A3 Proportion of the long-term unemployed	Persons who have been unemployed for at least one year (continuous unemployment has lasted for at least one year) and whose main type of activity during the statistical year has been unemployment, share (%) of all the unemployed.
	A4 Labor force participation rate	The ratio of persons aged 18-64 belonging to the labour force (employed + unemployed) to the population of the same age.
	A5 Share of entrepreneurs in employment	Share of persons with the occupational status of entrepreneur (%) of the employed.
	A6 Share of public sector employees of those in employment	Share (%) of employed in the municipal or central government sector of all employed persons. State majority-owned listed companies are not included in the public sector.
	A7 Proportion of part-time employees	(%) Employees whose employment contract-based regular weekly working hours is below 90% of the typical contract-based regular weekly working hours.
	A8 Proportion of employees in fixed-term work	(%) Employees whose employment contract has a predetermined termination date.
Education and Skills	B1 No post-primary qualification or place of study	Percentage of individuals who do not have a degree beyond basic level or a study place, compared to the same age population.
	B2 Completion rate of secondary education: Proportion of those who have completed vocational studies	The proportion (%) of people in the population who have completed an education leading to a vocational qualification. This includes all those who have completed a degree, regardless of whether it is the person's highest degree.
	B2 Completion rate of secondary education: Proportion of high school graduates	The proportion (%) of people in the population who have completed an education leading to a high school degree. This includes all those who have completed a degree, regardless of whether it is the person's highest degree.
	B3 Proportion of graduates with a tertiary degree	The proportion (%) of 25–64-year-olds who have completed a higher education degree compared to the corresponding aged population with a post-basic level degree. Post-basic level degrees include secondary level, specialist vocational training level, and higher education degrees. Higher education degrees include the lowest level of higher education, lower university level, upper university level, and research training level degrees.
	B4 Highest level completed: primary or unknown	The proportion (%) of people without a post-basic level degree in the corresponding age population.
	B4 Highest level: second degree or special vocational education	The proportion (%) of those who have completed at most a secondary degree or a specialist vocational degree compared to the corresponding age population. Secondary degrees include matriculation examinations, vocational basic degrees, and professional degrees.
	B4 Highest completed degree: higher degree	The proportion (%) of those who have completed a higher education degree in the corresponding age population. Higher education degrees include the lowest level of higher education, lower university level, upper university level, and research training level degrees.
	B5 Proportion of NEET youth	The proportion (%) of people who are not primarily employed, students, or conscripts in the corresponding age population. In addition, women with children under 7 years of age (= assumed housewives) are excluded from the NEET youth.

Wellbeing	C1 Premature mortality	The number of life years lost in the population due to deaths before the age of 80 per 100,000 inhabitants. NOTE: Due to the small number of deaths among people of foreign background, there is significant annual random variation in the figures. Information is not produced by postal code area and background country-specific information is only at the municipal level.
	C2 Proportion of disability pensioners	The proportion (%) of individuals aged 18-64 whose main activity is pensioner and whose pension type is marked as disability pension, of the corresponding age group population
	C3 Disposable income of the adult population: Average	Calculated from the disposable cash income of the population aged 18 and over: wage income + entrepreneurial income + property income + received transfers - paid transfers. Paid transfers mainly consist of direct taxes and social security contributions. The data is presented in the currency value of the statistical year
	C3 Disposable income of the adult population: Median	Median income is obtained when the population aged 18 and over is arranged in order of available cash income. The median income is the income of the middle-income earner. There are equal numbers of income recipients on both sides of the middle-income earner.
	C4 Wage and entrepreneurial income of the adult population: Average	The combined wage and/or entrepreneurial incomes of individuals aged 18 and older are calculated. Wages include all forms of compensation, whether paid in cash or in benefits in kind. Entrepreneurial incomes include income from agriculture, forestry, business activities, partnerships, and copyright royalties. The data is presented in terms of the currency value for the reference year.
	C4 Wage and entrepreneurial income of the adult population: Median	Median income is derived by arranging the population of individuals aged 18 and older in ascending order based on their available monetary incomes. The median income represents the income of the individual in the middle. An equal number of income earners fall on either side of the individual with the median income. The calculation involves adding up the combined wage and/or entrepreneurial incomes of individuals aged 18 and older. Wages include all forms of compensation, whether received as cash or in the form of benefits. Entrepreneurial incomes include income from agriculture, forestry, business activities, partnerships, and copyright royalties. The data is presented in terms of the currency value for the reference year.
	C5 Disposable income of households: Average	This indicator includes only households in which all individuals have a foreign background. The country of origin refers to the country of origin of the reference person in the household, who is typically the highest-earning individual in the household. The calculation involves the total available monetary incomes of households, including wage incomes, entrepreneurial incomes, property incomes, received transfers, and subtracting paid transfers. Paid transfers mainly consist of direct taxes and social security contributions. The data is presented in terms of the currency value for the reference year.
	C5 Disposable income of households: Median	Median income is obtained by arranging households in ascending order based on their available monetary incomes. The median income represents the income of the household in the middle. Available monetary incomes include wage incomes, entrepreneurial incomes, property incomes, received transfers, and subtracting paid transfers. Paid transfers mainly consist of direct taxes and social security contributions. The data is presented in terms of the currency value for the reference year.
	C6 At risk of poverty rate of households	The low-income rate of households reflects the percentage of low-income households among all households. Low-income households are defined as those whose equivalent income (available monetary income per OECD equivalent consumption unit) falls below 60% of the equivalent median income of all households.
	C7 At risk of poverty rate of employed persons	The low-income rate reflects the percentage of individuals living in low-income households among the entire housing population. It specifically refers to individuals aged 18-74 who are primarily classified as employed and reside in households defined as low-income. Low-income households are defined as those whose equivalent income (available monetary income per OECD equivalent consumption unit) falls below 60% of the equivalent median income of all households.
	C8 At risk of poverty rate of children	The low-income rate reflects the percentage of children under 18 years of age living in low-income households among the entire housing population. Low-income households are defined as those whose equivalent income (available monetary income per OECD equivalent consumption unit) falls below 60% of the equivalent median income of all households.

	C9 Proportion of people living in low-employment households	The percentage of individuals aged 0-59 living in households where all individuals aged 18-59 work less than 20% of their total work potential during the year is calculated as a proportion of the corresponding age group in the housing population. This information is generated by examining the number of workdays a person has during the year. Individuals aged 18-24, who are primarily students, are excluded from the analysis. Starting from 2019, the number of workdays for wage earners is calculated based on the duration of wage payment periods, whereas previously it was based on the duration of employment. This change is related to the introduction of the income register as the data source for employment statistics.
	C10 Housing: Proportion of the dwelling population living in owner-occupied dwellings	The percentage of individuals in the housing population who have a housing tenure basis of "owning a house" or "owning shares of an apartment" is calculated. Individuals permanently registered in institutions and those living in dormitories are not included in the housing population.
	C10 Type of housing: Proportion of the population living in rented dwellings	The percentage of individuals in the housing population whose housing tenure basis is "Arava-restricted rental housing," "rental housing with interest rate subsidy," or "other rental housing" is calculated. Individuals permanently registered in institutions and those living in dormitories are not included in the housing population.
	C10 Type of housing: Proportion of the population living in an Ara rental dwelling	The percentage of individuals in the housing population whose housing tenure basis is "Arava-restricted rental housing" or "rental housing with interest rate subsidy" is calculated. Individuals permanently registered in institutions and those living in dormitories are not included in the housing population.
	C11 Proportion of population living in crowded conditions.	The percentage of individuals in the housing population whose housing occupancy is considered "crowded" (more than one person per room, excluding the kitchen from the room count) is calculated. According to the given definition, individuals living alone are never considered to live in crowded conditions. Individuals permanently registered in institutions and those living in dormitories are not included in the housing population.
	C12 The percentage of households living in crowded conditions.	The percentage of households, among all households, whose housing occupancy is considered "crowded" (more than one person per room, excluding the kitchen from the room count). According to the given definition, individuals living alone are never considered to live in crowded conditions. Individuals permanently registered in institutions and those living in dormitories do not form households.
Participation	D1 Acquired Finnish citizenship	The percentage of individuals who acquired Finnish citizenship in a specific year among foreign nationals. Foreign nationals refer to individuals permanently residing in Finland on the last day of the year who do not possess Finnish citizenship. Individuals who acquired citizenship are not included in the count of foreign nationals. The residence status of those who acquired citizenship is determined based on the end-of-year situation. Therefore, only those individuals who acquired citizenship during the year and were still part of the permanent population in Finland at the end of the year are included.
Two-way integration	Unavailable	

Calculation Results

Employment Results

Dimension	Indicator
Employment	A1 Employment rate
	A2 Unemployment rate
	A3 Share of the long-term unemployed of all unemployed persons
	A4 Labor force participation rate
	A5 Share of entrepreneurs among employed persons
	A6 Share of public sector employees of employed persons
	A7 Share of part-time employees among wage and salary earners
	A8 Share of employed in fixed-term jobs among wage and salary earners

Employment Dimension	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tampere Migrants Employment Index	0.47	0.46	0.56	0.53	0.50	0.58	0.60	0.55	0.41	0.37
National Native Employment Index	0.30	0.37	0.44	0.50	0.56	0.60	0.60	0.53	0.45	0.42
Tampere Native Employment Index	0.42	0.51	0.58	0.65	0.58	0.65	0.73	0.63	0.51	0.36
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
National Employment Performance Gap	0.176	0.090	0.128	0.026	-0.062	-0.020	-0.006	0.016	-0.045	-0.058
Tampere Employment Performance Gap	0.047	-0.044	-0.016	-0.125	-0.085	-0.066	-0.133	-0.087	-0.103	0.008

Education and Skills results

Education and Skills	B1 No post-primary degree or place of study
	B2 Completion rate of secondary education: Proportion of those who have completed vocational studies
	B2 Completion rate of secondary education: Proportion of high school graduates
	B3 Proportion of graduates with a tertiary degree
	B4 Highest level completed: primary or unknown
	B4 Highest level: second degree or special vocational education
	B4 Highest completed degree: higher degree
	B5 Proportion of NEET youth (Not in Education, Employment, or Training)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tampere Migrants Education & Skills Index	0.55	0.51	0.46	0.43	0.44	0.47	0.39	0.37	0.56	0.49
National Native E & S Index	0.26	0.30	0.36	0.48	0.56	0.60	0.62	0.62	0.64	0.67
Tampere Native E & S Index	0.27	0.31	0.37	0.48	0.55	0.58	0.62	0.63	0.61	0.62

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
National E & S Performance Gap	0.292	0.211	0.101	-0.049	-0.115	-0.128	-0.233	-0.248	-0.084	-0.185
Tampere E & S Performance Gap	0.278	0.200	0.095	-0.049	-0.111	-0.109	-0.236	-0.257	-0.059	-0.133

Wellbeing results

Wellbeing	C1 Premature mortality
	C2 Proportion of disability pensioners
	C3 Disposable income of the adult population: Average
	C3 Disposable income of the adult population: Median
	C4 Wage and entrepreneurial income of the adult population: Average
	C4 Wage and entrepreneurial income of the adult population: Median
	C5 Disposable income of households: Average
	C5 Disposable income of households: Median
	C6 Low-income rate of households
	C7 Low-income rate of employed
	C8 Low-income rate of children
	C9 Proportion of people living in low-employment households
	C10 Housing: Proportion of the dwelling population living in owner-occupied dwellings
	C10 Type of housing: Proportion of the population living in rented dwellings
	C10 Type of housing: Proportion of the population living in an ARA (Social) rental dwelling
	C11 Proportion of people living in overcrowded dwellings
	C12 Proportion of families living in overcrowded dwellings

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tampere Migrants Wellbeing Index	0.34	0.38	0.43	0.43	0.50	0.50	0.52	0.55	0.63	0.56
National Native Wellbeing Index	0.53	0.55	0.50	0.51	0.49	0.46	0.44	0.45	0.47	0.51
Tampere Native Wellbeing Index	0.50	0.56	0.53	0.53	0.53	0.49	0.50	0.46	0.49	0.49
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
National Wellbeing Performance Gap	-0.190	-0.176	-0.070	-0.087	0.011	0.039	0.073	0.098	0.157	0.054
Tampere Wellbeing Performance Gap	-0.159	-0.182	-0.099	-0.103	-0.032	0.010	0.021	0.095	0.145	0.075

Holistic Integration Indicator (HII)

Holistic integration Index	A Employment
	B Education and Skills
	C Wellbeing

Weighted Holistic Integration Index

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tampere Migrants Holistic Integration Index	0.007	0.007	0.009	0.008	0.009	0.011	0.010	0.009	0.012	0.008
National Natives Holistic Index	0.003	0.005	0.007	0.010	0.013	0.014	0.014	0.013	0.011	0.012
Tampere Natives Holistic Index	0.043	0.066	0.085	0.124	0.130	0.139	0.169	0.137	0.114	0.081
Gap Index										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
National Integration Performance Gap	0.004	0.002	0.003	-0.002	-0.004	-0.002	-0.004	-0.003	0.000	-0.004
Tampere Integration Performance Gap	-0.036	-0.059	-0.076	-0.116	-0.120	-0.127	-0.159	-0.128	-0.102	-0.072

Unweighted Holistic Integration Index

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tampere Migrants Holistic Integration Index	0.029	0.030	0.038	0.032	0.037	0.046	0.040	0.038	0.047	0.033
National Natives Holistic Index	0.013	0.021	0.026	0.041	0.051	0.056	0.055	0.050	0.046	0.048
Tampere Natives Holistic Index	0.019	0.029	0.038	0.055	0.058	0.062	0.075	0.061	0.051	0.036
Gap Index										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
National Integration Performance Gap	0.016	0.009	0.011	-0.009	-0.014	-0.010	-0.016	-0.012	0.002	-0.015
Tampere Integration Performance Gap	0.010	0.000	0.000	-0.023	-0.021	-0.016	-0.035	-0.023	-0.003	-0.003

Supporting information

Postal Code	Neighborhood	Service Area	Total Population, 2019 (HE)	Average Household Income, 2019 (TR)	Average Household Size, 2019 (RA)	Population With Vocational Training ,2019 (KO)	Population with bachelor's degree or Equivalent, 2019 (KO)	Population with master's degree or higher, 2019 (KO)
33100	City Centre	Keskustan	17,738	38124	57.4	5208	3269	3161
33720	Hervanta	Kaakkoinen	25,488	28145	58.6	7371	2865	2656
34240	Kämmenteisko	Koillinen	1,622	53637	116.5	587	185	125

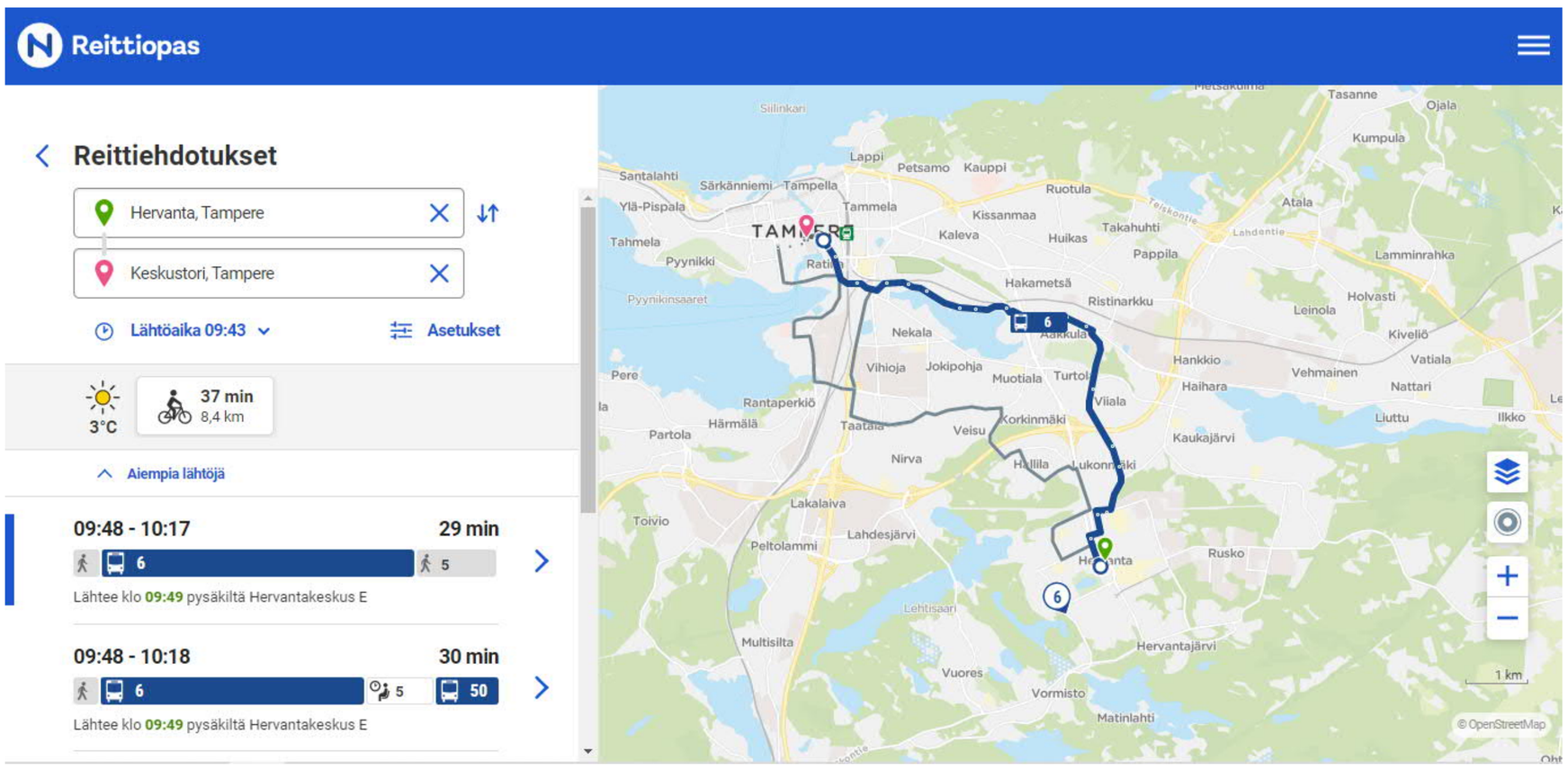

Figure 30: Travel time Hervanta to City Center (Tampere Regional Transport Administration) Accessed 10.4.2023.

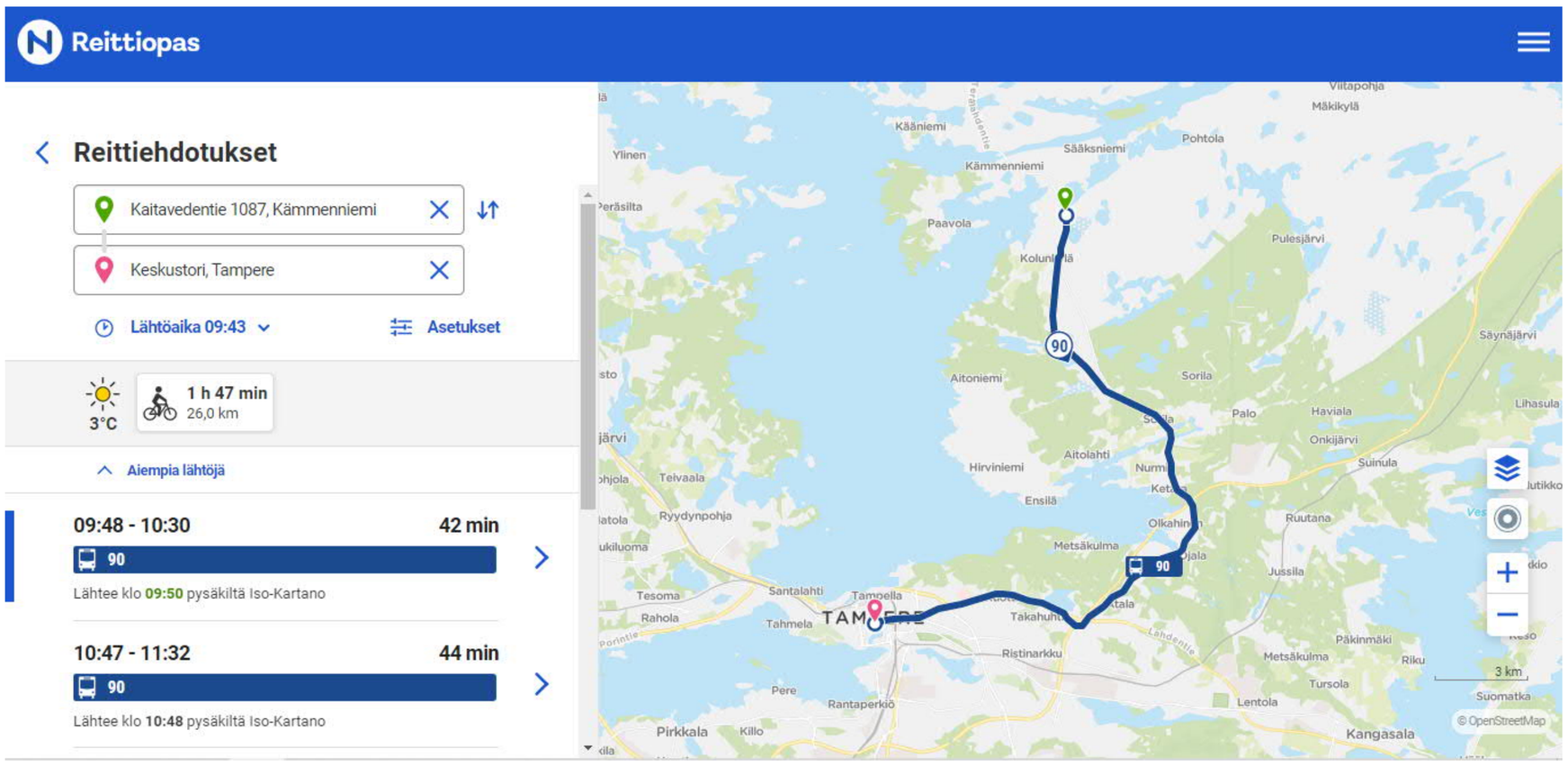

Figure 31: Travel time Koillinen to City Center (Tampere Regional Transport Administration) Accessed 10.4.2023.

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