Sustainable Tourism Opportunities in European Smart Cities

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Bachelor's Thesis

2021

Bachelor of Hospitality Management

Abstract

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Degree programme
Bachelor of Hospitality Management

Report/thesis title
Sustainable Tourism Opportunities in European Smart Cities

Number of pages and appendix pages
31 + 2

Smart cities and environmental sustainability are becoming more significant as a result of globalisation. Many industries are connected to globalisation as they can gain from it. One of these industries is hospitality industry, especially tourism. Tourism affects people all around the world. In tourism industry promoting sustainable development is crucial for the future of the industry. The promoting can be effectively done in and through smart cities.

The aim of this thesis is to research what kind of sustainable tourism actions are implemeted by European smart cities, what are the smart city characteristics and differences between Eropean smart cities as well as how the sustainable tourism opportunities are taken under consideration in these cities. In the research, it is observed how the chosen European smart cities reveal their actions on their webpages.

In the knowledge base of the thesis different subjects are handled in order to create a base for the content analysis. First smart cities and sustainability are given their definition, then more spesific focus on European smart cities, presentation of the research method, content analysis and final discussion.

The research was executed with qualitative method, content analysis, during November 2021. For the reseach, five European smart cities were chosen and the content analysis was done with the observations made from the cities own websites and each city's destination management organization website. The five European smart cities chosen for the research are Amsterdam, Copenhagen, Helsinki, Oslo and Zurich.

The research results show that all the chosen cities have ongoing environmentally sustainable tourism actions. The cities have different focus points on their sustainable tourism actions based on the needs of the city and visitors that they draw in. In discussion, the results of the content analysis were compared to the knowledge base and conclusion was made with the further research suggestions.

Keywords
Smart city, sustainable development, sustainability, digitalisation, technology

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1 Introduction

It is estimated that 70 percent of all humankind will live in an urban area by midcentury. Cities are physical locations that have large number of settled inhabitants, formed by communities. Cities also have government to oversee the overall infrastructure and interactions between all parties. For population to be able to continue living in urban cities, clean air and water, efficient transportation and energy, safety and convenient city services must be preserved and conducted while protecting the planet from climate crisis. These actions aim to improve the quality of life for all communities. (Reichental 2020.)

Smart city concept is related to many industries. One of these industries is the tourism industry. I chose the subject of this thesis because the meaning and use of technology is continually becoming more important to finding sustainable solutions for travelling. Cities are under pressure to create safe and stable environment, more sustainably end efficiently for inhabitants and travellers, and that is why smart city solutions have an important role now and in the future.

European smart cities are chosen as the research subject to this thesis because Europe is the global leader in the field on international tourism. This means there are over 700 million inbound tourists arriving to Europe each year. This has brought challenges for cities to find sustainable ways to manage with the growing number of tourists. (Statista Research Department 2021.) In this thesis, delimiting is based on geographical location. There are five European smart cities under the review. These cities are Amsterdam, Copenhagen, Helsinki, Oslo, and Zurich. The cities have been chosen based on their IMD Smart City Index. In overall, Europe includes multiple smart cities. The chosen cities are different compared to each other, but they were chosen because of their advanced sustainability and technology aspects.

The main research question that this thesis is answering to is what kind of sustainable tourism actions are implemented by European smart cities, and also these following research questions will be answered:

- What are the characteristics of a smart city?
- What are the differences between European smart cities?
- How are the sustainable tourism opportunities taken under consideration in European smart cities?

As a result of this study, by answering to the previous questions, there will be a mapping of what the chosen European smart cities are doing to advance the environmental sustainability. The base for the research is done by reviewing and analyzing the chosen cities' sustainable tourism actions through web and reading existing literature. For reviewing the actions through web, the author will use each city's homepage and destination management organizations (DMOs) webpages. Observation frame will be used as a guideline for the analysis. All the observation frames categories link to the knowledge base.

The author first got interested about the smart city concept during student exchange program. The student exchange located to Dublin, Ireland in the spring of 2020. During this time, the author lived there and studied in Technological University Dublin. The smart city concept was thoroughly studied during a Tourism & Technology modul and a report was written. Before this the author had little knowledge about the smart city concept via previous studies.

The thesis consists of defining the main concepts, smart city and sustainability. After defining the main concepts, the research method will be presented. With the research method, short introduction of each city is written. After these, the author will go through the observations and analyze the results. Lastly, author briefly assess the learning process in the discussion.

2 Smart city qualities

Smart city is a concept that has many different definitions. Use of the term smart city vary depending on the subject matter that is dealt with. In this study, smart city is defined by using different literature texts that cover smart city concept and combining the definitions to one comprehensive definition matching the aim of the thesis. From environmental perspective, smart cities aim to utilize energy and electricity in an efficient way.

European Commission (s.a. b) has defined smart city to be a place where the goal is to benefit city's inhabitants and businesses by making traditional networks and services more efficient by using digital solutions. European Commission states that the goal of smart city is to achieve better use of resource and create less emissions by going beyond the digital technologies. In practice this can be seen as smarter urban transport networks, more efficient solutions to light and heat buildings, upgraded water supply and waste disposal facilities. (European Commission s.a. b.)

Smart city concept can also be seen as a vision for urban development. The urban development can be achieved by integrating information and communication technology (ICT) solutions to manage city's assets. Smart cities are in charge of new infrastructure that provide and enable smart services in various sectors such as healthcare, energy, education, transportation, mobility, public safety, and environmental management. (Hérault, Ishikawa, Seghrouchni, & Tokuda 2016.)

Today or in the future there will not be any complete smart cities as technology and cities keep evolving and changing constantly. New needs, trends, ideas, and crisis will keep emerging and smart cities evolve to be able to response to these factors. The cities become smart when they implement 21st century solutions to today's problems. Smart city is a concept and an approach that uses innovative technologies to enhance community services, economic opportunities and reduce consumption. (Reichental 2020.)

City is a smart city when it learns from history and former mistakes, in that specific or equivalent city, applies technologies to benefit the environment and communities for more efficient future. Solutions must be applied in suitable way as there is no "one fits for all" solution because city characteristics vary depending on geography, population, governance and infrastructure. The city characteristics are also affected by the needs and culture that makes one unique.

In this thesis the focus will be on the environmental sustainability of smart cities. As there is no single definition for a smart city, author will use following definition that is formed of

previous definitions. A smart city is an urban city area that uses technological solutions to improve, preserve and develop the quality of life for its inhabitants and surroundings. These improvements will happen by implementing multiple means with the help of technology. In this thesis the focus is on what the cities are doing to improve and preserve the sustainability in a tourism industry.

2.1 Smart tourism destinations

In the hospitality industry a smart city can be seen as a smart tourism destination (STD). Smart tourism destinations are basically just smart cities that exploit the technology for the benefit of tourism. Benefits are formed by applying smart elements, such as technology, to address the traveler's needs and minimize the environmental impact. When addressing the needs before, during and after the visit, the destinations are able to increase their competitiveness level and form more comprehensive image about the next steps that the city has to take as a smart city and tourism destination. (Xian & Tussyadiah 2014.)

Smart cities are, in almost all cases, automatically smart tourism destinations. Smart cities aim to have more smart government, people and environment. These aspects of smartness correlate to amenities and accessibility, that both are in the core of smart tourism destinations. For many smart cities, the idea of also being a smart tourism destination is vital as tourism is a source of income for many cities, and this income provides to the development of becoming a smarter city. (Jasrotia & Gangotia 2018, 48-53.)

2.2 Smart city characteristics

Smart city concept's purpose is to manage city's assets by integrating multiple information and communication technology (ICT) solutions for urban development. Modern infrastructure and modern ICT infrastructure fuel sustainable growth, quality of life and more participative management of natural resources. Smart cities provide smart enablers that include for instance network infrastructure, technology platforms, services, applications, and user behavior via data. Smart enablers are key services that collect and update various types of content for providers and end users. Used techniques, frameworks and tools need to allow an efficient data processing. (Hérault et al. 2016.)

Internet of Things (IoT) has been part of the smart city concept and development throughout. IoT and its technologies are considered as a key infrastructure in a smart city. IoT in smart cities include sensors and support technologies that create successful implementation of "smart". Internet of things implemented in cities provides user-customized services via data collected by electronics. IoTs does not have one specific definition as it is differ-

ent depending on the level of implementation, but it can be referred as a set of technologies that assess the data collected by various devices with wireless and wired internet networks. (Park, Del Pobil & Kwon 2018, 1-2.)

Tourism in smart cities and smart city destinations utilize Information and Communication Technologies (ICTs). ICTs used in smart city destinations include World Wide Web (the Web), Internet, Intranet and Extranet. Information and communication technologies include the required hardware and software for users and stakeholders to interact. The Web enables distribution of information and works as a communication tool through the Internet. Internet is the network of all networks that connects multiple networks internationally. Intranet is a corporate level network which is secured to limited users, as extranet is a network that link multiple intranets. (Buhalis & Jun 2011, 4-5.) In any destination, use of ICTs is in order to facilitate the tourist experience before, during and after the visit by, among other things, providing information, coordinate and promote tourism policy (Buhalis, Leung & Law 2011, 206).

2.3 Different stages of smart city

Smart city stages or smart city development stages can be defined in more than one way. The definition of the stages depends on the perspective that is under observation. In this research Cohen's (2015) smart city stages and Yun and Lee's smart city stage will be presented. The summary of these different smart city development stages can be found from table 1.

Cohen (2015) has created three smart city stages that assess the evolutionary trajectory regarding how cities accept technologies and development, lead the business sector and how government lead the people. The first stage is smart cities 1.0. This stage is technology driven and solutions are offered to the city by technology suppliers. There is a lack of understanding regarding the effect that the solutions have on people's quality of life. The vision of how cities should agree with the citizens might be missing.

Smart cities 2.0 is led by cities and enabled by technology. This stage is characterized by city managers in the role of leading the city's future and smart technologies. The focus is on the technological solutions that improve the quality of life. Third, smart cities 3.0 is a citizen co-creation stage. In this stage fairness and social integration problems are focused on. Use of underutilized resources is being optimized by encouraging citizens to participate while the aim pursued is to improve the quality of life for everybody. Helping to create the next generation of smarter cities is embraced. (Cohen 2015.)

There are also suggestions for smart cities stage 4.0. The 4.0 stage is presented as “self-organizing smart city optimized by prediction and customization” and creates continuity to Cohen’s (2015) stages, as can be seen from table 1. In this stage the value of a platform can be found from the network effect. As a result of this productivity increases, the costs on issue solving lowers and, in the end, city evolves to self-organizing stage where it can recognize problems and solve them on its own. (Yun & Lee 2019, 8-9.)

SMART CITIES 1.0	SMART CITIES 2.0	SMART CITIES 3.0	SMART CITIES 4.0
• Technology driven • Not aware of all the effects that technological solutions have to quality of life • City-citizen relation not in place	• Enabled by technology, led by cities • Priority is to improve quality of life with technology	• Citizen co-creation • Aim to improve the quality of life for everyone • Next generation smart cities are embraced	• Self-organizing smart city • Lower cost for issue solving • More responsibility on the system itself through prediction and customization

Table 1. Smart city development stages in summary (in accordance with Cohen 2015 and Yun & Lee 2019)

2.4 IMD Smart City Index - SCI

For this research, the author has decided to use IMD Smart City Index (SCI). IMD is International Institute for Management Development and in 2017 it joined with Singapore University of Technology and Design to create smart city index. Balanced focus between economic and technological aspects as well as the humane dimension of smart cities. This Humane dimension includes aspects such as quality of life, environment and inclusiveness. The smart city index was created by reviewing and analyzing smart cities at different stages of development creating diverse international basis of experience. The SCI was used for global ranking of smart cities in 2019, 2020 and to be continued. (IMD s.a.)

To be recognized as a smart city globally is critical for attracting investment and creating potential and being part of advanced cities. IMD Smart City Index focuses on understanding the scope and impact of making cities smart from the citizens perspective. (IMD 2019.) According to IMD Smart City Index 2020 the top six European smart cities were Helsinki, Zurich, Oslo, Copenhagen, Geneva and Amsterdam (IMD 2020). The author chose five European top smart cities, all from different countries, for the study. As the smart city rating 2020 score is the same with Zurich and Geneva (IMD 2020), both located in Switzerland, author chose Zurich among the five cities because the smart city rating 2019 score was higher than it was with Geneva.

3 Sustainability

Sustainability is a concept that has three dimensions. These dimensions are social, economic and environmental. The common idea under all dimensions is to ensure the well-being of future generations. Sustainability should be related to preserving today's productive capacity for the indefinite future. (Kuhlman & Farrington 2010.) Sustainability is vital for improving the quality of life.

Environmental sustainability is based on preserving the non-renewable and renewable natural resources. These resources include, for instance, soil, biodiversity, fossil fuels, water, forest and clean air. (Kuhlman & Farrington 2010.) Sustainability regarding environment means minimizing the harm caused to biosphere from all the substances that are caused by human activities, especially in cities where large number of humans are concentrated (Heinberg 2010, 7-8). Improving and preserving the quality of life, humans are to sustainably meet their needs without compromising the future generations to meet their needs.

For the wide use of the concept of sustainability, it as a term is in danger to become equivalent to 'good' thus lacking any specific meaning. This can lead to the use of the term as an assurance of good intentions. Ideally sustainability is a positive or at least neutral effect on the state of futures resources. (Kuhlman & Farrington 2010.)

3.1 Sustainable development and tourism

Sustainable development has three dimensions, an environmental, economic, and socio-cultural aspect. Balance between all three dimensions must be achieved to guarantee long term sustainability. Sustainable tourism development follows same guidelines as overall sustainable development. Sustainable tourism development practices are suitable in all tourism forms, mass, and niche tourism, regardless the destination.

From environmental perspective, sustainable tourism aims to optimize the use of environmental resources. The resources have important position in tourism development and maintaining the state of ecological environments, natural heritage, and biodiversity. For sustainable tourism development to succeed, informed participation of stakeholders is to be included. Constant monitoring of impacts is necessary to make preventive or corrective measures. (UNWTO s.a.)

Sustainable tourism should raise awareness about sustainability issues and to promote practices that are sustainable, while offering high level of tourist satisfaction and meaningful experience. Tourism sector should address the needs of the industry, visitors, environment, and host communities while taking full account of environmental and social impacts, current and future economic. (UNWTO s.a.)

3.2 Sustainability in smart cities

The extraction, processing and consumption of nonrenewable resources is a serious form of pollution in today's world. For example, the greenhouse gases or burning coal, overall carbon dioxide (CO2) emissions have been building up for a long time and keep building up quickly. To avoid ecosystem threatening consequences, reductions in these emissions must occur at high rates. (Heinberg 2010, 7-8.)

Environmental sustainability in smart cities is monitored with scattered information and communication technologies that retrieve useful information, such as air quality. This information is then available online through webpages or applications. ICTs also collect data from energy consumption, and this can be acquired regularly to track the development. Through the tracking corrective actions can be executed. (Hérault et al. 2016.)

Challenges often emerge over time with old and inefficient solutions. One of these challenges is environmental damage. For instance, a dependency on carbon-based energy creates continuing, and potentially irreversible, damage. Flooding damages infrastructure and creates problems when it cannot be captured for productive use. Small and large cities have different sustainability issues, but it cannot be directly defined which is worse. The solutions and their implementation depend on budgets and decision processes. (Reichental 2020.)

3.3 Sustainability indicators

Sustainability aims to improve the quality of life. Sustainability, and indicators to measure the progress towards sustainability, are needed. Indicators provide useful information, usually in numerical terms, describing the state of something, detecting changes and show cause-and-effect relationships. (Farrell & Hart 1998.) Gross Domestic Product (GDP) can be very useful when measuring welfare as that is what it is intended for. When considering a hypothetical project, all three dimensions of sustainability should be considered to get the most comprehensive understanding of a situation. Some authors highlight that the dimensions, social, economic and environmental, should receive equal weight if for example policies are stated. (Kuhlman & Farrington 2010.)

Extensive efforts are and have been taken by many European countries to develop indicators for sustainability. Some of these have been carried out by governments and some by research institutions or environmental organizations. In European Union (EU) sustainability is an important goal. (Farrell & Hart 1998.) There are multiple indicators available that go under the Sustainable Development Index (SDI), some of these are Human Development Index (HDI), Environmental Performance Index (EPI) and Environmental Sustainability Index (ESI). The HDI measures average achievement, the EPI measures environmental objectives and the ESI measures sustainability through composite index. (Liu, Brown & Casazza 2017.)

As the mentioned indicators can be used to define sustainability, it is always several indicators that create comprehensive image. Sustainability being social, economic and environmental concept, the use of indicators and analyzing the results should be thoughtful. As a conclusion, sustainability indicators will not be used in the thesis as a part of the analysis of sustainable tourism opportunities in European smart cities.

4 European smart cities

European capitals of smart tourism is an European Union (EU) initiative that aims to reward innovative and promote smart tourism practices, network and strengthen destinations, facilitate and support the exchange of best practices. The European Commission is implementing the initiative that recognises outstanding achievements by European cities as tourism destinations in different categories. These categories are sustainability, accessibility, digitalisation, and cultural heritage with creativity. (European Commission s.a. a.)

The objective of the initiative is to promote, strengthen, increase, establish, encourage, and inform European smart cities to become more versatile destinations. Aim is to increase resident's sentiment of sharing local tourism related values through promoting the rich tourism offer of European countries. Strengthening tourism-generated and innovative tourism development, strengthen economic growth and job creation in the cities, their surroundings, and neighbour regions by increasing the attractiveness of European cities. Aim also includes to establish exchange of best practices framework between the cities, to create cooperation and partnership opportunities. Encouraging sustainable socio-economic development in European tourism destinations and to inform the travellers of their destinations sustainable and outstanding tourism practices. (European Commission s.a. a.)

4.1 Destination Management Organizations – DMOs

Destination management organizations (DMOs) work towards coordinated management of a tourism destination, for instance, a city or a country. The role of DMOs is to coordinate activities and lead under coherent strategy that benefits the destination. Common goal is to assure the competitiveness and sustainability of a destination. The purpose for these organizations is to become a strategic leader in destination development alongside tasks like marketing activities. To achieve the purpose, sufficient governance structure and integration of stakeholders need to operate towards the common goal. According to United Nations World Tourism Organization (UNWTO), strategic leadership, effective implementation and efficient governance are keys for destination management. (UNWTO 2019.)

Destination management takes a step further when a smart destination concept is taken under review. Smart destination concept is built on four pillars which are governance, innovation, technology and sustainability. Destination management organizations are crucial part of this transformation. With developing destinations, DMOs need to develop too, to become a part of the innovative tourism and its opportunities. Functions for these organi-

zations include working with several authorities, public and private, coordinating and managing the increasing innovations. Managing tasks may for example include strategic planning, digitalization, monitoring, promotion, marketing and funding. (UNWTO 2019.)

4.2 Sustainable Development Goals

Sustainable Development Goals (SDGs) are part of the 2030 Agenda for Sustainable Development set by the United Nations. There are 17 SDGs and tourism can directly or indirectly contribute to all of them. Sustainable tourism is strongly a part of the 2030 Agenda, and to achieve that, investment in technology and infrastructure must be made, among other things. (UNWTO 2015.)

The 2030 Agenda for Sustainable Development consists of the 17 SDGs and 169 integrated targets drawn from the SDGs. The agenda is meant to help and create a sustainable and resilient path that leads to stronger people, planet and prosperity. The sustainable development goals take into account different national realities and levels of development, and each government decides how the SDGs and targets are incorporated to planning processes, policies and strategies. Each country has their own challenges and circumstances, and this has been noted by recognizing that different approaches, tools, models, visions and priorities are in use to achieve the goals. (United Nations 2015.)

Among the SDGs, technology, innovation and knowledge sharing should be enhanced on mutually agreed terms. Developments of environmentally sound technologies should be promoted and the use of enabling technologies, such as information and communications technology, should be enhanced and operationalized. Also measurements for sustainable development progress are to be developed and utilized. (United Nations 2015.)

4.2.1 SDG 6 – Clean water and sanitation

Aim of sustainable development goal number 6 – Clean water and sanitation, is to ensure availability and sustainable management of water and sanitation for all. Clean water and its availability, technology efficiency, wastewater management, pollution control and appropriate safety measures all have critical role in sustainability and tourism. Tourism can help to achieve the security of this precious resource. (UNWTO 2015.)

In all sectors, including tourism, water-use efficiency should be increased to ensure the supply of freshwater. Freshwater and overall water quality has to be improved by reducing pollution and increasing recycling. In all areas such as urban areas, cities must improve water and sanitation management by strengthening the participation of local communities

with versatile means such as technological solutions. International cooperation must be expanded for the benefit of communities and surroundings. (United Nations 2015.)

Monitoring, managing and assessing water resources depend on technology that controls the data sources. Higher analytical precision and integration between information and national programs are critical for improved monitoring. In all destinations this means that increased community and stakeholder participation is required. Water management and its improvements should always be seen in context, but at its best, equitable access to water and sanitation will also progress environmental sustainability among other things. (World Bank 2017, p. 36-37.)

4.2.2 SDG 11 – Sustainable cities and communities

Sustainable development goal number 11 - Sustainable cities and communities. Goal 11 aims to make cities and human settlement inclusive, safe, resilient, and sustainable for citizens and tourists. “Sustainable tourism has the potential to advance urban infrastructure and universal accessibility, promote regeneration of areas in decay and preserve cultural and natural heritage.” Tourism depends on these assets and with sustainable tourism they can be secured. Smarter and greener cities are created with green infrastructure that can be implemented with the help of greater investments. The greener infrastructure includes, for example, reduced air pollution, efficient transport facilities and conservation of heritage sites. (UNWTO 2015.)

Sustainable transport systems, enhancing inclusive and sustainable urbanization, attention to air quality and waste management, access to inclusive and accessible – green and public spaces, are all goals that aim to reduce the adverse per capita environmental impact of cities. (United Nations 2015.) These goals also affect and are affected by tourism. Air quality and waste management need urgent attention and solutions. To build safer and more sustainable cities, it is crucial to reduce the adverse impact on the environment. (World Bank 2017, p. 62.)

4.2.3 SDG 13 – Climate action

Goal 13 – Climate action states to take urgent actions to combat the climate change and the impacts. As climate change is global phenomenon, tourism widely contributes and is affected by it. Therefore, transport and accommodation sectors are in notable position to tackle the challenge of climate change by, for instance, lowering energy consumption and shifting to renewable energy sources. (UNWTO 2015.)

National policies, strategies and planning should integrate climate change measures in them. Also, for effective climate change related planning and management, mechanisms for raising capacity have to be promoted. (United Nations 2015.) Through these integrations and improvements, different sectors, such as tourism, have more responsibilities and guidelines to implement the context and actions.

5 Research method

The thesis is executed with qualitative research method. In qualitative research, the meaning is to create an understanding around a certain phenomenon that is not yet fully understood or explained (Kananen 2019, chapter 5). The main research question in this thesis is:

- What kind of sustainable tourism actions are implemented by European smart cities?

The main research question is complemented and supported by sub-questions that are also answered:

- What are the characteristics of a smart city?
- What are the differences between European smart cities?
- How are the sustainable tourism opportunities taken under consideration in European smart cities?

The qualitative research is more focused on describing and understanding a phenomenon, unlike the quantitative research that aims to give a specific information on a certain phenomenon. In quantitative research the phenomenon should be known beforehand, and it is important to, for example, plan the questionnaire forms in detail to receive exact answers. (Kananen 2019, chapter 5.) In qualitative research it is always good to be aware that the researchers own understanding and perception of the phenomenon can affect the subject to be studied. Qualitative research method can include many different tools and timeframe, depending on the phenomenon. These two do not always directly affect the quality of the research, as the quality also depends on the skills of the researcher. (Vilkka 2021, chapter 5). Qualitative method was chosen to this thesis research because it best suits for small sample and to understand a phenomenon by looking for insight through analyzing (Physiopedia s.a.).

5.1 Content analysis as a study method

In this thesis the research method will be content analysis. Content analysis can be used to understand and analyze the material that has been harvested through different methods such as written text, interview and picture. For one to be able to use the content analysis as a study method, researcher has to understand the nature of the content. This study method is most often based on two factors, to identify and name the content elements. (Seppänen 2005, 146.) In the qualitative content analysis, the goal is to create a

verbal and clear description of the chosen phenomenon (Tuomi & Sarajärvi 2018, chapter 4). In the analysis the information will be presented in clear and compact form.

Content analysis can be done from material based, theory based or theory guided point of view (Leinonen 2018). In this thesis, the material that is analyzed is website material. Qualitative content analysis method was chosen because it suits to analyze small sample. During the material collecting and analysis, a better understanding will be created with the help of comparing the material to written theory and by comparing the chosen cities to each other.

5.2 Material collection and analysis

In this thesis the aim is to map out the sustainable tourism actions of the chosen smart cities. There is no need to get quantitative, as in numerical, information of the actions. The research aims to get a better understanding, in positive or negative way, by finding similarities and differences. The first step in this thesis was to create an observation frame, based on the observation categories, so that the material can be analyzed. The chosen cities, Amsterdam, Copenhagen, Helsinki, Oslo, and Zurich where chosen based on their location inside Europe and previous IMD Smart City Index. The cities are all different and that is the reason why observation of these cities in connection with the research questions is the best way to get knowledge, and therefore the research method was chosen to be qualitative.

The observation frame (table 2) made for the analysis consists of left pillar, top row, and individual columns. The left pillar has each city that is under the observation, on their own row and column, in alphabetical order. Under the cities there are the web addresses, also known as URLs (uniform resource locator) (Finnish Terminology Centre TSK 2019), to the city's main webpage and to the city's destination management organization (DMO) main webpage. During the entire observation frame, the information from these two sources are marked with * (one star) or ** (two stars), to tell apart which source the information came from. Information from city website is marked with * (one star) and information from the city's DMOs website is marked with ** (two stars).

As seen in the table 2, the cities will be observed through the top row that has its own column for smart city characteristics, development stage of the smart city, sustainable tourism actions now and in future, three chosen sustainable development goals (SDGs) and other noticeable points. In the smart city characteristics pillar certain aspects will be looked for, such as the use of information and communication technology (ICT), internet of things (IoT) and applications. Assessment of the stage of the smart city will be based on

Cohen's (2015) stages: smart cities 1.0, 2.0 and 3.0, and also to smart city stage 4.0 by Yun & Lee (2019). Sustainable tourism actions now and in future will be observed in separate pillars and references of these actions will be reflected to knowledgebase's chapter 3. Sustainable development goals are part of the United Nations 2030 Agenda for Sustainable Development, and they are actions to make more sustainable future. The three SDGs, their meaning, and goals, can be found from chapter 4.2 Sustainable Development Goals. The last pillar that has other noticeable points, is for possible specific messages that the city or city's destination management organization is delivering.

SMART CITY / URL of the *city and **DMO	Smart city characteristics	Development stage of the smart city	Sustainable tourism actions now	Upcoming sustainable tourism actions	SDG goal 6: Clean water and sanitation	SDG goal 11: sustainable cities and communities	SDG goal 13: Climate action	Other noticeable points
Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en								
Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/								
Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/								
Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/								
Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en								

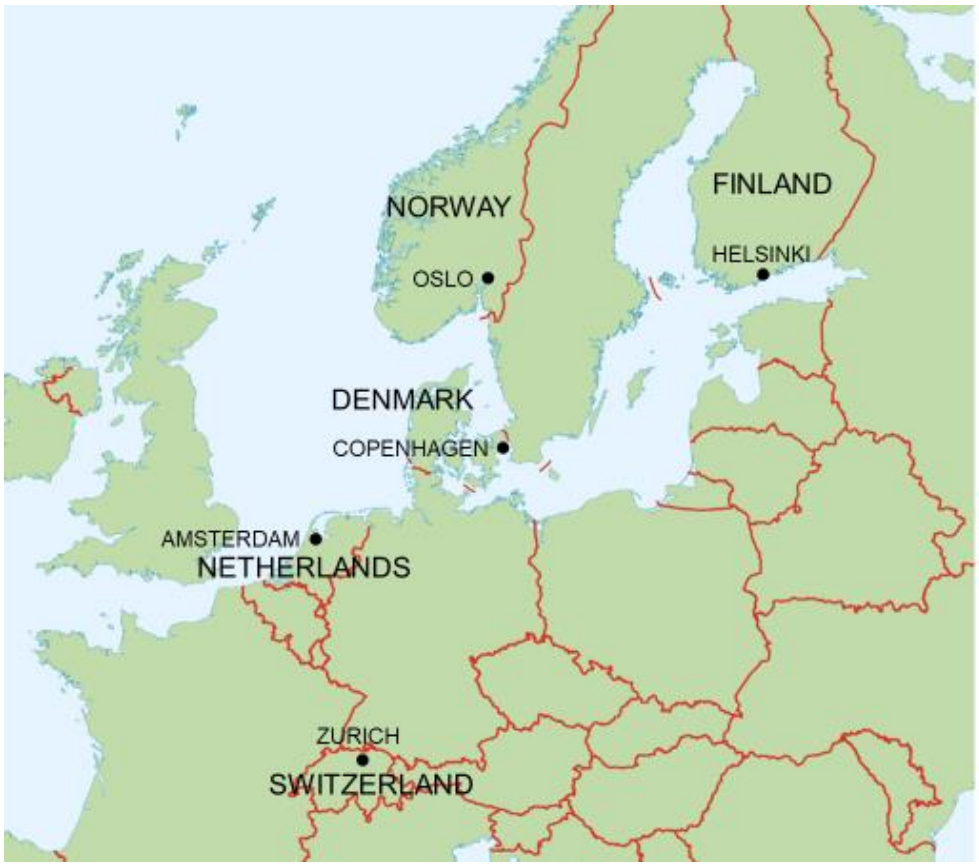
Table 2. Empty observation frame

The most important information will be gathered to the observation frame. Each city has their own column in each observation category and in the analysis every observation category will be processed separately. The analysis of the collected material will be done by opening up the results and then reflecting the material to the knowledge base and comparing each city's results to each other. In the knowledge base, all the categories have been reviewed in general matter related to the main and sub-questions of this thesis. During the presentation of the research results, the observation frame's results will be presented in separate tables correlating to each category at issue.

5.3 The chosen European smart cities

In this part of the thesis, the chosen European smart cities will be presented. The cities are Amsterdam, Copenhagen, Helsinki, Oslo and Zurich. Each of the cities have been

chosen to the qualitative research based on their location, that is in Europe (picture 1) and IMD smart city index (SCI). Each of these cities have comprehensive amount of information available on the internet, on the city's own website and city's destination management organization (DMO) website. For the observation of these cities, the observation frames order will be followed (table 2). From the picture 1 the location of each chosen smart city can be seen along with the countries and directive distance between each city.



Picture 1. Locations of the smart cities and their countries on Europe's map (in accordance with Karttakeskus 2017, 8)

Amsterdam is located in Netherlands and is officially the capital even though the administrative capital is Hague. The Dutch capital has a population of more than 820 000 people and generally temperate sea climate stands. Economy wise, about one-tenth of all jobs are in the tourism sector. Transportation is excellent via rail, water, road and air. In Amsterdam, public transportation has been favored since 1960s. Overall, the city keeps its popularity because of its accessibility, international business and cultural richness. The city is headed by council, that includes 45 members. (Wintle, 2021.)

Copenhagen is the capital of Denmark. One of the largest cities in northern Europe with the population of almost 800 000 people. The climate in Copenhagen is close to the same as in Central Europe. Denmark as a country has one of the highest living standards and

the Greater Copenhagen area has 1,1 million inhabitants. Copenhagen is easy to reach by air, sea and land. Around 80 percent of the working population are in the service sector. It is also stated that the Danish workforce is well educated. Copenhagen City Council includes 55 members. (Copenhagen.com 2020.)

Helsinki is the most populous city and also the capital of Finland. There are over 650 000 people living in Helsinki. The Helsinki Region has about 1,48 million inhabitants and 767 000 jobs. The city can easily be accessed via air or the Baltic Sea. In the city, public transportation is available with multiple options. (Visit Finland s.a.) Population of the city is becoming more international by the year. Climate in Helsinki is maritime climate. The rains evenly distribute for the entire year. (City of Helsinki 2021.)

Oslo is the capital of Norway and also the largest city. Location of Oslo is in the southeastern part of the country and population is almost 700 000 inhabitants. The city is a crossroad for road, rail and air transportation, including public transportation and possibility to cycle and walk accessibly. The climate in Oslo creates many opportunities regarding entertainment such as sports. As a city, it is the center for Norwegian trade, banking, and shipping. (Sommerfelt 2017.) New activities and attractions have been established during last few years. Oslo has invested in green experiences in everyday life and visits. (Visit Norway s.a.)

Zurich is the largest city in Switzerland. Zurich is the capital of the canton of Zurich, but the capital of Switzerland is Bern. Population in Zurich is over 420 000. In Switzerland, one out of every eleven jobs are in the city of Zurich. The airport and central railway station are on the line with Europe’s main intersections. Noticeable progress with environmental quality has been made and therefore also city of Zurich has top rankings in quality of life. Culture is one of the main attractions alongside the nature. Zurich is the gateway to Switzerland, along with Geneva and international networks. (Stadt Zürich 2021.)

6 Sustainable tourism opportunities in European smart cities

In this chapter the results of the research will be presented. The research was executed with qualitative content analysis method by observing the webpages of the research subject cities. The material was collected in November 2021 and an observation frame (Appendix 1) was used to gather the information. The meaning of the research is to answer to what kind of sustainable tourism actions are implemented by European smart cities. The results will be presented by subject areas, as they are presented in the observation frame (Appendix 2).

6.1 Smart city characteristics

Smart city characteristics chapter focuses on the qualities that a smart city should have. These characteristics include qualities such as implementation of information and communication technologies (ICT), modern infrastructure, network, technology platforms, applications, data, internet of things (IoT), sensors and sharing the knowledge with providers as well as consumers. The notes related to smart city characteristics, from the observation frame can be seen from table 3.

SMART CITY / URL of the *city and **DMO	Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
Smart city characteristics	*network, cooperation, IoT, platforms and digital services e.g. My Amsterdam, digital safety, open data, broad involvement **high speed internet, Amsterdam Smar City platform	*platforms, network, IoT, implementation of smart solutions through technology e.g. mobility, collaborations **data collection	*digitalisation, use of technological innovations, IoT, platforms,data collection and sharing e.g. Digital Helsinki website, artificial intelligence, network, digital services e.g. accessibility	*network of IoT and ICT, environmental and energy technologies, funding and investement for digitalisation, cyber safety, platforms	*network, Iot and ICT, digitalisation, platforms for and from innovations, technology investments **computer models – simulate and predict

Table 3. Smart city characteristics

The content analysis made it clear that all five smart cities, Amsterdam, Copenhagen, Helsinki, Oslo and Zurich, have smart city characteristics. Networks, information and communication technology and internet of things can be found from all the cities, as these are the basic characteristics for a smart city. Technological innovations and digital solutions are in the heart of each city's actions and development. All the cities have platforms for the smart city agenda, how to execute and develop it.

Biggest differences between these European smart cities and their smart city characteristics are the collection of data and its presentation. Amsterdam and Helsinki had clear effort on sharing the data openly through websites such as Amsterdam Smart City -platform and Digital Helsinki -platform. Emphasis on cyber safety, digital accessibility and investments varies notably throughout the different cities' webpages. Certain smart city characteristics were mentioned less than expected. These characteristics include high speed internet by Amsterdam, artificial intelligence by Helsinki and computer model simulations by Zurich, as all these are something that smart cities should use or aim to use.

6.2 Development stage of the smart city

Different stages of smart city are elaborated in chapter 2.3. Development stage of a smart city takes a stand on how the smart city is led and what is the technological progress. Defining the development stage of a smart city is not simple as multiple factors need to be taken into account. In some cases, the development stage might even be between two stages because the progress is between implementations. City's participation, cooperation, technological solutions and goals are the most defining factors (table 4).

SMART CITY / URL of the *city and **DMO	**Amsterdam** *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	**Copenhagen** *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	**Helsinki** *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	**Oslo** *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	**Zurich** *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
Development stage of the smart city	*city council, the College of Mayors and Alderpersons, district committees, participating	*participation from individual residents to administrative bodies **big data – unaffected by human error	*cooperation between policy makers, city and citizen, interactivity, long term investments, sharing knowledge	*international cooperation, sharing solutions, citizen, city council and city government, public-private partnership	*citizens, municipality, government, exchange of experiences, projects **application for easy access information

Table 4. Development stage of the smart city

Through the observation it can be stated that all the cities fulfill the criteria of being on the Cohen's (2015) smart cities 3.0 stage where the smart city is developing with citizen co-creation and the goal is to improve the quality of life for all. Each city has their citizen involved in the smart city innovations and decision-making processes, as they should be. Schools, such as universities were also mentioned as part of this process. Responsibilities have been distributed to different departments and organizations, making it easier to get more innovation and cooperation. Each city is doing cooperation and experience exchange with domestic and international organizations, to learn smarter. Smart city stage 3.0 aims to improve the quality of life for all, and this applies in every city as the environmental impacts of different solutions are considered. Solutions that create true information

are valued. For example, Copenhagen has invested on data collection through systems that minimize the human error to get more specific information.

6.3 Sustainable tourism actions now

Observation frames columns (table 5) for sustainable tourism actions now include actions that the cities are doing and promoting today. Each city has their own unique surroundings and that is why the sustainable tourism focus points shift between each city. Some of the actions can be connected directly to tourism industry and some indirectly. According to the observation, the most common sustainable tourism actions at the moment is to develop transportation through carbon emission reduction and implementing smart transport infrastructure. Monitoring and indicators are in use to get data of the consumption in tourism. Carbon emission reduction is not only sustainable tourism action as water area protection is also found and is related to growing traveler count.

SMART CITY / URL of the *city and **DMO	**Amsterdam** *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	**Copenhagen** *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	**Helsinki** *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	**Oslo** *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	**Zurich** *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
Sustainable tourism actions now	*CO2 emission reduction, sustainable waste management, investments and monitoring **eco tourism companies	*reducing waste of clean water, protecting transport water areas from pollution **provide consuming information	*smart transport infrastructure, mapping customer needs, Think Sustainably service **providerscategorized based on sustainability	*well developed public transportation, emission indicators **eco-certified accommodation and attractions	*promoting public transportation, renewable energy sources **tourism service providers aware of sustainability

Table 5. Sustainable tourism actions now

Amsterdam, Helsinki, Oslo and Zurich all brought forward the importance of sustainability among tourism service providers. Sustainability as a part of the organizations like Amsterdam's eco-tourism companies and Oslo's eco-certified services, is important for the development of providers but also for consumers that inflict the sustainability positively or negatively with their actions. Think Sustainably service in Helsinki is an example how the consumers can be activated. Almost all the cities have same sustainable tourism actions now and it is not surprising because of the smart city development stage status.

6.4 Upcoming sustainable tourism actions

SMART CITY / URL of the *city and **DMO	Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
Upcoming sustainable tourism actions	*overviewing regulations, sustainable businesses, Schiphol to be most sustainable hub airport **expand the visitor focus and income also outside city center	*carbon neutrality by 2025, sustainable business growth **sustainable visitor growth through initiatives	*carbon neutral city by 2035, taylor-made services for sustainable service and experience, digitalisation of public trasport **continous promoting of goods	*fossil free by 2030, creating more smart control indicators, more reuse of waste	*continous sustainability awareness events **goals for zero CO2 emmission in future

Table 6. Upcoming sustainable tourism actions

As it is presented in the table 6, the most common upcoming sustainable tourism action among the five cities is to become fossil free, or at least carbon neutral. The year of implementation of these goals vary between the cities. Copenhagen aims to reach carbon neutrality by 2025, Helsinki by 2035 and Oslo aims to be fossil free by 2030. Continuous actions, that are categorized to upcoming actions, include maintaining regulations, sustainable business growth and sustainable services, creating and monitoring smart indicators, and continuous sustainability awareness events. All these actions benefit sustainable tourism, from provider and consumer perspective.

All cities have upcoming sustainable tourism actions, others more universal and others very specific. For instance, Amsterdam aims Schiphol to be most sustainable hub airport. Observation also shows that tourism visitor growth should be controlled to upkeep the sustainability, social, economic and environmental. This is achieved through initiatives and utilizing newest technology such as indicators. Oslo states that reuse of waste is also goal for future actions. In tourism this goal is meaningful for many different services and is linked to the growth of sustainable businesses that benefit the inhabitants and visitors.

6.5 SDG 6 – Clean water and sanitation

Sustainable development goal (SDG) 6 aims to ensure the availability of clean and fresh water for all. Some means to reach this aim are wastewater management, controlling pollution, technology updates, use of indicators and monitoring results regularly. Community and stakeholder participation is relevant for successful clean water and sanitation preservation. The objectives for each city are different and depend on location, city structure, infrastructure and regulations (table 7).

SMART CITY / URL of the *city and **DMO	Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
SDG goal 6: Clean water and sanitation	*attention on port activity, investments to waste water management, more focuse on water use, reduce the water usage in entertainment **startups on clean water recycling	*cleaner water areas e.g. harbor, separate sewage system, drinking water monitoring, water ambassadors	*Baltic Sea protection, cost-efficient water management **water hydrants for fresh water – citizens and visitors, pollution reduction	*protection of water infrastructure, strengthening of water distribution, water quality improvement – botable and nature	*water quality indicators, drainage systems, environmentally friendly water supplies **preserving drinking water sources, public fountains

Table 7. Clean water and sanitation

Clean water and sanitation observations show that preserving or improving water quality is definitely activity that all the cities do. For each city the observation shows that the water quality preservation focuses on the nature waters (harbors and swimming) and fresh waters (drinking water supply and fountains). Clean water actions are investments on water infrastructure such as wastewater processing, water quality indicators and monitoring and decrease of harbor pollution. Amsterdam stands out with the lack of information on the fresh water, but they have given attention to the water usage in entertainment and water recycling projects. Other examples of clean water projects are Copenhagen's water ambassadors and Helsinki's Baltic Sea protection. Environmentally sustainable improvements, with the help of technology, are ongoing focus among all cities.

6.6 SDG 11 – Sustainable cities and communities

SMART CITY / URL of the *city and **DMO	Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
SDG goal 11: Sustainable cities and communities	*investments on infrastructure, emission reduction on transportation, controlling accommodation quantity, sustainable energy, car free agenda **green innovation applied in construction	*CO2 reduction, sustainable transportation and energy production, promoting green areas, reduction in power consumption	*investing on sustainable and accessible infrastructure, updating and improving trasportation, automation, smart region	*new and old - energy efficient building, zero emission deliveries and trasportation **multiple public transportation options	*modern transport network, sustainable buildings – low energy, **high quality infrastructure

Table 8. Sustainable cities and communities

Sustainable cities and communities goal focuses on greener infrastructure. The infrastructure is created with investments that lead to emission reduction, more efficient transport, better waste management and better air quality. Even if it is not separately mentioned, it is obvious that Amsterdam, Copenhagen, Helsinki, Oslo and Zurich all make investments to enhance the infrastructure in each city (table 8). This can be seen from the nature of the observations, creating more sustainable and accessible transportation and upgrading old and new buildings to be more energy efficient.

The improvements made in the cities benefit the communities and visitors. Certain agendas, such as Amsterdam's car free agenda creates a base for future changes and expands the possibilities, such as Helsinki creating smart region instead just focusing on the capital city itself. Agendas are crucial part of the sustainable development by creating defined steps to follow. Observation brings forward that the cities also promote green areas as a part of the sustainability.

6.7 SDG 13 – Climate action

Through globalization, climate actions become more relevant, and tourism has its own contribution to climate change. Policies and planning actions are critical measurements to prevent climate change. Environmentally sustainable actions are in the core of development. All five cities in this research have climate policies that they are executing. These policies have multiple common factors, emission reduction, energy efficiency and sustainable initiatives. Amsterdam Climate Neutral 2050, Helsinki Climate Watch and Zurich's 2000-Watt Society are examples of agendas that are being and will be carried out to prevent negative climate effects (table 9).

SMART CITY / URL of the *city and **DMO	Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
SDG goal 13: Climate action	*implementation of policies, CO2 emission reduction, better air quality, focus on green solutions, e.g. Amsterdam Climate Neutral 2050 **newest technologies utilized	*continuous monitoring of air pollution, iniatives e.g. installation of green roofs, invesments on challenge areas **2030 tourism positively impacts local and globaL development	*digital solutions to anticipate change and crisis, developing indicators, web tool Helsinki Climate Watch **monitoring through multiple systems	*reductions in energy need, multiple sustainable iniatives, air quality preserving, statistics tracking	*energy efficiency innovations e.g. 2000-Watt Society, new forms of participation from community **particular atenttion on e.g. air travel and hotel stays

Table 9. Climate action

Better air quality goals and actions are highlighted. To reach this goal technological solutions like indicators are implemented and they go hand in hand with monitoring the statistics. Also in the core of climate actions are green solutions that are deployed through actions, for instance building green roofs. Utilizing multiple systems and solutions the cities are able to create comprehensive entireties. Each city has their own focus areas depending on the pre-existing solutions and problem areas, but climate actions take place in all of them.

6.8 Other noticeable points

In other noticeable points some compact outlines of all the cities will be presented. These points represent the core ideas of each city and they have been found from the cities own webpages or their destination management organizations (DMO) webpages. From the table 10 it can be seen which website each quote is from.

SMART CITY / URL of the *city and **DMO	Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/	Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/	Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/	Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en
Other noticeable points	*Coalition agreement: ”Amsterdam is a city for living and doing business, only in the second place is it a tourist destination.”	** ”…sustainability isn’t just something we say: it’s something we live and share.”	* ”To Helsinki, the concept of sustainable tourism includes a focus on quality instead of quantity.”	* ”Oslo is a city in constant growth and transformation.”	** ”…to systematically develop sustainability concepts and pursue their strategy for a long-term Smart Destination.”

Table 10. Other noticeable points

Amsterdam has Coalition agreement and, in the agreement, it is stated that the first priority for Amsterdam is the welfare of the citizens and businesses. After this the second priority is to be a tourist destination. This implies that all solutions, including sustainable tourism solutions and smart city solutions, are implemented with city-oriented perspective. Copenhagen’s destination management organization expresses that sustainability is included to everyday life and that it can be seen because of the knowledge sharing aspects. Quality before quantity is in the core of Helsinki’s take on the sustainable tourism. The idea is to produce services that have sustainable aspects and quality for stakeholder and consumers from the beginning to end. City of Oslo supports the becoming development by stating that growth is inevitable, and transformation comes with this growth. Through globalization and internationalization of cities tourism integrates to the changes and even positively impacts on them. Zurich has a goal to become smart destination. This implies that sustainability is continuously developed for the benefit of the inhabitants and visitors for better tomorrow.

6.9 Content analysis summary

Summary of the content analysis which is based on the observation frame, shows that all chosen European smart cities, Amsterdam, Copenhagen, Helsinki, Oslo and Zurich, have sustainable tourism action that have been, are being or will be executed. The communication through the cities and destination management organizations webpages varies. Some destinations presented the agendas and actions in a very clear and organized way, but others in a weaker manner. For example, I was unsuccessful to find any agenda report from Zurich city's website in English.

The research shows coherent results among all cities. Same kind of policies, agendas and actions are being implemented everywhere. The smart city characteristics and development stages reflect each other. At the same time the results show that each city is unique, with different challenges and focus points. Sustainable tourism opportunities are taken under consideration in all seriousness, and they are thoroughly considered from the citizens and visitors perspective. All the different sections support each other.

7 Discussion

The purpose of this thesis was to find out what is the current stage of sustainable tourism actions in European smart cities. The research was done based on the webpages of the chosen European smart cities. An observation frame was used to collect the information that was analyzed later on. The five European smart cities were chosen based on their IMD Smart City Index and selected cities were Amsterdam, Copenhagen, Helsinki, Oslo and Zurich. The main research question is:

- What kind of sustainable tourism actions are implemented by European smart cities?

The main research question is complemented and supported by following sub-questions:

- What are the characteristics of a smart city?
- What are the differences between European smart cities?
- How are the sustainable tourism opportunities taken under consideration in European smart cities?

7.1 Conclusion

As stated in chapter 2, author used the following smart city definition: “A smart city is an urban city area that uses technological solutions to improve, preserve and develop the quality of life for its inhabitants and surroundings.” This smart city definition is complemented by smart city characteristics that include actions such as using information and communication technologies (ICT), smart enablers and internet of things (IoT). During the observation, it became clear that every city involved in the research presented multiple smart city characteristics. All cities have information and communication technologies, digital platforms and solutions, and internet of things. Surprisingly only Amsterdam’s destination management organization clearly communicated that high-speed internet is available. Digital safety was also not highlighted as much as expected. Technological progress brings out new challenges, especially in the integration and use, and this was not a focus point at any of the observed webpages.

Smart city development stages were established according to Cohen’s (2015) model of three different development stages and Yun & Lee’s (2019) 4.0 stage. Smart cities 3.0 is a citizen co-creation stage where underutilized resources are being optimized. The 3.0 stage also encourages citizen participation and goal is to improve the quality of life for everybody. The observation clearly showed that each city has policymakers and citizen

participating the smart city development for the benefit of, businesses, inhabitants and visitors. Cities are also doing parallel cooperation with other cities, and this showed that learning process is on a developed stage. Based on the observations, all the cities are on the smart cities 3.0 stage, even though there were no specific mentions on embracing the next generation smart cities.

In the knowledge base, regarding this thesis research, sustainability is limited to environmentally sustainability. The sustainable tourism actions in smart cities now and in future are those that have positive or negative effect on environment. As written in knowledge base these actions are solutions that decrease the environmental harms caused by tourism, or tourism related actions. Similarities were found among all five cities. The most attention were on actions and agendas that have the goal to reduce carbon emission. Sustainable waste management and more energy efficient transportation were also given a fair amount of attention. It can be seen that almost all the actions have very close connection to the wellbeing of the inhabitants. Not many actions were brought up only in the tourism context as it can be expected from smart cities that are on the 3.0 development stage. Sustainable tourism actions had some unexpected observations that came up, such as Zurich's continuous sustainability awareness events and Copenhagen's sustainable visitor growth. These initiatives were an example of bringing the sustainability closer to the consumer. More actual examples on actions related to tourism were expected.

Sustainable development goals (SDG) were brought to the research because the topic of the thesis is limited to European smart cities and SDGs are known agenda. Clean water and sanitation, sustainable cities and communities, and climate action are the three sustainable development goals that have been explained in the knowledge base. Clean water and sanitation observations had a strong focus on the wastewater management and nature water protection. Compared to the knowledge base it is surprising that fresh water, as in drinking water, had so much less attention. This can of course be related to the fact that all the cities under the research are advanced cities and the infrastructure for fresh water has been a priority even prior smart city concept. Again, overall implementations, such as harbor water quality improvement had bigger attention than specific projects. Helsinki's Baltic Sea protections was given wider spotlight.

Sustainable cities and communities goal is focused on sustainable transport systems, better air quality, accessibility and green solutions. The observations of this goal include many actions that are also related to other categories that were observed. Carbon reduction through transportation and increasing technological solutions were mentioned. Building infrastructure was mentioned in relation to sustainability and energy efficiency. Expectation was to find more agendas that would have more detailed information on the actions

that complete the goal. Climate action goal covers all actions that prevent climate change. The findings were similar and comprehensive among the five cities. Innovations, implementations and solutions that consist of technology inspired actions. As mentioned in knowledge base, climate change is global phenomenon and tourism is affects it widely. The findings in observation frame confirmed that climate actions are fulfilled by each city. Operating the actions is unique in all but they match the knowledge base findings.

The last category in the observation frame is for other noticeable points. The category summarized the sustainability messages from the cities' websites or their destination management organizations (DMO) websites. When observing these messages, it became clear that each city has their own problem areas and focus points. Amsterdam focuses on implementing the sustainable tourism actions through the welfare of its habitants. Copenhagen's focus for sustainability can be seen from their actual physical actions and the sharing of knowledge. With sustainable tourism, Helsinki focuses on quality over quantity. Oslo is under constant change with their situations and solutions because of growth. Zurich has a goal to become long-term smart destination through sustainability. These messages compared to the knowledge base gives obvious answer that each city is smart city implementing sustainable tourism solutions on their own level.

In review, European smart cities are implementing various sustainable tourism actions. These actions include investing money, creating more sustainable infrastructure though technology, planning and executing agendas made by consumers and citizen, digitalization of services, monitoring outcomes, supporting sustainable services and options, and giving consumers an access to knowledge. The sustainable tourism opportunities are taken under consideration in European smart cities with open mind. This can be confirmed by the thrive of cities to invest to the sustainability and digitalization that creates more sustainable tourism for everyone's benefit. Sustainable tourism opportunities are also generated by the cities themselves to thrive.

7.2 Reliability

As written in the chapter 5, the research method for this thesis was qualitative content analysis. The research method itself is focused on describing and understanding a phenomenon. The knowledge base of the research is created from pre-existing knowledge through books, articles and other research material. Regardless of that, it is important to remember that researchers own understanding and perception of the phenomenon can affect the subject that is under observation.

During the research, there were some changes regarding the actual implementation of the research. The subject itself is also complicated as each city in the research is individual and differs from one another. This means that results have wide outcome scale and not one infinitive answer can be given. This added with researcher possible own perception, it can be said that research result would be different if someone else would conduct it. The knowledge for the observations was taken from online and it can be said, that not all the information was available in English and that automatically affects the outcome.

7.3 Suggestions for further research

There are multiple possibilities for further research on the subject. In my opinion it would be useful to consider the specific regulations stated by each city. The regulations could be observed through agendas, agreements and specific actions that are implemented. The actions could be compared to the goals and policies, possibly from the implementation schedule perspective. Sustainable tourism actions could also be studied from a perspective where social media communication is assessed as social media is one of the most influential ways for consumers to get information and inspiration for their travelling.

It would also be useful to do research where the content analysis is focused on each city specifically. The reason for this is that even though all the destinations are European smart cities, they have individual problem areas and the observation result should also be compared to these individuality markers, not just overall theory. All the categories under sustainable tourism go together in a “hand in hand” way, and therefore more specific aspects can be added to make the research more comprehensive. If author were to write again form the same subject, more specific and narrow sub-questions would take place. More narrow sub-questions could give even more accurate knowledge and answers.

7.4 Assessment of learning and process

Starting the thesis was challenging. It took a long time to figure out a subject which would be interesting and also motivating to myself. The process of writing my thesis was quite long and disconnected. I came up with the idea in the beginning of 2021, started the process in the spring but the summer employment disconnected the process, and the actual start of the writing was in the autumn of 2021. The first idea for the thesis was to do an inquiry but it changed to content analysis because of the subject and time limitations. Easiest part for myself was to write the knowledge base. Difficulties started when beginning to do my own observation and analysis as it is much harder for me to produce my own text. Motivation during the thesis writing wasn’t optimal as there wasn’t anything else studying related during this time and that caused an issue for scheduling and determination.

My personal interest and goal were to create a general idea of the actions and possibilities that European smart cities do for sustainable tourism. There is a lot of information available and it was definitely difficult to try and make the project fitting for my goals. In my opinion the result could be more precise if the research would have been more comprehensive. I do think that I found good result that answer the research questions. As said, the process was challenging but I am still interested in the subject and wish to get more knowledge about it in the future, maybe even career wise. I learned and deepened my understanding on the subject, and I feel that for others, the thesis can also offer that.

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Appendices

Appendix 1. Empty observation frame

SMART CITY / URL of the city and DMO	Smart city characteristics	Stage of the smart city	Sustainable tourism actions now	Upcoming sustainable tourism actions	SDG goal 6: Clean water and sanitation	SDG goal 11: sustainable cities and communities	SDG goal 13: Climate action	Other noticeable points
Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en								
Copenhagen *https://international.kk.dk/ **https://www.wonderfulcopenhagen.com/								
Helsinki *https://www.hel.fi/helsinki/en **https://www.myhelsinki.fi/								
Oslo *https://www.oslo.kommune.no/english/#gref **https://www.visitoslo.com/en/								
Zurich *https://www.stadt-zuerich.ch/en **https://www.zuerich.com/en								

Appendix 2. Filled observation frame

SMART CITY / URL of the *city and **DMO	Smart city characteristics	Development stage of the smart city	Sustainable tourism actions now	Upcoming sustainable tourism actions	SDG goal 6: Clean water and sanitation	SDG goal 11: Sustainable cities and communities	SDG goal 13: Climate action	Other noticeable points
Amsterdam *https://www.amsterdam.nl/en/ **https://www.iamsterdam.com/en	*network, cooperation, IoT, platforms and digital services e.g. My Amsterdam, digital safety, open data, broad involvement **high speed internet, Amsterdam Smar City platform	*city council, the College of Mayors and Alderpersons, district committees, participating	*CO2 emission reduction, sustainable waste managemen t, investments and monitoring **eco tourism companies	*overviewing regulations, sustainable businesses, Schiphol to be most sustainable hub airport **expand the visitor focus and income also outside city center	*attention on port activity, investments to waste water management, more focuse on water use, reduce the water usage in entertainment **startups on clean water recycling	*invesments on infrastructure, emission reduction on transportation, controlling accommodation quantity, sustainable energy, car free agenda **green innovation applied in construction	*implementati on of policies, CO2 emission reduction, better air quality, focus on green solutions, e.g. Amsterdam Climate Neutral 2050 **newest technologies utilized	*Coalition agreement: ”Amsterdam is a city for living and doing business, only in the second place is it a tourist destination.”
Copenhagen *https://internati onal.kk.dk/ **https://www.w onderfulcopenha gen.com/	*platforms, network, IoT, implementation of smart solutions through technology e.g. mobility, collaborations **data collection	*participation from individual residents to administrative bodies **big data – unaffected by human error	*reducing waste of clean water, protecting transport water areas from pollution **provide consuming information	*carbon neutrality by 2025, sustainable business growth **sustainable visitor growth through initiatives	*cleaner water areas e.g. harbor, separate sewage system, drinking water monitoring, water ambassadors	*CO2 reduction, sustainable transportation and energy production, promoting green areas, reduction in power consumption	*continuous monitoring of air pollution, iniatives e.g. installation of green roofs, invesments on challenge areas **2030 tourism positively impacts local and global development	** ”…sustainabili ty isn’t just something we say: it’s something we live and share.”
Helsinki *https://www.hel .fi/helsinki/en **https://www. myhelsinki.fi/	*digitalisation, use of technological innovations, IoT, platforms,data collection and sharing e.g. Digital Helsinki website, artificial intelligence, network, digital services e.g. accessibility	*cooperation between policy makers, city and citizen, interactivity, long term investments, sharing knowledge	*smart transport infrastructur e, mapping customer needs, Think Sustainably service **providers categorized based on sustainabilit y	*carbon neutral city by 2035, taylor-made services for sustainable service and experience, digitalisation of public trasport **continous promoting of goods	*Baltic Sea protection, cost-efficient water management **water hydrants for fresh water – citizens and visitors, pollution reduction	*investing on sustainable and accessible infrastructure, updating and improving trasportation, automation, smart region	*digital solutions to anticipate change and crisis, developing indicators, web tool Helsinki Climate Watch **monitoring through multiple systems	* ”To Helsinki, the concept of sustainable tourism includes a focus on quality instead of quantity.”
Oslo *https://www.osl o.kommune.no/e nglish/#gref **https://www.vi sitoslo.com/en/	*network of IoT and ICT, environmental and energy technologies, funding and investement for digitalisation, cyber safety, platforms	*international cooperation, sharing solutions, citizen, city council and city government, public-private partnership	*well developed public transportati on, emission indicators **eco-certified accommoda tion and attractions	*fossil free by 2030, creating more smart control indicators, more reuse of waste	*protection of water infrastructure, strengthening of water distribution, water quality improvement – botable and nature	*new and old - energy efficient building, zero emission deliveries and trasportation **multiple public transportation options	*reductions in energy need, multiple sustainable iniatives, air quality preserving, statistics tracking	* ”Oslo is a city in constant growth and transformatio n.”
Zurich *https://www.sta dt-zuerich.ch/en **https://www.z uerich.com/en	*network, Iot and ICT, digitalisation, platforms for and from innovations, technology investments **computer models – simulate and predict	*citizens, municipality, government, exchange of experiences, projects **application for easy access information	*promoting public transportati on, renewable energy sources **tourism service providers aware of sustainabilit y	*continous sustainability awareness events **goals for zero CO2 emmission in future	*water quality indicators, drainage systems, environmentall y friendly water supplies **preserving drinking water sources, public fountains	*modern transport network, sustainable buildings – low energy, **high quality infrastructure	*energy efficiency innovations e.g. 2000-Watt Society, new forms of participation from community **particular atenttion on e.g. air travel and hotel stays	** ”…to systematically develop sustainability concepts and pursue their strategy for a long-term Smart Destination.”