2015•2016
SCHOOL FOR TRANSPORTATION SCIENCES
Master of Transportation Sciences

Master's thesis
Towards more sustainable tourism mobility

Supervisor:
Prof. dr. Elke HERMANS

Ngoc Thuy Nguyen
Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences
Master's thesis
Towards more sustainable tourism mobility

Supervisor:
Prof. dr. Elke HERMANS

Ngoc Thuy Nguyen
Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences
Preface

I am much honored to have the topic of ‘Towards more sustainable tourism mobility’ as my graduation thesis. In order to come to this end result, I firstly would like to thank The Transportation Research Institute (IMOB) for assigning me a nice topic. I also would like to send thankful words to Ms Caroline Arien for her introduction and guidance work to start my thesis.

Then I would like to specially thank my supervisor Prof. Elke Hermans who helped me from the beginning with research material to elaborate the topic as well as to structure my ideas. Her instructions were essential for me to build a solid literature review and scientific background of the thesis. I also very appreciate her time on correcting and giving feedback to improve my work. That was very helpful to enhance my scientific research skills. Moreover, she also dedicated her time for effective communication both by emails or meetings to help me solve difficulties.

I also would like to give many thanks to Ms Anna Koens for her supervision on the second part of my thesis, for her suggestion on investigating the Limburg province as the case study of the thesis. Especially, I had many valuable and detailed feedback from her to improve my thesis as well as my written English. For the second part, I also had the help from Ms Veerle Cops to have contact with Tourism Limburg. I very appreciated meeting with Mr Herwig Dessers from Tourism Limburg to discuss on the Limburg Tourism Life Cycle and other related topics. The talk with Mr Dessers contributed to the content of my thesis and helped me to put my thesis into a broader context of tourism in Limburg.

Finally, I also want to express my thanks to the BTC scholarship program and all my friends who constantly support my study and encourage me on the completion of my thesis.
Table of content:
Preface........................................................................................................................................... 0
Summary ........................................................................................................................................ 5
Chapter 1. Introduction.................................................................................................................... 7
  1.1 Problem statement.................................................................................................................. 7
  1.2 The importance of sustainable tourism mobility................................................................. 7
  1.3 Objectives of the research.................................................................................................... 8
  1.4 Research scope of work........................................................................................................ 9
Chapter 2. Literature review ......................................................................................................... 11
  2.1 Understanding tourism mobility and the impact on the environment ......................... 11
    2.1.1 Tourism and mobility................................................................................................... 11
    2.1.2 Tourism mobility and its impacts............................................................................... 12
  2.2 Transport mode and transport mean usage for tourism purpose .................................. 15
  2.3 Future trend of tourism industry and tourism mobility..................................................... 18
  2.4 The concept of Tourism Area Life Cycle ........................................................................... 21
  2.5 Conclusion........................................................................................................................... 24
Chapter 3. Developing indicators for sustainable tourism mobility evaluation and monitoring ......................................................................................................................... 25
  3.1 Sustainable tourism mobility and the development of indicators .................................. 25
    3.1.1 Sustainable tourism mobility..................................................................................... 25
    3.1.2 The development of indicators................................................................................ 26
  3.2 Tourism mobility indicator settings .................................................................................. 27
  3.3 Tourism indicators................................................................................................................ 31
    a. Destination Management Core Indicators...................................................................... 32
    b. Economic Value Core Indicator .................................................................................. 33
    c. Social and Cultural Impact Core Indicators................................................................... 33
  3.4 Conclusion:........................................................................................................................... 34
Chapter 4. Limburg’s accessibility via public transport networks .............................................. 37
  4.1 Introduction to Limburg Tourism ....................................................................................... 37
    4.1.1 Limburg geography and tourism area ...................................................................... 37
    4.1.2 Inbound tourist’s characteristics.............................................................................. 38
  4.2 Public transport networks for Limburg’s inbound tourists .............................................. 45
    4.2.1 Aeroplane ................................................................................................................... 45
    4.2.2 Public transport infrastructure (train and bus)......................................................... 46
4.3 Limburg and the Tourism Area Life Cycle.................................................................54

Chapter 5. Sustainable mobility plan for Limburg’s inbound tourism market ............57

5.1 Case study examples of public transport initiatives as means of sustainably managing tourism mobility ..........................................................................................57

5.1.1 ACCESS2MOUNTAIN project: ........................................................................57
5.1.2 TransDanube: ...................................................................................................58
5.1.3 Alpine Pearl Passage: .....................................................................................59

5.2 Main weaknesses in public transport networks for visitors travelling to Limburg province ..............................................................................................................60

5.2.1 Safety: ............................................................................................................60
5.2.3 Punctuality: ....................................................................................................61
5.2.4 Comfort: .........................................................................................................61
5.2.5 Economy: .......................................................................................................62
5.2.6 Convenience: ................................................................................................62

5.3 Main actions required to make the public transport network more accessible for inbound tourists ......................................................................................................63

5.3.1 Short term actions: ........................................................................................63
5.3.2 Long term actions: ........................................................................................65

5.4 How does the current phase of Limburg’s tourism development impact on findings/recommendations? .........................................................................................66

5.5 Sustainable public transport indicators for inbound tourists to Limburg ..........67

Chapter 6. Conclusions & recommendation for future research .............................69

References: ..................................................................................................................71
### Table of figures:

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Source(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>International tourist arrivals and receipts 2013</td>
<td>(UNWTO, 2014)</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Inbound tourism by purpose of visit</td>
<td>(UNWTO, 2014)</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Tourism CO2 emissions 1900-2050</td>
<td>(Gossling, Peeters, 2014)</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Mode share for tourism purpose</td>
<td>(UNWTO, 2014)</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>Transport mode for tourism purpose versus other purposes in Europe</td>
<td>(Peeters, 2004)</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>External cost per mode</td>
<td>(Peeters, 2004)</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>Safety cost per transport mode</td>
<td>(Peeters, et al., 2004)</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>European City break hierarchy destinations</td>
<td>(Peeters, et al., 2004)</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>The actual and forecasted international arrivals by market till 2030</td>
<td>(UNWTO, 2014)</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>Daily crude oil price chart</td>
<td>(US Department of Energy, Energy Information Administration) (UNWTO, 2014)</td>
<td>21</td>
</tr>
<tr>
<td>11</td>
<td>Modification of Butler Tourist Cycle Model</td>
<td>(Butler, 2011)</td>
<td>22</td>
</tr>
<tr>
<td>12</td>
<td>European Tourism Product Life Cycle</td>
<td>(Butler, 2011)</td>
<td>23</td>
</tr>
<tr>
<td>13</td>
<td>Sustainable Transport Goals</td>
<td>(Litman, 2015)</td>
<td>25</td>
</tr>
<tr>
<td>14</td>
<td>Location of Limburg province</td>
<td>(Belgium root project, 2008)</td>
<td>37</td>
</tr>
<tr>
<td>15</td>
<td>Tourism regions in Limburg province</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>16</td>
<td>Tourist arrivals to Limburg in 2014</td>
<td>(Tourism Limburg, 2014)</td>
<td>39</td>
</tr>
<tr>
<td>17</td>
<td>Number of overnights of tourists in Limburg in 2014</td>
<td>(Tourism Limburg, 2014)</td>
<td>40</td>
</tr>
<tr>
<td>18</td>
<td>Percentage of Belgian visitors in Limburg from 2001-2015</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>19</td>
<td>Proportion of tourist age groups</td>
<td>(Tourism Limburg, 2014)</td>
<td>43</td>
</tr>
<tr>
<td>20</td>
<td>Type of group visitors</td>
<td>(Tourism Limburg, 2014)</td>
<td>43</td>
</tr>
<tr>
<td>21</td>
<td>Reasons visitors chose Limburg for holiday during 2012-2014</td>
<td>(Tourism Limburg, 2014)</td>
<td>43</td>
</tr>
<tr>
<td>22</td>
<td>Visitor satisfaction survey</td>
<td>(Tourism Limburg, 2014)</td>
<td>44</td>
</tr>
<tr>
<td>23</td>
<td>Accommodation location chosen by tourists</td>
<td>(Tourism Limburg, 2014)</td>
<td>45</td>
</tr>
<tr>
<td>24</td>
<td>Accommodation location chosen by couples 45+</td>
<td>(Tourism Limburg, 2014)</td>
<td>45</td>
</tr>
<tr>
<td>25</td>
<td>Airports nearby Limburg province</td>
<td>(Euroflights, 2016)</td>
<td>46</td>
</tr>
<tr>
<td>26</td>
<td>Train stations location within Limburg province</td>
<td>(Belgian rail website)</td>
<td>46</td>
</tr>
<tr>
<td>27</td>
<td>Mode share of inbound tourists 2012-2014</td>
<td>(Tourism Limburg, 2014)</td>
<td>47</td>
</tr>
<tr>
<td>28</td>
<td>Rail network Belgium</td>
<td>(Belgian rail website)</td>
<td>48</td>
</tr>
<tr>
<td>29</td>
<td>Train connection from Liege to Hasselt</td>
<td>(Belgian rail website)</td>
<td>49</td>
</tr>
<tr>
<td>30</td>
<td>Connection from Knokke (via Brussels) to Limburg</td>
<td>(Belgian rail website)</td>
<td>50</td>
</tr>
<tr>
<td>31</td>
<td>Connection from Blankenberge (via Brussels) to Limburg</td>
<td>(Belgian rail website)</td>
<td>50</td>
</tr>
<tr>
<td>32</td>
<td>Connection from Antwerp to Hasselt via Belgian national airport</td>
<td>(Belgian rail website)</td>
<td>51</td>
</tr>
<tr>
<td>33</td>
<td>The second connection from Antwerp to Hasselt</td>
<td>(SNCB)</td>
<td>51</td>
</tr>
<tr>
<td>34</td>
<td>Connection from Leuven to Hasselt</td>
<td>(Belgian rail website)</td>
<td>52</td>
</tr>
<tr>
<td>35</td>
<td>High speed train network in Belgium</td>
<td>(Belgian rail website)</td>
<td>52</td>
</tr>
<tr>
<td>36</td>
<td>Train connection from Maastricht to Hasselt</td>
<td>(Belgian rail website)</td>
<td>53</td>
</tr>
<tr>
<td>37</td>
<td>Bus connections between Limburg and the Netherlands</td>
<td>(Grensbus, 2015)</td>
<td>53</td>
</tr>
<tr>
<td>38</td>
<td>Travelling time by public transport compared with car to Hasselt</td>
<td></td>
<td>61</td>
</tr>
<tr>
<td>39</td>
<td>Relation between speed-ratio and mode choice</td>
<td></td>
<td>63</td>
</tr>
</tbody>
</table>

3
List of tables:
Table 1. Tourism total emission proportion (Gossling, 2013) ................................................................. 8
Table 2. Transport modes and Transport means (Sanna, et al., 2004) .......................................................... 12
Table 3. Top International Tourist Arrivals (UNWTO, 2014) ......................................................................... 19
Table 4. Indicator suggestion per category (Litman, 2015) ......................................................................... 28
Table 5. List of feasible additional economic indicators of tourism mobility (Litman, 2015) .................. 30
Table 6. List of feasible additional social indicators of tourism mobility (Litman, 2015) ......................... 30
Table 7. List of feasible additional environmental indicators of tourism mobility (Litman, 2015) .......... 30
Table 8. Tourism aspect indicator set (Tajani, 2013) ................................................................................. 32
Table 9. The number of tourist arrivals (Tourism Flanders, 2014) ............................................................. 39
Table 10. Domestic visitor origin and Dutch visitors (Tourism Limburg, 2014) ........................................ 41
Table 11. Origin of international tourists coming to Limburg (Tourism Flanders, 2014) ....................... 42
Table 12. Short term actions ...................................................................................................................... 65
Table 13. Long term actions ....................................................................................................................... 66
Table 14. Economic indicators Limburg .................................................................................................... 67
Table 15. List of social indicators .............................................................................................................. 68
Table 16. List of Environmental indicators ............................................................................................... 68
Summary

Tourism industry has grown significantly over years, both in terms of the number of travelers and the distance travelled. Despite of global economic stagnation and political constraints, tourism industry stays steadily on the rise and is predicted increasingly to rise in the future. In some countries and regions, revenue from tourism activities is the greatest contribution to income and the most important economic driver. Tourism exists geographically spread around the world. However, today it adds new destinations especially from developing countries. Those countries together create a picture of tourism with new trends and heterogeneous behavior yet attract trip generation in a worldwide context. Beside creating jobs and contributing to economics, tourism also implies negative consequences, e.g. tourism mobility emissions representing a large proportion of the leisure environmental impact. Therefore, from the mobility management point of view, sustainable mobility for tourism has been required to study to identify and capture the impact of a touristic mobility footprint and then possibly adjust the trend in coming years and decades into a sustainable way. In addition to the environmental issue, tourism mobility also deals with accessibility and traffic safety problems that need to be tackled in order to provide sustainable mobility in touristic destinations. The research is designed under the framework of using indicators to monitor and governing policy as device to alter and harmonise tourism mobility sustainability. Mode choice and the use of mode are investigated in detailed study and analysis. This is served as background for the research to investigate Limburg province tourism, especially for inbound tourists, thus develop public transport accessibility plan for sustainable development in the next part. In the end, sustainable tourism mobility will add value to sustainable tourism development in the long run.

Key words: tourism mobility, sustainable, environmental impact, transport mode, public transport, indicator, Limburg, accessibility plan
Chapter 1. Introduction

1.1 Problem statement

Traveling for recreational purpose is part of human mobility beside daily activity home based trips. Tourism does not only result from the demand to see things, to explore landscape and culture but is also a lifestyle, a need of social interaction of human beings with the world. Due to living standard’s upgrade, today’s travelling as leisure is not only an opportunity for a small group of people but at present it is the surge of tourism mobility from everywhere and almost everyone in the world, including coming to and from developing countries. Therefore trip distance has substantially increased with inter-regional, inter-continental travelling involving air transport.

The concept of sustainable mobility today cannot proceed without taking tourism mobility into account. The usage rate of every transport mode and the way humans travel for leisure directly contribute to the environmental effect; if we understand the behavioral influence in that process, we can develop strategies and policies to manage this mobility sustainably. Besides the environmental focus, the fact that more people are travelling also puts the issue of safety and accessibility into account of this.

In the thesis framework, the research is going to study the factors that influence on the transport mode choice of tourists, the indicators to monitor and adjust in terms of sustainable mobility regarding tourism activities. Understanding the behavior of visitors and knowledge on transportation characteristics are essential to develop a strategy and actions to achieve the mission of more sustainable tourism mobility. In the second part of this thesis, Limburg province is taken for investigation. By using the approach of public transport as the key intervention, the thesis will present good practices in other areas as references. The result is actions which can be applied on Limburg province to improve the accessibility for inbound tourists by sustainable transport modes. Besides that, the thesis will develop a set of indicators for local authority to manage and check the public transport performance for inbound tourists in the province.

1.2 The importance of sustainable tourism mobility

Tourism has been one of the largest and fastest growing economic sectors in the world over the last decades. Despite occasional prevention due to the political situation, economic stagnation and natural disasters, international tourist arrivals have shown a remarkable growth from 25 million in 1950 to 278 million in 1980, 528 million in 1995, and reached 1087 million in 2013 (UNWTO, 2014). International tourist arrivals worldwide are expected to increase by 3.3% per year from 2010 to 2030 according to UNWTO’s forecasts. The emerging economies are expected to have twice the increase rate compared with advanced economies and their market share will expand from 30% in 1980 to reach 57% by 2030. In general, tourism contributes to 9% of the GDP (direct, indirect and impacts), generates 1.4 trillion USD in export and accommodates 29% of services export (UNWTO, 2014).

From the mobility management perspective, the fact of 1087 million international tourist arrivals and 1159 billion US dollars international tourism receipts (Figure 1.) has shown the importance of paying attention to the trip generation and its consequential issues. How can these trips be organized in a sustainable way to preserve natural resources and mitigate the environmental impact?
Moreover, the table below shows how tourism contributes to total national emissions and reveals that tourism has a significant impact on the environment. That is why global sustainable development also pays attention to the tourism sector and puts the importance of tourism mobility into research.

<table>
<thead>
<tr>
<th>Country</th>
<th>Tourism proportion in national total emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>3.9 – 5.3 %</td>
</tr>
<tr>
<td>Barbados</td>
<td>41%</td>
</tr>
<tr>
<td>Germany</td>
<td>4.5%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>5.2%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>9.1%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>24.3%</td>
</tr>
<tr>
<td>Sweden</td>
<td>11%</td>
</tr>
<tr>
<td>Jamaica</td>
<td>13%</td>
</tr>
<tr>
<td>Norway</td>
<td>13.3%</td>
</tr>
<tr>
<td>Maldives</td>
<td>68%</td>
</tr>
</tbody>
</table>

Table 1. Tourism total emission proportion (Gossling, 2013)

1.3 Objectives of the research
This research is going to provide insights in sustainability issues of tourism mobility with the concern on its impacts. Within the mission of more sustainable mobility, the research is going to present public transport as a key solution. Furthermore, the research will take a specific region as a case study. Within this context, this research will take Limburg province for investigation on the aspect of the use of public transport for inbound tourists. In particular, the thesis will contain these following objectives:

- To investigate mobility within tourism activities, what mode tourists use to transport, the share of each mode and the favored mode.
- To research the environmental impact of transportation for leisure activity per mode share.
- To present the trend of tourism development in the future, the prospect in terms of tourist’s volume, the trend of development in each continent and most visited cities, transport for tourists, the change in leisure activity and the development cycle life of the tourism industry.
- To introduce a general set of indicators in order to manage sustainable mobility.
- To highlight some best practice examples of public transport that are suitable for inbound tourists in specific regions.
- To critically analyse the accessibility of the current public networks for tourists coming to Limburg to understand the weaknesses and status of the network.
- To draft a tourism public transport accessibility plan for Limburg province including suggestions and recommendations for involved stakeholders.
- To introduce a suitable set of public transport indicator for local authority of Limburg province to monitor and evaluate public transport for inbound tourists.

1.4 Research scope of work

The research is designed into two main parts. Firstly, the research gives an overview of tourism mobility and its impacts, the usage of transport for leisure activities and its perspectives. Tourism is expected to gain a greater portion in economics in the coming time. This puts pressure on sustainable development, requires sustainable management also covering tourism and its major accompanied activity which is mobility. From the management point of view, the first part will also propose an approach for sustainable development of tourism mobility. Even though the environmental impact of this industry is still relatively small compared with overall impacts of other heavy industries, its steady increase calls attention to further investigate on the impacts on sustainable development. Therefore, the second half of this thesis will tackle the problems and give solutions for sustainable mobility by giving examples and input for a strategic accessibility plan for a chosen investigating area.

For that, chapter 2 of the thesis emphasises the development growth of the tourism industry due to the technology advancement and increase in possibilities for people to go travelling. From the mobility point of view, the research presents the relationship between tourism and transportation. How transportation is performed within the context of tourism in terms of the scale in space and the means people use to mobilise. The research gives insights on the negative impacts of common transport modes and an overview on their contribution in total tourism emissions. Also, the research indicates the usage of transport modes favored by inbound tourists.

Furthermore, chapter 2 reviews the trends of tourism mobility regarding to most visited countries, most visited cities, forecasted tourism market development, the tourist’s attitude towards visiting purposes, the possibility to take a trip in concern of crude oil price drop, technical assistance, the success of low cost carriers and including global issues (terrorism, war and infectious diseases).

However, the development of any industry often fluctuates or has a circle of life. For tourism, it is the same. Therefore, in chapter 2, the research phases tourism into stages by introducing the Tourism Area Life Cycle as one concept to approach deeper the inherent
development in a certain period. Based on that theory, we can understand the status of regions which are chosen for research and have appropriate improvements on the transport network.

In chapter 3, in investigating how to sustainably manage tourism mobility, the research develops an appropriate indicator set in terms of environment, society and economy for the local authority to use to develop tourism mobility, foresee and mitigate its negative impacts and contribute to the whole general sustainability plan of the region. The indicator set was composed based on the review of sustainable transport system indicators and sustainable tourism indicators and thus has a meaningful contribution to tourism mobility.

In the goal to achieve sustainable development, there are many approaches and techniques. Chapter 4 and chapter 5 will investigate public transport as a key intervention to manage sustainability of tourism mobility. Besides that, the research will also highlight successful case studies applied in Europe to illustrate and strengthen the validity of public transport. These are solid materials to investigate the current status and improve the network in a specific area.

Within this thesis framework, Limburg province is taken as a case study for investigation. Limburg’s tourism and the transport situation for tourists are described in chapter 4, by means of visitor’s volume, key market, tourist’s demography, and the most important are the current accessibility situation by public transport. The thesis also is going to identify the development status of tourism development in Limburg according to the TALC model described in chapter 2.

Chapter 5 is going to find the main weaknesses in public transport networks and main actions required for involved stakeholders to make the public transport network more accessible for inbound tourists. Some good practices from other regions also are introduced as good examples and references. Also, the thesis suggests a particular set of public transport indicators for managing and monitoring sustainable tourism mobility in Limburg province.

The research is going to create a public transport accessibility plan for inbound tourists coming to Limburg. Tourists may come from Belgium but also international arrivals are considered, tourists also have different expectations and holiday plans such as a cycling trip, horse riding trip, camping trip, etc. so the accessibility plan can be improved in order to enhance the mobility in a sustainable way according to tourist’s characteristics. In addition, the accessibility plan can draw out actions and recommendations for involved stakeholders, including suggestions to improve the public transport network.

Chapter 6 is the conclusion for sustainable tourism mobility in general and Limburg province specifically. Also, the limitations of the research as well as some recommendations for future research are indicated.
Chapter 2. Literature review

This chapter gives insights into tourism mobility and its environmental impact due to the mobility activities. It will draw attention to the sustainability matter for tourism which was used to be considered as “smokeless” industry by using official facts and figures to identify the current situation of tourism mobility. This has a different contribution depending on the type of transport mode that tourists use to mobilise. However, tourists have various types of trips in terms of holiday types, distance travelled, etc. Thus, the share of each transport mode is not equal. This section also gives background information on the development of transportation for tourists. Afterwards, we focus on the future development and the life cycle of tourist areas which are essential to understand the trend of tourism mobility to develop suitable indicators and especially a policy and interventions to monitor and improve sustainability. The trend of tourism mobility is expressed by forecasted market development, most visited cities, influencing factors including political issues, infectious diseases, tourist behavior transitions, new business models and technology innovation.

2.1 Understanding tourism mobility and the impact on the environment

This section gives insights into the tourism development as worldwide recognition. Furthermore, when taking account of tourism mobility there are two different types of movements of passengers that need to be defined. Depending on the scale of transport in space, the requirement of the transport system should be adapted accordingly. Moreover, for sustainability of tourism mobility, it is essential to look into the impacts that tourism mobility is causing to the ecological system.

2.1.1 Tourism and mobility

**Tourism**: The international definition of tourism as given by the World Tourism Organisation - United Nations (2001) includes all travel purposes, as tourists are all visitors staying between one night and one year outside their usual environment and are not working for a company based at the destination. The remainder is defined as ‘same day visitor’. In the meanwhile, the transportation field normally defines ‘tourism’ as leisure related only. Another definition of tourism is: “Tourism comprises the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited” (source: WTO, 2002).

**Tourists**: those who are undertaking all trips involving more than one night stay, but less than one year for leisure and holiday, business and visits to friends and relatives. (Peeters, et al., 2004)

![Figure 2. Inbound tourism by purpose of visit (UNWTO, 2014)](image)

It is illustrated by figure 2 that visitors coming for purely leisure holiday accommodate more than half of total visitors. There exist combinations of two or more purposes of visiting; nevertheless recreational activities are the ultimate reason to take people away from their
home-base. Therefore, in terms of transportation planning and management, travelling for leisure purpose should be put in greater concern.

**Transport:** From the definition of tourism it results that it is impossible to carry out a tourism activity without transportation. At least the tourist has to be moved from his or her place of residence to the destination of holiday, leisure, business or friends/relatives. But also during the stay on the destination, the tourist will often travel within the region. Due to these two types of transport demand, there are two kinds of transport that tourists would use (Peeters, et al., 2004) and therefore, in terms of providing and managing transportation services, the authority and policy makers also should put remarks on their strategy.

- Origin-Destination (OD) transport refers to transport between the residential place of the tourist and the tourist destination. It refers to the way people make the movement from home and the tourist accommodations through transfer of different modes at airports, harbours, railway stations or other. Therefore, OD-transport is generally long distance compared with local transport.

- Local transport refers to transport at destinations between arrival and departure for transfers, excursions and activities during the tourist’s stay at the destination. This will be all leisure and business related local transport by non-residents.

**Supply side of Tourism mobility:** there are many different ways to perform transport. As a result of continuous innovation and mechanical engineering accomplishment, today people do not only travel on the ground surface, using animal power, but the supply side of the transport market offers different ways to transport regarding to speed, capacity, safety and the level of service experience. That we call Transport modes expressing the ability of Transport means (see Table 2) travelling across different environments and having specific characteristics.

<table>
<thead>
<tr>
<th>Transport modes</th>
<th>Transport means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Car, bus, motorbike, bicycle, walking, horse, coach, etc</td>
</tr>
<tr>
<td>Rail</td>
<td>Train, tram, metro, funicular</td>
</tr>
<tr>
<td>Short-sea/ Inland waterways/ Maritime sea</td>
<td>Ship, ferry</td>
</tr>
<tr>
<td>Air</td>
<td>Airplane, hot-air balloon, zeppelin, etc</td>
</tr>
<tr>
<td>Intermodal</td>
<td>Combination of the given means</td>
</tr>
</tbody>
</table>

**Table 2. Transport modes and Transport means (Sanna, et al., 2004)**

**2.1.2 Tourism mobility and its impacts:**

Travel and tourism together form the world’s fastest-growing economic sector, and this has mainly been the case during the past half century. Worth around US$ 3.5 trillion per year and employing 200 million people at the end of the 20th Century, the growth rate for national and international travel/tourism has averaged to be some 3-4% (i.e. more than the general growth) for many years. Europe is still the most frequently visited tourist destination in world terms (roughly 60% of international tourism), but many developing countries gain significant income from the trade. This is particularly true for islands or countries with substantial coastal tourism: in these cases tourism often represents a major proportion of the gross domestic product, for instance, Caribbean countries are four times more dependent on tourism economy than any other area in the world. Moreover, marine and coastal tourism is one the fastest growing areas within the world's largest industry. (Sunlu, Camarda (ed.), Grassini (ed.), 2003) As a result, tourism brings economic benefits to regions, but there are
usually substantial socioeconomic and environmental costs associated with it. (Davenport, Switalski, 2006)

In the United States, tourism is the third-largest retail industry just after automotive dealers and food stores. (Davies, Cahill, 2000) Although tourism was considered as a “smokeless” industry with little environmental impacts, there is increasing awareness of the economic and environmental significance of tourism in recent years. Natural resources experience negative impacts from tourism when the level of visitor use is greater than the environment's ability to cope with this. For instance, tourism development can put pressure on natural resources, especially fresh water resource, one of the most critical natural resources when it increases consumption in areas where resources are already scarce. (Sunlu, Camarda (ed.), Grassini (ed.), 2003) The tourism industry generally overuses water resources for hotels, swimming pools, golf courses and personal use of water by tourists. Besides that, tourism can create great pressure on other local resources especially in main tourist centers or in tourist seasons, due to the consumption of visitors concerning energy, food, and other raw materials that may already be in shortage and as consequences, degradation/land erosion issues. Since the demand for leisure activities is rising, the tourism projects and recreational facilities put increased pressure on these resources and on scenic landscapes. Direct impact on natural resources, both renewable and non-renewable, in the provision of tourist facilities can be caused by the use of land for accommodation and other infrastructure provision, and the use of building materials.

From a mobility point of view, transportation in the context of tourism can cause the same pollution problems as any other industries which used to be disregarded in the past like air emissions, noise, solid waste and littering, releases of sewage, oil and chemicals, even architectural/visual pollution. (UNEP, 1999)

Transport by air, road, and rail is continuously increasing in response to the rising number of tourists and their greater mobility. The International Civil Aviation Organization reported that the number of international air passengers worldwide rose from 88 million in 1972 to 344 million in 1994. One consequence of this increase in air transport is that tourism accounts for more than 60% of air travel and is therefore responsible for an important share of air emissions. One study estimated that a transatlantic return flight could produce emission almost half the total CO2 emissions produced by other sources (lighting, heating, car use, etc.) of an average person per year (UNEP, 1999)

Transport emissions and emissions from energy production for transport activity are direct reasons of acid rain, global warming and photochemical pollution. Air pollution from tourist transportation has impacts on global level, with regards to carbon dioxide (CO2) emissions and other chemical substance emissions generated from transportation energy use. And it can contribute to severe local air pollution. Noise pollution from airplanes, cars, and buses, as well as recreational vehicles and cruise ships cause distress to wildlife, especially in sensitive areas. (Sunlu, et al., 2003)

Air transport has a share of 50%-78% of all impacts and was responsible for 80% of greenhouse gas emissions in the tourism transport sector in 2000 (Peeters, 2004). Road transport causes the greatest impacts on air quality while rail, coach and ferry represent almost 20% of all trips but have a very limited environmental impact due to a relatively low emissions rate on a passenger basis. Air transport causes negative impacts on the environment in terms of noise pollution, air quality effect and climate change. Emissions of aircrafts are not only contributing to ozone pollution but also to the local air pollution during the taxi, landing or takeoff procedure at the airports. Technology is in challenge of innovation regarding to cost, safety of the aircraft fleet and applicability on three domains (noise, air, climate) together. As air transport has the greatest impact on environment and these sectors also have the strongest growth, policy makers in tourism should therefore consider measures reducing both air transport and intercontinental travel (Peeters, 2004). In the
meanwhile, rail transport should be further investigated to implement as an eco-friendly transport mode for tourists to reduce the share of air transport.

On the other hand, one of the transport modes that causes a high rate of emissions is the cruise ship. Cruise ships in the Caribbean are estimated to produce more than 70,000 tons of waste each year. Solid waste and littering can degrade the physical appearance of the water and shoreline and cause the death of marine animals. (UNEP, 1999) Cruise ships are special modes; due to the character of not only transport mean but also accommodation for tourists they create a number of ecological impacts. Due to the lack of regulatory framework and control, it is common to discharge of substances illegally (mainly discharge of oil or other hydrocarbons). Cruise ships with anchoring in tropical waters cause severe long-term damage to coral reefs. Besides that, vessels becoming larger so they need sufficient draft water level. Therefore it generates dredging activity which damages both corals and sea grass beds to deaths. During operation, the turbulence produced by their propulsive screws of vessels also stirs up sediment, digging up biological communities and thus decreasing biodiversity. A cruise ship could be considered as a village; the largest one (Allure of the Seas) can carry more than 6,000 passengers and crew, and produce substantial quantities of waste water and sewage that are often discharged directly into the ocean without proper treatment. A typical cruise ship discharges around 1 million litres of ‘black water’ (sewage) during a 1 week voyage (United States Environmental Protection Agency 2000). Another problem is that cruise ships also disembark large numbers of people onto remote sites that have natural preservation sites. As a result, high number of visitors can damage nature balancing and cause habitants loss. Finally, if solid waste is not dumped at sea, it is often dumped in landfill sites at tourist destinations contributing to the area’s pollution. Operators of cruise ships in polar waters usually concentrate on eco-tourism and minimal environmental impacts. However, polar waters are inherently dangerous and in the concern of oil spills. There is still a debate whether vessels should run around or break an iceberg. Fuel oil spillage is a problematic issue as heavy fuel oil is more toxic than crude oil and the time required for the breaking down of petrochemical substances is much longer due to cold water with an ice covered surface. (Davies et al., 2000)

Therefore, the decision of holiday type is relatively important because it is the primary factor of transport mode decision and thus relates to the level of emissions caused by transportation of the trip. For instance, compared with an average emission of a Dutch holiday which is expected to be 49 kg CO2 per day (de Bruijin, et al., 2008), the highest average environmental impact per day are from the following holiday types:

- Cruises (+265%)
- Intercontinental (long-haul) holidays (+200%)
- Holiday by airplane (+102%)
- Holiday in hotel/motels (+78%)
- Organized holidays (+35%)
- Outbound holidays (+27%)

And the holiday types with the lowest environmental impact per day are:

- Domestic cycle holidays (-76%)
- Outbound holidays by train (-55%)
- All camping holidays with a tent (-50%)
- Domestic holiday (-47%)
- All non-organised holidays (-39%)
- All nearby outbound holidays (-31%)

Figure 3 shows the growth and contribution of tourism mobility emissions by car and air compared with other categories of tourism emissions.
2.2 Transport mode and transport mean usage for tourism purpose

This section gives facts on the usage of every mode for tourism mobility. In addition, this section also gives an overview of transport mean usage dominated for tourism in comparison with other purposes in the context of the European market. Besides that, it should be taken into account that tourism is associated with lifestyle and changeable over time. This is due to the trend of leisure and recreational activity defined by human society. Therefore, we recall the history of development of the common transport modes for tourism that are roadway, waterway and air transport to understand the insights leading to the present situation of tourism mobility. The way in which people are executing recreation is a core factor defining not the only type of vacation but also directly effects selecting the transport mode. Thus in this section brief background information on common transport means for movements from origins (home-base) to destinations (holiday places) is explained. Finally, each transport mode has a different environmental impact rate and safety level; this section uses a figure to illustrate this variety by means of monetary values.

Firstly, it is essential to remark in a worldwide context which transport mode is having a major contribution to tourism mobility. Despite densely constructed road networks, the report of the World Tourism Organisation 2014 indicated that air travel is the main transport mode in terms of inbound tourism mobility. This causes consequentially pressure on the transport hub capacity and raises the requirement of the construction of larger and more modern airports. As a result, it creates tension on the transport infrastructure system of such transport hub cities.
Similarly, in Europe air transport also presents as the main transport mode in tourist’s mindsets, followed by the ferry. Air transport and ferries constitute between 15% and 20% of all passenger-kilometres travelled (Peeters, et al., 2004).

The 20th Century has been seen as era for tourist resort constructions. For connectivity, these resorts require effective transport links to the transport system. Thus the consequences are the explosion of car and coach fleets that contributed greatly to the development of extensive road networks and increasing residential fragmentation. That matter has occurred in developed countries such as the tourist development along the Mediterranean coastal side, Alpine area ski resorts and now continues in emerging economies. Tourist resorts also require extensive car-parking facilities and accommodate more land use. For example, in Italy 50% of the 8000 km of coastline has been built over in the past 3-4 decades and in the US it is estimated that 16 million hectares are covered by roads and car parks (Davenport, Switalski, 2006). Despite the effort to develop ecotourism destinations, the number of trips due to the demand to travel to such destinations still remains or even triggers more.

Before the 1960s decade, large passenger vessels were the primary mode of trans-oceanic transport for about a century. After 20 years of stagnation, the last 30 years has been characterized by a renaissance of cruise ships and yachting services. By 2003 about 250 cruise ships carried some 12 million passengers per year. Most attention is to polar waters for adventurous tourism. Cruise ships are also popular in some freshwater waterway
systems, particularly along the Rhine, Danube, Amazon, St Lawrence and Nile rivers (Davenport, Switalski, 2006).

The appearance and steady rise of Air Transportation has changed the tourism mobility since the last century. On January 1, 1914, the world’s first scheduled flight across the bay separating Tampa and St. Petersburg, Florida took place for a fare cost at $10 per person round-trip (about $200 in 2007 price) (John Bowen, et al., 2013). The year 1919 marked the first commercial international air transport service between England and France. During the 1930s and 1940s an air ticket could account for up to 50% of the average annual per capita income of an American. In another context, World War I began just a few months after the historical flight from Tampa and for the first time, Air force began to be used and thus better aircrafts were commanded to quickly design. This side effect was the great contribution to the development of commercial aviation especially when the war ended; a legacy of thousands of unemployed pilots and surplus aircrafts became available. However, air transport still had constraints of capacity and range. By the beginning of World War II, air travel was quite literally taking off. Technology tried to improve both speed and distance travelled and was still able to gain profit. However, the market for long-haul travel was very small due to extraordinary high costs. Many of the long-haul air services were just to colonies and dependency territories. Therefore, only the elite or government officials were able to afford air travel. By 1958, airlines carried more passengers than ocean liners across the Atlantic for the first time and Boeing 707 with its commercial flight route linking New York and Paris was first introduced (stop in Gander, Newfoundland for refueling). The B707 successfully increased the productivity of commercial airlines with double speed which enabled fares to fall. Few years after the B707’s debut, air transport service had been extended to most major world markets opening the period called ‘Jet Age’ that commercial aircrafts have advanced markedly in capacity and range. (Bowen, et al., 2013).

Taking advantage of the airplane, accompanied with better income and reduced working days, there have been more and more people taking holiday by air transport. Today air transportation contains a total fleet of 1,397 commercial airlines with 25,332 aircrafts in commercial service, 3,864 airports in operation producing 36.4 million commercial flights worldwide (IATA, 2013). Three major categories of passenger jet planes may be recognized. They are Short range aircraft (Bombardier’s CRJ series and Embraer’s ERJs) which can load from 30-100 passengers travelling for short distances and feeding hub airports, Medium range aircraft (Airbus A320, Boeing B737) with a range of 3,700 km designed to service destinations within a continent and Long range aircraft. There are a variety of aircrafts capable of crossing the oceans and linking together the continents and having a range up to 17,400 km (B777 series, A350 series, and A380 series) seating about 656 passengers or up to 960 passengers in all economy configurations. (Bowen, et al., 2013).

As mentioned above, transportation for tourism purpose directly contributes to environmental impacts and global pollution. However, each transport mode dedicates in different rates. Environment impact is expressed in terms of noise pollution, air pollution, and climate change and landscape damage. Below is the illustration of these costs per transport mode of tourism mobility, also taking the accident cost into account as one external cost. It shows that travelling by car is in concern of air pollution and accidents while air travelling has the greatest cost of climate change and nature/landscape cost.
Besides that, with the concern of comfortable and safe travelling, it is essential to have information on the average cost of accidents or the safety cost per transport mode as described by the following chart (Peeters, et al., 2004). It can be seen that travelling by rail has relatively equal safety cost with travelling by air but travelling by rail has considerable low external costs as shown in the previous figure.

![Safety cost per transport mode](chart)

**Figure 7. Safety cost per transport mode (Peeters, et al., 2004)**

### 2.3 Future trend of tourism industry and tourism mobility

This section gives the trend and prediction of tourism development as well as tourism mobility development. Policy makers should align these forecasts to take action and prepare a framework according to the extent to which the tourism mobility will develop, to the market to capture and the type of activities to concern about.

Despite some fluctuation, the top international tourist arrivals are predicted to remain these top 10 countries in the coming years. (UNWTO, 2014)

<table>
<thead>
<tr>
<th>Top International Tourist Arrivals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>2012</td>
</tr>
<tr>
<td>Country</td>
</tr>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td>France</td>
</tr>
<tr>
<td>United States</td>
</tr>
<tr>
<td>Spain</td>
</tr>
<tr>
<td>China</td>
</tr>
<tr>
<td>Italy</td>
</tr>
<tr>
<td>Turkey</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>United Kingdom</td>
</tr>
<tr>
<td>Russian Federation</td>
</tr>
<tr>
<td>Thailand</td>
</tr>
</tbody>
</table>

**Table 3. Top International Tourist Arrivals (UNWTO, 2014)**

In Europe, the most favorite visited cities are listed in Figure 8.

![Figure 8. European City break hierarchy destinations (Peeters, et al., 2004)](image)

These 15 cities are receiving more than 50 million visitors per year and generating more than 200 million bed-nights (Peeters, et al., 2004) seeking for intensive compact touristic activities in one place (sightseeing activities, dining, shopping, exhibition/events). They usually create the travel flows between these cities and rely much on air travel. Customers are diverse, the fastest growing inbound market is Asia and Pacific with 70% growth while the Americas showed only 18%. Still the major market, tourists within Europe, grows a little above average.

Growth has been above average for Eastern Mediterranean (129%), Central/Eastern Europe (67%), Southern Europe (49%) and Northern Europe (44%), and below average for Western Europe (24%)

In general, the American market is forecasted to grow steadily in the future and is the second largest market while the European market as a traditional tourism market with slight increase in tourist arrival numbers will remain to represent the biggest portion of total visitors worldwide. In addition, new destinations that bring experiences of natural exploration in combination with human heritage and cultural treasure push African, Asian and the Pacific and Middle East markets continue to surge. Due to airline services expanding, visitors today
can access the places that were hard to approach before, thus these destinations are well preserved in terms of cultural features and local specialties which today highly attract tourism. Another reason is that the travelling expenses in those markets are affordable for mainly tourist’s budgets from businessman to backpackers. Below is the forecasted trend of international arrival per market conducted by the World Tourism Organization (2014).

![Figure 9. The actual and forecasted international arrivals by market till 2030 (UNWTO, 2014)](image)

Associated with the development of tourism mobility, following key issues and findings are stated by Peeters, Egmond and Visser (2004)

- The purpose of trips shifts from leisure, recreation and holidays to business and visiting friends and relatives.

- The total revenue of tourism depends more on the individual leisure time budget and disposable income of tourists than on the distance between departure and destination. The number of trips people undertake is independent of the economy, population, political system or climate of the region. It is mainly a function of the population. However, the distance covered per trip is depending on the money budget and the time budget. Travel time has a close relation to available transport systems providing transport service. Countries with a high GDP invest more in physical infrastructure and therefore increase the average speed of transport systems. In the meanwhile the money budget is a fixed share of disposable income (population base). It is also noticed that a larger transport budget will increase access to private cars, sport motorcycles; high speed rail and air transport and thus trigger the distance travelling.

- Terrorism, war and diseases currently had only a regional and temporary impact on tourism development because tourists are away from political issues and tend to concentrate on protected areas from disease or tension demonstrations. And this appreciates to air transport; WTO sees that total air transport did not suffer much from terrorist attacks, global diseases (SARS) and war outbreaks (WTO, 2003). In other cases, if long haul travel suffers from war, SARS or terrorist attacks, the domestic tourism will take over this share.

WTO data show the following trends between 1990 and 2001: air transport showed the largest growth with 64%, water 40%, road (car plus coach) 33% and rail only 2%. And
without strong interventions, it is forecasted that passenger kilometres will be distributed more unevenly over the modes as air transport takes much further distance than other modes. (Peeters, 2004)

With respect to air transport WTO also sees a transition from traditional main air carriers to low cost carriers (LCCs). This has been recently reflected by a trend towards intra-European and domestic tourism taken by low cost carriers. Tour operators also take this advantage to promote a European tourism marketing strategy and domestic markets. In the concern of low cost carrier business’s explosion, by 2010 more than 30% of all air European transport was carried by LCC’s, taking away passengers from coach and rail and for over much larger distance for short and more frequent breaks. This puts both direct and indirect effects on employment and the economy both in a negative and positive way. (Peeters, 2004) Cheap air transport leads to a combined mode-destination shift for instance the speed train ticket sometimes costs more than the air fare. This results in strong influences on the environmental impact.

Besides that, the crude oil price drop (see Figure 10) is expected to decrease airfares, reduce costs for driving and therefore generate more trips.

![Figure 10. Daily crude oil price chart (US Department of Energy, Energy Information Administration) (UNWTO, 2014)](image)

Last but not least, new technology development allows more and more individuals to be “free to live where they want and travel as much as they want” (Hannam, et al., 2014). For instance, internet connectivity instantly provides required information. More accurate navigation devices, better protection gears or development of media and photographic equipments make travelling much easier and more enriching than in the past. This “geographical independent” lifestyle pulls the relationship between mobility and technology closer. Many IT applications are devoted to planning, giving information about the destination, scheduling leisure trips. Mobile devices also put an added value for travellers. Social networks or the travelling communities are really helpful in assisting tourists before and during the trips. In other words, internet promotes tourism and leisure trips, wipes information contraints and encourages people to take more trips (Hannam, et al., 2014).

### 2.4 The concept of Tourism Area Life Cycle

Tourism Area Life Cycle is a process describing how a destination starts up and levels off as a tourist attraction having a recovery slowly through stages. The reason to introduce the concept is that as the destination attracts more visitors, amenities of the area tend to improve, and visitor numbers grow rapidly towards and sometimes beyond the carrying capacity of the destination. (Butler, 2011) From the mobility management aspect, understanding of this process will help authority and policy makers in strategy preparation to
capture the tourist flows, provide sufficient capacity as well as maintain physical infrastructure and mitigate environmental impacts.

Figure 11. Modification of Butler Tourist Cycle Model (Butler, 2011)

Butler developed a model which shows how any tourist area may grow. That most tourist areas may start off from a very small scale, low key destination and get bigger and bigger until stagnation occurs. He suggests that all areas go through the same sort of process of seven stages of tourist development.

1. **Exploration**: a small number of tourists visit the area who are adventurous people and looking for something different in a holiday and find a place that is special in terms of its culture, natural beauty, history or landscape. The area is unspoiled and there may be no tourist services available and local people are not involved in touristic business activities.

2. **Involvement**: local people start to notice that there are increasing numbers of people coming to their local area and start to provide some facilities for tourists. Next, they start business to provide accommodation, food, tour guides, and transport.

3. **Development**: the host country starts to develop and advertise the area. The area becomes recognised as a tourist destination. Big companies start to see the emerging potential of the area as a tourist resort and therefore start to invest money in the region. They build large hotel complexes and sell package holidays (a package might include travel, accommodation, food and excursions). This makes the numbers of tourists rise dramatically and massively expands the number of job opportunities for people in the local region, in both tourist related jobs and in construction and services.

4. **Consolidation**: the area continues to attract tourists. The growth in tourist numbers may not be as fast as before. Some tensions develop between the host and the tourists. For instance, the local economy is probably dominated by tourism at this stage, and many local people work in tourism industry as their major income. However, this can remove people from other industries such as farming and fishing and these industries can suffer as a result. There will be continued building and expansion of the resort however some of the older buildings will start to become unattractive.
5. Stagnation: the strict competition among resorts, the crowdedness and loss of the original features (e.g. it had a great beach but that is now crowded and full of rubbish) can cause the resort to stop growing. Or the facilities for the tourists become old and run down. The numbers of tourists may decline too, threatening the local business and service.

6. Re-orientation: continuing as the result of stagnation, the host puts effort to offer more promotion and improvement. The success or failure of this stage creates stage 7 of the tourist area process.

7. Different possibilities for development direction: Rejuvenation - investment and modernisation may occur which leads to improvements and visitor numbers may increase again. Decline - if the resort is not rejuvenated (stage 6) then it will go into decline. Decline can be slow or rapid, and regular visitors are replaced by people seeking a cheap break or day trip. People lose their jobs related to tourism. The image of the area suffers.

There still is a debate on the validity and applicability of the TALC proposed by Butler, like not all areas experience the stages of the cycle as clearly as others. This suggests that the model cannot be applied to all destinations in the same uniform manner. (Zhonga, et al., 2008). The author still noted the difficulty of determining where individual cases may be best represented within the model. Other research conducted show that some cases are in lack of a stage or skip a particular stage. The model still cannot explain for how long a stage will be taking place because it ignores the participation of other stakeholders such as authority and a proactive business sector in tourism industry in effort of sustaining or improving the tourist product. These interventions will change the shape of the development process. However, it suggests the possibility of a sustainability option in which the line will remain flat. Nevertheless, the model is still implied commonly and assisted on explaining the development process and has a certain forecasting value. Below is one implication of Butler’s model on the European tourist products life cycle. Based on that, transportation experts can foresee to what extent the transport system should be prepared and enhanced to adapt with the development demand.

Figure 12. European Tourism Product Life Cycle (Butler, 2011)
2.5 Conclusion

Traveling for recreational purpose, business relationship or friend/family visiting is part of human mobility activities beside daily home based trips. Today’s travelling as leisure is not only an opportunity for a small group of people. Tourism is one of the fastest growth economic sectors with a contribution of 9% to GDP and 1.4 trillion USD export. (UNWTO, 2014) However, tourism development can result in impacts on natural resources such as energy, food, raw materials and especially fresh water resource and cause land degradation. Tourism emission can account up to 5% of national emissions (like in Australia) or up to 68% overall emission (in Maldives) (Gossling, 2013) depending on the scale of economics.

From a mobility point of view, the operation of transportation for tourism can cause the same pollution problems as any other industries like air emissions, noise, solid waste and littering, releases of sewage, oil and chemicals, even architectural/visual pollution. Remarkably, emission from tourism mobility is a major contributor in total tourism emission. In that context, Air transport has a share of 50%-78% of all impacts and it is also the major transport mean for international tourism (more than 50% share of modes). (Peeters, 2004). Furthermore, accounting for 5% of total trips, cruise ships cause a significantly negative impact on environment, an unsustainable footprint on ecology and disturb both marine life and nature of the destination.

Tourists are seeking for new destinations with more attractions in terms of culture, landscape and local experience. That is the reason why the forecasted figure from the World Tourism Organization has predicted that Africa, Asia and Middle East will attract most tourist flows while America and Europe remain the second and the largest tourism market respectively. Tourists nowadays benefit from the crude oil price drop, abundant tourist information and technology innovation. For that, air transport is still the major transport means for tourists. The explosion of low cost carriers taking customers from the road and rail transport market raises more concerns of environmental impact from the air transport sector. The number of trips is a matter of population base depending on disposable income and time budget. Therefore, the global issues such as terrorist attacks, war and infectious diseases are just temporal and have a regional effect.

With the understanding of the impact of tourism mobility per mode, the trend of tourism economics, tourist attitude and the tourist product life cycle, in the next chapter we develop indicators reflecting these characteristics. Indicators are supposed to be useful tools for authority and policy makers to manage sustainability of tourism mobility.
Chapter 3. Developing indicators for sustainable tourism mobility evaluation and monitoring

This chapter is going to describe sustainability in tourism mobility and approach indicators to manage its sustainability. Based on theory and guidelines of sustainable transportation systems, this section is going to review and develop a general set of indicators to assess the level of sustainable mobility of a region. These indicators can be used as theory tools for authority for monitoring the sustainability of tourism mobility. An important and appropriate indicator relates to emission and the use of the local transport as well as the emission of the transport mode to and from the vacation destination.

3.1 Sustainable tourism mobility and the development of indicators

3.1.1 Sustainable tourism mobility

The United Nations define sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Thus sustainable mobility tourism is under mission of preservation of the natural and cultural resources of the tourist destination and region, whilst simultaneously ensuring the greening of the products and services that deliver the visitor experience (ECOTRANS, 2004).

Therefore sustainable management is a whole process implemented by partnerships of government, private and civil stakeholders and is guided by a sustainability monitoring and indicator system that provides transparent information on the three dimensions of sustainability: the social, environmental and economic aspect. Sustainable management is also an interaction process to improve policy-making and decision-taking within all stakeholders. The process is initiated at the destination level by a benchmarking exercise and answering questions in terms of social, economic and environmental aspects. These processes or the effect on the destination landscape are then measured by selective performance indicators, which provide feedback and reference for policy making. As tourism mobility is part of the transport system, therefore sustainability is defined under these three following dimensions: economic sphere, social sphere and environmental sphere.

![Figure 13. Sustainable Transport Goals (Litman, 2015)]

Sustainable mobility tourism ultimately needs a zero emission goal, a healthy and environmentally friendly, energy efficient and carbon neutral, comfortable and flexible movement from home door to hotel door, with in the meanwhile sufficient transport means for movement within tourist destinations (Tajani, 2013). Thus three dimensions of sustainability can be described as:

**Economy:** Support economic vitality while developing infrastructure in a cost-efficient manner. Costs of infrastructure and operation expenses must be within the society’s ability and the willingness to pay of tourists. Operation of tourism mobility should be in an efficient
and productive way to avoid redundant resources or in temporal shortage and smoothly harmonizes with the transport system.

**Social:** Meet tourist’s needs by making transportation accessible, safe, and secure; include provision of mobility choices for all tourists (various tourists sections such as businessman, family holiday travelers or budget travelers, also including disabled people); and develop infrastructure that is an asset to communities.

**Environment:** Create solutions that are compatible with and enhancement to the natural environment, measurements to mitigate emissions and pollution, and reduce the material resources (energy, natural resource) required to support transportation activities.

Therefore, implementation of sustainable tourism mobility often uses these general objectives when setting a strategy or development scenario (Ceron, Dubois, 2007), (Tajani, 2013):

- Reduce emission of tourism transport to a sustainable level
- Preserve and enhance mobility opportunities for the general population of both developed and developing countries
- Reduce conventional pollutants by enforcement of standards and regulations.
- Keep stable or reduce road transport in the concern of reducing noise and congestion.
- Balance the air and rail transport ratio
- Improve road security measures and reduce hazardous collective transport.
- Improve information for decision making
- Effective risk management
- Prioritize action projects
- Performance benchmarking
- Improve community buy-in and support for tourism stakeholders
- Enhance visitor experience
- Increase cost savings
- Increase value per visitor

3.1.2 The development of indicators

The development of sustainable development indicators was first brought up as a political agenda issue at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. The UNCED policy declaration Agenda 21 requested countries at the national level and international governmental and non-governmental organizations at the international level to develop indicators in the context of improving information for decision making. Since then, indicators are thought to be important tools for measurement of different aspects of sustainable development, including transport related issues. (Dobranskyte-Niskota, et al., 2007)

Tourism mobility is put within the context of sustainable development of the transport sector and has to deal with key challenges and issues nowadays such as: air pollution from a wide range of emissions, climate change especially from emerging economies, congestion in mega cities, energy security and natural resource consumption, equity of access, habit fragmentation and land consumption, noise and road safety. Therefore, the set of indicators of tourism mobility is developed not only to indicate the tourism’ circumstances but also to tackle the general problems of the transport sector for tourism. Although most developing countries are in lack of sustainable transport development goals (Bongardt, et al., 2011) as well as the sustainability in a tourism mobility framework, the indicators indeed provide benefits in many ways. Firstly, they identify the challenge and problem, to what extent the strategy should target. The set of indicators also is an effective communication way in terms
of transparency and systematic that a country or region can therefore learn from each other in terms of successful implementation. Countries can control whether political measures contribute to progress towards sustainability goals. If necessary, they can adjust their concept. (Bongardt, et al., 2011) This is also the way to gain competitive advantage on the global ranking as today countries can present themselves in comparison with others to prove their attractiveness as location. Finally, indicators can be seen as platform to dialogue between local governance and multiple involved stakeholders.

The report of the Canadian Victoria Transport Policy Institute (VTPI) prepared by Litman (2007) the best practices for selecting indicators to measure transportation performance take into account the following quality criteria:

- Comprehensiveness: indicators should reflect various economic, social and environmental impacts, and various transport activities.
- Data quality: data collection practices should reflect high standards to ensure that information is accurate and consistent
- Comparability: data collection should be standardized so the results are suitable for comparison between various jurisdictions, times and groups. Indicators should be clearly defined.
- Easiness to understand: indicators must be useful to decision makers and understandable to the general public.
- Accessibility and Transparency: indicators (and the data they are based on) and analysis details should be available to all stakeholders.
- Cost effectiveness: indicators should be cost effective to collect. The decision making on the value of the indicators must outweigh the cost of collecting them.
- Net Effects: indicators should differentiate between net (total) impacts and shifts of impacts to different locations and times.
- Performance targets: indicators should be suitable for establishing usable performance targets.

3.2 Tourism mobility indicator settings

Some quantitative targets established by various recognized institutions may serve as criteria for the development of sustainability indicators. For instance, these quantitative criteria imply that transportation will be characterized as environmentally sustainable in the target year 2030 if the following conditions are achieved (Dobranskyte-Niskota, et al., 2007):

- CO2: total emissions from transport should not exceed 20 per cent of total CO2 emissions in 1990;
- NOx: total emissions from transport should not exceed 10 per cent of emission levels in 1990;
- VOCs: VOCs should not exceed 10 per cent of the emission level in 1990;
- Particulates: depending on local and regional conditions, a reduction of 55-99 per cent of fine particulate emissions from transport;
- Noise: 55-65 decibels during daytime and 45 decibels at night and indoor;
- Land use: compared to 1990 levels, this criterion is likely to entail a smaller share of land devoted to transport.

Several specific quantitative targets aiming as sustainable transport activities are suggested by the European Road Transport Research Advisory Council (ERTRAC, 2004). These objectives take the 1990 record as baseline and are recommended to apply comprehensively on transportation for tourism as it is a part of the transport system.

- Improvements in vehicle efficiency delivering as much as a 40% reduction in CO2 emissions for passenger cars for the new vehicle fleet in 2020;
- In addition to passenger cars, good vehicle maintenance and driving for fuel efficiency reducing fuel consumption and CO2 emissions by at least 10%;
- Improvements in the road transport infrastructure, best use of transport modes, information technology systems, higher passenger car occupancy rates contributing to further reductions in fuel consumption by 10-20%;
- By 2020, establishing Euro 5 & 6 emissions standard vehicles in the vehicle fleet. The research target is to achieve these near 0 emissions levels at minimum cost while still improving energy consumption and CO2 emissions;
- Reducing transport noise by up to 10 dB(A) through a systems approach including better indicators and improvements to vehicles, tires and infrastructure.

All the above presented quantitative criteria help to make the definition of sustainable transport more operational. In this report we particularly refer to the Canadian Victoria Transport Policy Institute studies carried out by (Litman, 2015) which proposed a list of recommended indicators and grouped them into the three major groups.

There is a group of the most important indicators that the author suggests to be usually used which are most helpful indicators and intended to reflect particular needs of the objective. Below is the suggestion for common indicators by three categories of sustainability in descending order of importance, adapted from Litman (2015).

<table>
<thead>
<tr>
<th>Economic</th>
<th>Social</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Income per capita</td>
<td>• Per capita traffic crashes</td>
<td>• Per capita energy consumption, disaggregated by mode</td>
</tr>
<tr>
<td>• Annual person-miles or trips</td>
<td>• Per capita traffic facilities</td>
<td>• Per capita air pollution emission (CO2 emissions)</td>
</tr>
<tr>
<td>• Mode split (non-motorized, automobile and public transport)</td>
<td>• Quality of transport for disabled people</td>
<td>• Air and noise pollution exposure</td>
</tr>
<tr>
<td>• Per capita congestion cost (in mega city, tourist center)</td>
<td>• Affordability (portion of person’s budget devoted to tourism mobility)</td>
<td>• Use of renewable fuels</td>
</tr>
<tr>
<td>• Total per capita transport expenditures</td>
<td>• Universal design (consideration of disabled people’s need in transport planning)</td>
<td>• Impacts on special habitats and environmental resources</td>
</tr>
<tr>
<td>• Relative quality (availability, speed, reliability, safety and prestige) of non-automobile mode (walking, cycling, ridesharing and public transit)</td>
<td>• Degree cultural resources are considered in transport planning</td>
<td>• Heat island effect (on touristic island specifically)</td>
</tr>
<tr>
<td>• Number of public services within 10-minute walk.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Indicator suggestion per category (Litman, 2015)

Depending on the requirement and the sustainable strategy, suitable indicators will be chosen. Below is the consideration for additional indicators by category.

**Additional economic indicators:**

Sustainable transportation economic indicators should reflect both the benefits and costs of motorised vehicle use. Increased mobility that provides little or negative net benefits to economic factor of the tourist area and the budget of tourists can be considered to reduce sustainability, while policies that increase the net benefits can be considered to increase sustainability.
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>User satisfaction</td>
<td>Overall transport system user satisfaction ratings.</td>
<td>More is better</td>
</tr>
<tr>
<td>Travel Time</td>
<td>Average travel time regarding to distance travelled (from home location to arrival points and within destinations)</td>
<td>Less is better</td>
</tr>
<tr>
<td>Accessibility</td>
<td>The availability of public provision and commercial services connecting to attraction places</td>
<td>More is better</td>
</tr>
<tr>
<td>Land Use Mix</td>
<td>Average number of basic amenities (medics, shops and restaurants and food court) within walking distance from tourist concentrated areas.</td>
<td>More is better</td>
</tr>
<tr>
<td>Electronic communication</td>
<td>Provision of Internet connectivity and on-site travel information (time, direction, cost)</td>
<td>More is better</td>
</tr>
<tr>
<td>Vehicle travel</td>
<td>Per capita motor vehicle-mileage</td>
<td>Less is better</td>
</tr>
<tr>
<td>Transport diversity</td>
<td>Variety and quality of transport options available in a community.</td>
<td>More is better</td>
</tr>
<tr>
<td>Mode share</td>
<td>Portion of travel made by efficient modes: walking, cycling, rideshare, public transit.</td>
<td>More is better</td>
</tr>
<tr>
<td>Congestion delay</td>
<td>Per capita traffic congestion delay.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Affordability</td>
<td>Expenditures devoted to transport in kilometres travelled, in terms of OD transport and local transport.</td>
<td>More is better</td>
</tr>
<tr>
<td>Cost efficiency</td>
<td>Transportation costs as a portion in comparison of other costs and expenditure of the destination (food, accommodation, entrance ticket).</td>
<td>More is better</td>
</tr>
<tr>
<td>Facility costs</td>
<td>Per capita expenditures on roads, parking and traffic services.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Facility-Cost Ratio Efficiency</td>
<td>Portion of road and parking costs carried directly by users.</td>
<td>More is better</td>
</tr>
<tr>
<td>Commercial transport</td>
<td>Quality and trustworthiness of commercial transport services</td>
<td>Higher is better</td>
</tr>
<tr>
<td>Crash costs</td>
<td>Per capita crash costs</td>
<td>Less is better</td>
</tr>
<tr>
<td>Planning Quality</td>
<td>Comprehensiveness of the planning process: whether it considers all significant impacts and factors that influence on tourist’s experience and uses best current evaluation practices.</td>
<td>More is better</td>
</tr>
</tbody>
</table>
Mobility management

Implementation of mobility management programs to address problems and increase the transport system’s efficiency.

Pricing reforms

Portion of transport costs (road and parking fee, environment taxation, airport tax, fuel, etc.) that are efficiently priced (charged directly to tourists).

Land use planning

Applies smart growth land use planning practices, resulting in more accessible, multi-modal, and easy to use areas for tourists.

Table 5. List of feasible additional economic indicators of tourism mobility (Litman, 2015)

Additional Social Indicators

Social impacts include equity, human health, community livability (local environmental quality as experienced by residents and visitors), impacts on historic and cultural resources (such as historic sites and traditional community activities) due to construction of tourist projects, and aesthetics. Some indicators could be consulted from these data resources:

- The United Nations Development Programme’s Human Development Index (http://hdr.undp.org/en)
- The Legatum Institute’s Prosperity Index (www.prosperity.org/ranking.aspx).
- Mercer Quality of Living Survey (www.mercer.com)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>User rating</td>
<td>Overall satisfaction of transport system by tourists</td>
<td>More is better</td>
</tr>
<tr>
<td>Safety</td>
<td>Per capita crash disabilities and fatalities.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Fit and health</td>
<td>Portion tourists that use non-motorized transport (walks and bicycles) for city trips</td>
<td>More is better</td>
</tr>
<tr>
<td>Community livability</td>
<td>Degree to which transport activities support community livability objectives (local environmental quality).</td>
<td>More is better</td>
</tr>
<tr>
<td>Cultural preservation</td>
<td>Degree to which cultural and historic values are reflected and preserved in transport planning decisions.</td>
<td>More is better</td>
</tr>
<tr>
<td>Disabilities solution</td>
<td>Quality of transport facilities and services for disabled people.</td>
<td>More is better</td>
</tr>
<tr>
<td>Non-motorized transport</td>
<td>Quality of walking and cycling conditions.</td>
<td>More is better</td>
</tr>
<tr>
<td>Children’s travel</td>
<td>The availability of supporting service for travelling with children.</td>
<td>More is better</td>
</tr>
</tbody>
</table>

Table 6. List of feasible additional social indicators of tourism mobility (Litman, 2015)
### Additional Environmental Indicators

Environmental impacts include various types of air pollution (including gases that contribute to climate change), noise pollution or water pollution due to cruise ship operation, depletion of non-renewable resources, landscape degradation because of productive lands dedicated to tourism mobility, habitat fragmentation and hydrologic disruptions due to construction of physical infrastructure (airports, harbors, road network, railways) in touristic centers. In addition, in touristic islands and archipelagos, the heat island effect due to increased ambient temperature resulting from concrete pavement also should be taken into account. Moreover, the effort to approach natural preservation also causes a number of wildlife deaths because of collisions and violated environment. (Litman, 2015)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change emissions</td>
<td>Per tourist fossil fuel consumption, CO2 and other climate change emissions.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Other air pollution</td>
<td>Per tourist emissions of “conventional” air pollutants (CO, VOC, NOx, particulates, etc.)</td>
<td>Less is better</td>
</tr>
<tr>
<td>Air quality commitment</td>
<td>Frequency of air pollution standard violations.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Noise pollution</td>
<td>Portion of local residents exposed to high levels of noise in airport locations, touristic areas</td>
<td>Less is better</td>
</tr>
<tr>
<td>Water pollution</td>
<td>Per capita vehicle fluid losses.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Land use impacts</td>
<td>Per capita land devoted to tourism transportation facilities.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Habitat protection</td>
<td>Preservation of high-quality wildlife habitat (wetlands, old-growth forests, etc.)</td>
<td>More is better</td>
</tr>
<tr>
<td>Habitat fragmentation</td>
<td>Average size of roadless wildlife preserves.</td>
<td>More is better</td>
</tr>
<tr>
<td>Resource efficiency</td>
<td>Non-renewable resource consumption in the production and use of vehicles and transport facilities.</td>
<td>More is better</td>
</tr>
</tbody>
</table>

*Table 7. List of feasible additional environmental indicators of tourism mobility* (Litman, 2015)

### 3.3 Tourism indicators:

Associated with sustainable tourism mobility indicators is the selection of indicators of Sustainable Tourism (Tajani, 2013) which range from destination management core indicators, economic value core indicators, and social and cultural impact core indicators to environmental core indicators. Below is the set of indicators from the tourism side but having a direct contribution to sustainable tourism mobility or the other hand, the result of it. The next section gives a description of these indicators.

<table>
<thead>
<tr>
<th>Group</th>
<th>Indicator</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination</td>
<td>Sustainable Tourism Public Policy</td>
<td>More is better</td>
</tr>
<tr>
<td>Management Core Indicators</td>
<td>Sustainable Tourism Management in Tourism Enterprises</td>
<td>More is better</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>Customer Satisfaction</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Information and Communication</td>
<td>More is better</td>
</tr>
<tr>
<td>Economic Core Indicators</td>
<td>Tourism Flow (volume &amp; value) at Destination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tourism Enterprise(s) Performance</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Safety and Health Indicator</td>
<td>More is better</td>
</tr>
<tr>
<td>Social Core Indicators</td>
<td>Community/Social dissatisfaction</td>
<td>Less is better</td>
</tr>
<tr>
<td></td>
<td>Gender Equality Indicator</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Equality/Accessibility</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Protecting and Enhancing Cultural Heritage, Local Identity and Assets</td>
<td>More is better</td>
</tr>
<tr>
<td>Environmental Core Indicators</td>
<td>Reducing Transport Impact</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Climate Change</td>
<td>Less is better</td>
</tr>
<tr>
<td></td>
<td>Solid Waste Management</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Landscape and Biodiversity Protection</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Light and Noise Management</td>
<td>More is better</td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td>Less is better</td>
</tr>
</tbody>
</table>

Table 8. Tourism aspect indicator set (Tajani, 2013)

a. Destination Management Core Indicators
Sustainable Tourism Public Policy Indicator:
- Percentage of the destination with a sustainable tourism strategy/action plan, with agreed monitoring, development control and evaluation arrangement having a plan and policy for tourism mobility development and improvement. It is considered as a fundamental step towards sustainability. The plan should be multi-year including the three dimensions of sustainability economic, social and environmental issues; have clear, time-bound goals; and be developed with the participation of all relevant stakeholders. It should also be available to the community who is affected by tourism mobility activities and should be communicated externally with the parties concerned.

Sustainable Tourism Management in Tourism Enterprises Indicator:

Customer Satisfaction Indicator:
- Percentage of visitors that are satisfied with their overall experience about transportation services at the destination.

Information and Communication Indicator
- The introduction of available sustainable transport mode and the percentage of visitors who note that they are aware of destination sustainability efforts. This indicator is designed to encourage information sharing and communication of sustainability issues and achievements.

b. Economic Value Core Indicator

Tourism Flow (volume & value) at Destination Indicator
- Number of tourist nights per month
- Daily spending per tourist (transport, accommodation, food and drinks, other services).

Tourism Enterprise(s) Performance Indicator
- Average length of stay of tourists (nights)
- Occupancy rate in commercial accommodation per month and average for the year

Destination sustainability affects the performance of individual enterprises. The average length of stay of tourists in number of nights is one of the most important indicators for accommodation businesses. Long lengths of stay result in higher occupancy rates, the longer tourists stay, the higher the number of trips and more investment in the transportation system.

Safety and Health Indicator
- Percentage of tourism enterprises inspected and having applied safety travelling strategy in terms of safety equipment supply and safety regulation compliance.

c. Social and Cultural Impact Core Indicators

Community/Social Dissatisfaction Indicator
- Number of tourists/visitors per 100 residents. Resident satisfaction is a key indicator of the social impact of tourism on a community. Keeping track of changes in levels of satisfaction, and comparing these to the levels of tourist flow can help to identify problems in advance so these can be addressed and directly influence planning decisions.

Gender Equality Indicator
- Percentage of men and women employed in the tourism mobility job market.

Equality/Accessibility Indicator
- Percentage of visitor attractions that are accessible to people with disabilities

Protecting and Enhancing Cultural Heritage, Local Identity and Assets Indicator
- Percentage of the destination covered by a policy or plan that protects cultural heritage identity is under threat worldwide. When heritage buildings are destroyed or replaced with modern structures, the character of the destination changes. Having a policy to identify, protect and enhance the built (tangible) and other expressions cultural heritage e.g. music, (intangible) is vital to the sense of place and resident pride. Holding festivals and polling residents on their view about the impact of tourism on destination identity are both important.

d. Environmental Impact Core Indicators

Reducing Transport Impact Indicator:
- Percentage of tourists and same day visitors using different modes of transport to arrive at the destination (public/private and type)
- Average travel (km) by tourists to and from home or average travel (km) from the previous destination to the current destination. Transport to and around a destination contributes to greenhouse gas emissions and local air pollution generated by tourism. Tracking visitor distance travelled and mode of transport helps raise awareness of this issue and encourages improvements in the use of environmentally-friendly transportation for tourism.

Climate Change Indicator
- Percentage of tourism enterprises involved in climate change mitigation schemes such as CO2 offset, low energy systems, etc, and adaptation responses and actions to climate change mitigation (reducing the impacts) and adaptation (responding to some of the inevitable impacts) strategies need to be considered in every sector of the economy but particularly in tourism, where many businesses are located in areas vulnerable to flooding, drought and other impacts. This criterion highlights the importance of integrating climate change awareness into sustainable tourism planning and management.

Solid Waste Management Indicator
- Waste volume produced by tourist transport at the destination.

Landscape and Biodiversity Protection Indicator
- Percentage of destination (area in km\(^2\)) that is designated for protection. Protected areas are a key asset of a destination’s tourism product. High biodiversity helps to ensure the sustainability of nature and benefits the destination’s image and is attractive to tourists. This measure highlights the importance of investing in landscape and biodiversity protection and the tourism sector’s role in supporting this process.

Light and Noise Management Indicator:
- The destination has policies in place that require tourism enterprises to minimise light and noise pollution. Light and/or noise pollution may be a significant source of disturbance for resident communities and stress on wildlife in some destinations. These issues may be of particular concern in areas with an active night-time economy and isolated rural settings, star-gazing areas, turtle nesting sites, and mountain retreats, for example. Policies for beach/waterfront lighting, noise-levels and time for noise reduction need to be considered for current and future/proposed development.

Energy Indicators:
- Volume of bio-fuel and less environmental impact energy.
- The innovation of energy technology producing fewer emissions to the environment.

Depending on the goal of sustainable tourism mobility defined by a specific region, the set of indicator is developed within that framework, with the mission of trying to tackle as much as the aspects of the three spheres social, economic and environment. However, in practice, there is obstacle to collect suitable indicators and sometimes it is infeasible to apply all the indicators described above, due to data collection and analysis costs.

3.4 Conclusion:
To manage this development towards sustainability, a set of indicators is composed to target three spheres: environmental, social and economic aspects. Before taking solutions and creating action plans to reduce the tourism mobility impacts, a set of indicators offers fundamental background information illustrating the status of a region. Indicators are the
effective communication dialogue between the involved partnerships of sustainable tourism mobility both in terms of quantitative and qualitative reflection.

In the context of tourism mobility, sustainable indicators are the conjunction of mobility indicators and tourism indicators. In which mobility indicators are how transport network performs for tourism activities under the consideration of economic effectiveness factor, social and environmental impact. Policy makers will choose from the most essential indicators and additional and more detailed indicators depending on the scale of evaluation work as well as the availability of data. On the other hand, tourism indicators are the results and on the same time the contributors to tourism mobility.

In the next part, based on the understanding of the Tourist Area Life Cycle (Butler, 2011) we will investigate one specific area and try to develop a strategic plan within this thesis to capture the demand of travelling of inbound tourists. Therefore, the research will embrace different touristic characteristics and find a suitable approach to capture the possible negative impacts as well as provide adequate transport supply learned from successful examples.

The research will put public transport as a strategic device for sustainable tourism mobility. Public transport is considered to be a low emission and safe transport mode. It can bring visitors rather far away from their home location but also can be a partner supplying local transportation at the destination. In this research framework, public transport is in request to bring tourists to the chosen investigated area. Public transport needs to deal with the problem of seasonal fluctuation of tourism, event tourism that requires an optimization model for public transport operation, etc. (Potier) (Verbeek, Bargeman, Mommaas, 2011) (Black, 2004). Thus, the research should design a strategic plan for accessibility in such region.

At the authority management level, the research tries to suggest indicators to manage sustainable development focusing on public transport in a particular region. What needs to be modified and improved both in terms of infrastructure system and the way to change tourist’s behavior into public transport usage from private vehicles?
Chapter 4. Limburg’s accessibility via public transport networks

In this and the next chapter, the research will take Limburg province for investigation. Firstly, we are going to have an overview on Limburg tourism in terms of tourists’ demography, tourist arrivals and tourists’ characteristics. Also, this chapter will study the public transport network used by key tourism markets who travel to Limburg province by mapping rail/bus network. Data are retrieved from Tourism Limburg and the Belgium railways network. Another aim of the chapter is to identify the development stage of tourism in Limburg according to Butler’s Tourist Area Life Cycle. This is an important step to get insights into the status of the researched region before going to build up a plan to improve its accessibility.

4.1 Introduction to Limburg Tourism

4.1.1 Limburg geography and tourism area

Limburg is located in the Flemish area of Belgium where it has a border with the Netherlands and Germany on the east side and by south with the Wallonia region of Belgium.

![Figure 14. Location of Limburg province (Belgium root project, 2008)](image)

Limburg has a collection of different landscapes from wooded areas, inland dunes, the Valley of Meuse River, numerous ponds till the hilly region with castles, courtyard farms and half-timbered houses. Moreover, the Belgium National Park Hoge Kempen (Tourism Limburg, 2014) is also located in Limburg, ideally for hiking, cycling and horse riding. The province is divided into 10 tourism regions with different tourist’s attractions by Tourism Limburg. However, there are 5 main destinations:
4.1.2 Inbound tourist’s characteristics

In order to provide an adequate public transport service, it is essential to understand customers who are targeted to use public transport. The research retrieved required information from official Tourism Limburg survey data to get the tourists’ profile. From the mobility point of view, it is also required to know where tourists stay (which regions of the province) and also how public transport performs for inbound tourists. Therefore, this section is going to present the figures related to tourist’s characteristics coming to Limburg province in terms of number of arrivals, number of nights staying, origins of both domestic tourists and international tourists, age categories, type of group visitors, the reason for spending a holiday in Limburg, their satisfaction with tourism facilities and infrastructure in Limburg and the accommodation locations where tourists chose to stay during their trips.

a. Tourist arrivals: The number of tourist arrivals fluctuates over time and depend on the season. In general, the figure of tourist arrivals shows more tourists during spring and summer time than in fall and winter time. In addition, the evolution number in table 9

Figure 15. Tourism regions in Limburg province

Haspengouw: local product of fruits, blossoms season, rich history and culture with heritage site and old religious area.

Maasland: green area with nice nature which is suitable for summer recreational activities such as bird watching, fishing, kayaking. There is located a shopping village consisting of many well-known luxury brand names.

Limburgse Kempen: where the Hoge Kempen National Park is located. It is the place for camping, horse riding, walking in the wood, kid’s playground, etc.

Voerstreek: walking and nice cycling routes.

Hasselt and surroundings and Genk: leisure, city sightseeing, restaurants, shopping. (Tourism Limburg, 2014)
shows that fewer tourists came to Limburg in 2013 and 2014 compared with previous years.

![Figure 16. Tourist arrivals to Limburg in 2014 (Tourism Limburg, 2014)](chart)

Evolution of visitors from 2010 – 2014 shows that number of foreign tourists coming to Limburg is not a significant contributor to number of foreign tourists coming to Belgium. However, the total number of visitors coming to Limburg has a meaningful part of total visitors to Belgium. Which is shown in detail as below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>Foreign tourists</td>
<td>7,186,419</td>
<td>7,494,141</td>
<td>7,560,025</td>
<td>7,684,285</td>
<td>7,887,426</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>12,988,051</td>
<td>13,618,136</td>
<td>13,872,644</td>
<td>14,152,360</td>
<td>14,641,070</td>
</tr>
<tr>
<td>Limburg</td>
<td>Foreign tourists</td>
<td>489,472</td>
<td>489,072</td>
<td>409,280</td>
<td>380,906</td>
<td>388,817</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>1,158,829</td>
<td>1,183,814</td>
<td>1,112,226</td>
<td>1,070,929</td>
<td>1,094,311</td>
</tr>
</tbody>
</table>

Table 9. The number of tourist arrivals (Tourism Flanders, 2014)

According to a data portal of statistical data, Belgium is placed as 38th in number of tourist arrivals (http://www.indexmundi.com/). For comparison, France has most visitors in the world with more than 84 million visitors (UNWTO, 2014), and the Netherlands is ranked at the 21st place in the index (http://www.indexmundi.com/). Switzerland is placed as 32nd. Tourists arrivals in Belgium are expected to go on the rise however the trend from 2010 to 2014 of tourists coming to Limburg province showed a slight reduction. During the period 2010 – 2014, Limburg was in the trend of 5.6% decrease of foreign tourists and 1.4% decline of total tourists. Last but not least, the total number of visitors to Limburg has a meaningful value to total tourist numbers of Belgium as Limburg is one of the eleven provinces of Belgium (www.belgium.be). It is also noticed that foreign tourists have a higher share in Belgian tourism while in Limburg, foreign tourists represent have roughly one third of the total visitors.

b. Number of nights: Among visitors coming to Limburg, 46.2% stay 2 nights in general. (Tourism Limburg, 2014). The length of stay also strongly depends on the type of accommodation or visiting time of the year. Winter time is supposed to offer fewer activities than summer time and therefore visitors tend to stay shorter. The average length of stay was 2.8 nights in 2014. It was 2.9 in 2013 and 3.3 nights in 2012. (Tourism Limburg, 2014). The number of overnights in Limburg in 2014 per month is shown in figure 17.
c. The origin of Limburg tourists:

The data collected from Tourism Limburg shows that Limburg is mostly visited by domestic visitors, the graph below illustrates the evolution figures and the trend of Belgian visitors in Limburg with data collected from Tourism Limburg.

Another survey taking into account the tourists from the Netherlands shows the proportion of domestic visitor from 2012 – 2014 as following:

<table>
<thead>
<tr>
<th>Region</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Flanders</td>
<td>25.3%</td>
<td>22.7%</td>
<td>26.4%</td>
</tr>
<tr>
<td>East Flanders</td>
<td>21.4%</td>
<td>24.4%</td>
<td>23.7%</td>
</tr>
<tr>
<td>Antwerp</td>
<td>20.7%</td>
<td>22.9%</td>
<td>23.4%</td>
</tr>
<tr>
<td>Vlaams-Brabant</td>
<td>8.6%</td>
<td>10.6%</td>
<td>9.2%</td>
</tr>
</tbody>
</table>
Table 10. Domestic visitor origin and Dutch visitors (Tourism Limburg, 2014)

- International visitors: research has data retrieved from the Tourism Flanders database on detailed international visitors. Due to the geographical location, visitors from the Netherlands and Germany are the first and second largest foreign markets of Limburg tourism with 54.9% and 17.8% respectively according to 2014 data. French person dominated as third foreign visitors. But there are also tourists from further away such as Italy, Great Britain or even United States even though it represents for a small portion of number of tourists coming to Limburg. The table below shows origin of visitors. The top 3 countries Netherlands, Germany and France stand in the first three rows, and the following rows are visitors grouped by geographical location.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>314,212</td>
<td>311,718</td>
<td>232,900</td>
<td>211,412</td>
<td>213,459</td>
<td>-3.1%</td>
</tr>
<tr>
<td>Germany</td>
<td>77,577</td>
<td>74,436</td>
<td>67,498</td>
<td>63,930</td>
<td>68,766</td>
<td>+1.6%</td>
</tr>
<tr>
<td>France</td>
<td>45,044</td>
<td>44,729</td>
<td>48,540</td>
<td>46,816</td>
<td>42,556</td>
<td>+2.3%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>16,307</td>
<td>17,475</td>
<td>18,149</td>
<td>16,555</td>
<td>19,607</td>
<td>+4.2%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>3,609</td>
<td>3,990</td>
<td>3,465</td>
<td>3,219</td>
<td>3,441</td>
<td>+4.5%</td>
</tr>
<tr>
<td>North Europe (Ireland, Denmark, Norway, Finland, Sweden)</td>
<td>4,593</td>
<td>5,199</td>
<td>5,804</td>
<td>5,810</td>
<td>5,649</td>
<td></td>
</tr>
<tr>
<td>South Europe (Italy, Portugal, Spain, Greece)</td>
<td>9,280</td>
<td>9,013</td>
<td>8,725</td>
<td>8,219</td>
<td>8,327</td>
<td></td>
</tr>
<tr>
<td>East Europe (Austria, Poland, Czech Republic, Hungary, Romania)</td>
<td>6,000</td>
<td>6,555</td>
<td>6,494</td>
<td>6,338</td>
<td>6,900</td>
<td>+7.6%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1,945</td>
<td>2,725</td>
<td>2,411</td>
<td>2,234</td>
<td>1,895</td>
<td>+7.6%</td>
</tr>
<tr>
<td>Russia</td>
<td>626</td>
<td>807</td>
<td>1,062</td>
<td>960</td>
<td>799</td>
<td>+9.1%</td>
</tr>
</tbody>
</table>
### Table 11. Origin of international tourists coming to Limburg (Tourism Flanders, 2014)

The following data (d to h) was retrieved from a survey conducted in 2014 by Tourism Limburg which had data a collection in 2012, 2013 and 2014. The survey was an online based questionnaire and tourists were requested to visit www.toerismelimburg.be/jouwmeningtelt and to complete the questionnaire which related to their experience on aspects of hospitable Limburg during their stay. In 2012 the survey had 1.415 respondents, 1.020 respondents in 2013 and 1.223 respondents in 2014.

**d. Age group:**

In 2014 the share of the group above 50+ years old is further increased to 63.9% overall. People from 50 to 65 years are the major age category which accounts for 46.4% tourist's volume.

<table>
<thead>
<tr>
<th>Country</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>332</td>
<td>420</td>
<td>430</td>
<td>522</td>
<td>499</td>
<td>+10.6%</td>
</tr>
<tr>
<td>Turkey</td>
<td>681</td>
<td>744</td>
<td>848</td>
<td>888</td>
<td>869</td>
<td>+15.6%</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>2,889</td>
<td>3,593</td>
<td>3,814</td>
<td>3,794</td>
<td>3,581</td>
<td>+5.7%</td>
</tr>
<tr>
<td>Canada</td>
<td>254</td>
<td>329</td>
<td>440</td>
<td>338</td>
<td>347</td>
<td>+5.1%</td>
</tr>
<tr>
<td>Japan</td>
<td>598</td>
<td>663</td>
<td>616</td>
<td>933</td>
<td>800</td>
<td>+8.4%</td>
</tr>
<tr>
<td>China</td>
<td>576</td>
<td>436</td>
<td>813</td>
<td>613</td>
<td>894</td>
<td>+20.6%</td>
</tr>
<tr>
<td>India</td>
<td>202</td>
<td>377</td>
<td>258</td>
<td>271</td>
<td>379</td>
<td>+8.1%</td>
</tr>
<tr>
<td>Australia</td>
<td>302</td>
<td>501</td>
<td>558</td>
<td>326</td>
<td>360</td>
<td>+7.3%</td>
</tr>
<tr>
<td>Brazil</td>
<td>230</td>
<td>240</td>
<td>258</td>
<td>227</td>
<td>211</td>
<td>+15.3%</td>
</tr>
<tr>
<td>Others</td>
<td>4,215</td>
<td>5,122</td>
<td>6,197</td>
<td>7,501</td>
<td>9,478</td>
<td>+7.3%</td>
</tr>
</tbody>
</table>

The share of the group above 50+ years old is further increased to 63.9% overall. People from 50 to 65 years are the major age category which accounts for 46.4% tourist's volume.
e. **Type of group visitors:** tourists coming to Limburg often come without children. Also, Limburg is favored by friend groups visiting.

![Figure 19. Proportion of tourist age groups (Tourism Limburg, 2014)](image)

f. **Reason for choosing Limburg holiday:**

As mentioned, Limburg is described as destination for outdoor activities such as cycling and walking. The province also offers various possible activities to carry out during holiday. Therefore, a survey conducted by Tourism Limburg (2014) showed different reasons for tourists to come to Limburg as detailed below.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycling</td>
<td>16.8%</td>
</tr>
<tr>
<td>Walking</td>
<td>12.2%</td>
</tr>
<tr>
<td>Nature</td>
<td>9.7%</td>
</tr>
<tr>
<td>Beautiful landscape</td>
<td>8.3%</td>
</tr>
<tr>
<td>Peace</td>
<td>7.4%</td>
</tr>
<tr>
<td>Discovery</td>
<td>5.0%</td>
</tr>
<tr>
<td>Friendliness</td>
<td>3.6%</td>
</tr>
<tr>
<td>Discovery</td>
<td>3.5%</td>
</tr>
<tr>
<td>Gastronomy</td>
<td>3.2%</td>
</tr>
<tr>
<td>Nearby</td>
<td>3.1%</td>
</tr>
<tr>
<td>Hospitality</td>
<td>2.7%</td>
</tr>
<tr>
<td>City sightseeing</td>
<td>2.6%</td>
</tr>
<tr>
<td>Fruit/Flowers season</td>
<td>2.5%</td>
</tr>
<tr>
<td>Visiting again</td>
<td>2.4%</td>
</tr>
<tr>
<td>Events</td>
<td>1.9%</td>
</tr>
<tr>
<td>Attractions</td>
<td>1.8%</td>
</tr>
<tr>
<td>Accommodation</td>
<td>1.6%</td>
</tr>
<tr>
<td>Culture</td>
<td>1.5%</td>
</tr>
<tr>
<td>Pleasantness</td>
<td>1.4%</td>
</tr>
<tr>
<td>Other (shopping, family/friend visit, museum, gift, festivals, wellness, antique market, …)</td>
<td>8.9%</td>
</tr>
</tbody>
</table>

![Figure 20. Type of group visitors (Tourism Limburg, 2014)](image)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Couple, no children</td>
<td></td>
</tr>
<tr>
<td>Friend group</td>
<td></td>
</tr>
<tr>
<td>Family with children joining</td>
<td></td>
</tr>
<tr>
<td>Family with children staying</td>
<td></td>
</tr>
<tr>
<td>staying at home</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 21. Reasons visitors chose Limburg for holiday during 2012 -2014 (Tourism Limburg, 2014)](image)

g. **Satisfaction:** the graph below is the result from the survey which shows the satisfaction of tourists coming to Limburg based on tourism facilities and infrastructures in the province. In general, tourists are satisfied with their stay in Limburg, they often
grade above 8 on 10 overall. However, it is noticed that the public transport service scores the least satisfying on the evaluation of tourists. It was only 7.6/10 compared to the highest rate of 9.2.

**Figure 22. Visitor satisfaction survey (Tourism Limburg, 2014)**

**h. Accommodation:** tourists tend to stay at different locations in the province, spread among regions. While Hasselt is the capital city of the province, it hosts the least visitors. The average cost for one night is about 100 euro which is also higher than the average rate in Flanders. The figures below show the locations where tourists chose their accommodation (Figure 23) and the same (Figure 24) for the group of 45+ visitors. It also shows that Limburgse Kempen hosts the most visitors due to its popularity, the nature and outdoor activities.
Couples from 45 year old choose to spend the night in the following areas:

- Limburgse Kempen: 39.8%
- Haspengouw: 13.5%
- Maasland: 13.8%
- Vooestreek: 13.8%
- Hasselt en omgeving: 19.1%

\[ n = 319 \]

In conclusion, cycling, nature, hiking, the beautiful region and the peaceful atmosphere are the top five motivations for tourists coming to Limburg. The major arrival comes from domestic visitors who mostly are from Flanders. Together they represent 73.5% of all visitors to Limburg in the 2014 survey. The most important foreign markets are the Netherlands and Germany. Visitors spend on average 2 nights in the province. However, most of them do not stay centrally in the capital city of the province, Hasselt but in the countryside regions where attractive activities of the province are located. The target age group for Tourism Limburg is 40+ year olds whilst currently the largest age group is from 50 to 65 years old.

Tourists are generally very satisfied with their visit to Limburg. The average score of satisfaction according to the survey from 2012 – 2014 is 8.9/10. The cycling route network has the highest satisfaction score of 9.2/10. The landscape and nature also score high (9.0/10). However, the public transport is the least satisfying, with 7.6/10.

4.2 Public transport networks for Limburg’s inbound tourists

In this section, the research is going to illustrate the use of public transport for tourism to Limburg. The research also reviews and presents the available connections to Limburg by public transport such as train, bus and coach provided by government transport to bring Belgian and international tourists to Limburg.

4.2.1 Aeroplane

There are several ways to connect from surrounding airports to Limburg province to receive visitors who arrive by airplane. Limburg is reachable from important international and regional airports such as Brussels airports, Maastricht Aachen airport, Cologne Bonn airport, Dusseldorf airport as well as smaller airport like Brussels Charleroi, Eindhoven, and Liege. These airports have connections with most cities of Europe and worldwide cities such as Berlin, Rome, Barcelona, London, etc operated by both standard airlines and low cost carriers. It explains that Limburg has tourists coming from over Europe. Moreover, the province also has visitors from Far East Asia and even America. From airports, tourists have to commute by train or bus to reach the province. The journeys often occur via a transit station which is usually Brussels or Maastricht due to no airport located in the province.
4.2.2 Public transport infrastructure (train and bus)

Limburg has a train network that is part of the Belgian railway system. Visitors coming to Limburg could reach Hasselt station as the capital city of Limburg region or other main stations such as Genk, Sint-truiden, Tongeren or Bokrijk which are closer to visited sites.

Alternatively, the bus system operated by De Lijn which is a Flemish regional bus operator has connections to many local communities in Limburg province. Regarding international bus routes, there are only direct bus connections from areas in the Netherlands. Because De Lijn is the operator, holders of a De Lijn pass are allowed to use bus services free of charge in Limburg and therefore many Flemish visitors will be able to travel by bus around Limburg free of charge.
However, at present, public transport is not favored by visitors, most of the tourists (92.1%) arrive by their own private car. Detailed mode usage is illustrated in the figure below:

![Figure 27. Mode share of inbound tourists 2012-2014 (Tourism Limburg, 2014)](image)

The following section will explain the connection by train and bus to Limburg to have insights in the transport service in terms of the availability of service, trip duration, comfort and frequency of service.

a. **Rail network**: the rail connections to Limburg go via Hasselt city, the capital of the province. The rail network does not cover all the main regions of the province and has no further extents to Maasland and Voerstreek. There are 5 direct connections that originally departed from Antwerp, Liege, Bruges and Knokke (Brussels on the way) and Leuven. Therefore, from other directions or other regions of Belgium and also international connections, visitors must take a transit at Brussels, Leuven, Antwerp or Liege to change to the train that goes to Limburg.
The detailed connection from each direction is described as below (based on Belgian rail website):

- From Wallonia region (French speaking region – south of Belgium): the only direct connection from Wallonia region is the intercity train from Liege to Hasselt as end station via Tongeren, Bilzen, Diepenbeek station every hour. The journey takes one hour for the distance of about 45.5 km. It means that there is no direct connection from the province of Hainaut, Namur or Luxemburg of Wallonia region of Belgium.
For international connections, in Liege of Wallonia region, there is a high speed train from Aachen/Cologne in Germany by ICE or Thalys. Therefore, visitors coming by high speed train, usually visitors coming from Germany, can go to Liege to change train from Liege to Limburg. Besides that, the Thalys network itself has stops in Brussels and connections to France and the Netherlands.

- From East and West Flanders: there are two connections, from Knokke and Blankenberge. These routes have Bruges, Gent, Brussels and Leuven on service and stops in Sint – Truiden, Alken, Hasselt and Genk. These routes have connections to the fruit region Haspengouw as mentioned above via Sint – Truiden and Alken station. The total connection from Knokke/Blankenberge to the end station in Genk takes almost 3 hours. The journey takes about 1 hour 15 minutes from Brussels to Hasselt and another 15 minutes to get to Genk. The interval of each train per route is 1 hour which means there are 2 direct connections from Flanders (via Brussels) within an hour.
Figure 30. Connection from Knokke (via Brussels) to Limburg (Belgian rail website)

Figure 31. Connection from Blankenberge (via Brussels) to Limburg (Belgian rail website)

- Connection from Antwerp: there are 2 route connections. However, the journey takes quite a long time, 1 hour 38 minutes and 1 hour 43 minutes. The connection via the national aiport Zaventem only connects to Hasselt as end station, the capital of the province but no other areas in Limburg.
Figure 32. Connection from Antwerp to Hasselt via Belgian national airport (Belgian rail website)

The alternative train service from Antwerp to Hasselt stops in the Limburg stations of Beringen, Zolder, Heusden and Schulen.

Figure 33. The second connection from Antwerp to Hasselt (SNCB)

The journey from Antwerp to Hasselt which took 1 hour as in 2014 is no longer in service. However, from Antwerp there are train services operated by Dutch railways to Rotterdam and Amsterdam, and Antwerp is also in the route of the high speed train Thalys from Paris to Amsterdam.

- Connection from Leuven: the local train service takes 49 minutes from Leuven to Hasselt.
For international tourists coming by high speed train, they can come by services of Thalys, Eurostar and TGV and stop in Brussels, Antwerp or Liege and change to Belgian train to reach Limburg. The high speed train networks are as on the following map:

Another direct international route is from Maastricht to Hasselt. However, the journey detours via Liege that prolongs the trip duration to 1 hour 43 minutes.
b. Bus network:

At present, the most convenient connections to urban areas of the Netherlands such as Maastricht city and Eindhoven city and other locations in the Netherlands are by bus routes, not by train connection. For instance from Hasselt to Maastricht by bus it takes about one hour. The bus departs every hour. The connections between Limburg and the Netherlands with detailed routes updated to 22 October 2015 are as below:

![Bus connections between Limburg and the Netherlands](image)

**Figure 37. Bus connections between Limburg and the Netherlands (Grensbus, 2015)**

Visitors coming by bus from Germany have to take the bus to Maastricht or Liege by German bus service and change to another bus to Limburg.

De Lijn does not have a service linking Limburg to the Wallonia region. The connections from other Flemish provinces are only short distance between local communities. The considerate connections are from Landen of Vlaams-Brabant province to Hasselt and from Geel in Antwerp province It means that visitors can only mainly rely on railway network to get to Limburg.

There is no long distance and direct public bus service from other cities to Limburg. However, the Maasmechelen shopping village in the region of Maasland offers an express bus service for visitors coming for shopping with a charged fee. The bus departs at the
Brussels city tour office and returns on the same day. There is only one departure per day. In July and January additional buses depart from Brussels, Hasselt and Genk station with more frequent service and sometimes offering free service. (http://www.maasmechelenvillage.com/)

In general, there is limited public transport service to reach Limburg especially to the main touristic areas such as Haspengouw, Limburgse Kempen or the Voerstreek. Visitors heading to the Maasland need to get to Hasselt or Genk to change to a local bus service. There is also no bus service to Haspengouw but only trains which have connections with Brussels and other Flemish provinces. Trains from Antwerp take longer and are less frequent. After all, even though Limburg is located in proximity with many international airports, there is only direct connection from the Belgian national airport to Limburg.

4.3 Limburg and the Tourism Area Life Cycle

Based on the literature review in Chapter 2 about the Tourism Area Life Cycle (Butler, 2011), it is essential to identify what stage Limburg’s tourism belongs to in order to to foresee the future development to design an equivalent transport network. This section is going to give the current status of tourism development in Limburg province as well as the vision and perspectives for the future of Limburg tourism. Therefore, within this research, the student interviewed the Strategic Advisor, Mr Herwig Dessers, from Tourism Limburg to answer these concerns in terms of the development stage and other related issues of tourism such as strategy plan, tourist product, customer groups, challenges and new extents of Limburg tourism.

According to the theory of Butler of the Tourism Area Life Cycle, Tourism Limburg has defined Limburg province in between stage of development (stage 3) and consolidation (stage 4).

At present, Limburg has an authorized organization to develop and advertise the area called Tourism Limburg. The province contributes to total tourists arrivals in Belgium and is recognised as a tourist destination with outdoor activities and natural landscape. Even though Limburg is not a mass tourism place, worldwide business groups also start to see the emerging potential of the area and therefore start to invest money in the region in term of providing accommodations. Tourism Limburg and its related teams have developed package holidays (a package might include travel, accommodation, food and excursions) for visitors.

In detail, cycling is well known for Limburg tourism and a unique experience among activities for tourists coming to Limburg with about 2000 kilometers network. Cycling routes have 20 years of development offering a comprehensive and detailed cycling map network. Importantly, they are designed with facilities and services (restaurants, accommodation, cafeteria, etc.) added on the routes. Limburg’s strategy on the tourism market is a destination with beautiful and diverse landscapes. Visitors coming to Limburg have different motivations of leisure activities (horse riding, cycling, hiking, etc.) and therefore strongly depend on the area’s characteristics such as the river basin Muse valley, the largest forest in Flanders, sand dunes, ponds and lakes, the Belgian national park or castle and heritage areas.

For future development, to reserve the peaceful environment, Limburg tourism targets on individual tourists but not the group tour visitors operated by tour companies. In the longer term development, it also will not focus on mass tourism to preserve the tranquility and authentic nature of the region which are the reasons visitors come to Limburg. It means that
the province will not centralize a touristic area where most tourists gather. Each region will take over the responsibility of providing hospitality services for tourists upon its capacity of accommodation and facility.

A position in between the stage 3 and 4 of Butler's life cycle means the area still continues to attract tourists. However, the growth in tourist numbers is supposed not to be as fast as before. The local economy is contributing to the from tourism industry and there are labors working in the tourist sector and providing professional hospitality services as their major income. The fact is that some of the older buildings and facilities start to become unattractive. Thus, the province wants to improve the cycling network and make it more attractive and create a new destination for tourists such as child-friendly visiting sites to exploit the market of families with children sector. Also, they will newly deploy mining sites from the past, one of the heritages of the province to become innovative museums.

In conclusion, Limburg has a brand name for its unique nature and tourism activities. The province has its own specific tourist products but still explores new perspectives for development evenly among its regions. In addition, Hasselt city has limited capacity of accommodation; tourists seek for other options in rural areas as they are also their main location for holiday. From the mobility point of view, it is the challenge of providing sufficient service for tourists coming to Limburg in terms of convenience, frequency and reliability. However, it also raises the opportunity to combine transport service with other hospitable service as whole package to encourage tourists to use public transport for their holidays if they see the benefits from public transport.
Chapter 5. Sustainable mobility plan for Limburg's inbound tourism market

In this chapter, the thesis is going to indicate the weaknesses of the public transport network bringing visitors to Limburg. Based on these understandings, the thesis can suggest the way to improve the transport service to meet the needs of its inbound tourists. But before that, the chapter will give case studies of good practice examples of public transport for tourists that are implemented in some other European regions. Based on these examples and the development stage of Limburg province, the thesis will present actions and improvements required for involved stakeholders to make public transport more accessible for inbound tourists. Finally, in order to manage sustainability of tourism mobility, the chapter will present a set of public transport indicators for local authorities and policy makers in Limburg.

5.1 Case study examples of public transport initiatives as means of sustainably managing tourism mobility

The European Environment Agency estimate that up to 80% of all tourist journeys to the Alps, where public transport is crucially lacking, are by car. (Verbeek, 2009). Despite a different terrain and main tourist activity, Alpine region and Limburg have the same mission of natural preservation, reduced ecological footprint and sustainable tourism development. This section will give good practices from the case studies: Access2mountain, TransDanube and Alpine Pearl Passage. The areas of these projects are dedicated tourism development for nature preservation and environmental impact mitigation. They have the same difficulty of approaching rural areas and switching car usage into public transport usage for holidays.

5.1.1 ACCESS2MOUNTAIN project:

The project ACCESS2MOUNTAIN (www.access2mountain.eu/) aims to achieve durable, environmentally friendly tourism, as well as to ensure accessibility and connection to, between and in sensitive regions of the Alps and the Carpathians. The project duration was 36 months from May 2011 to April 2014 under the title of Sustainable Mobility and Tourism in Sensitive Areas of the Alps and the Carpathians sponsored by South East Europe Transitional Cooperation Programme and European Regional Development Fund. The project involved 12 Project Partners and more than 30 Observers with the lead partner the Environment Agency Austria. Within the project background, it had to face the problem of demographic challenges such as different tourist age groups, different languages and crossing border development. The sustainable transport facilities were still underdeveloped and insufficient. On the other hand, a growing number of privately owned cars coming to the region was the result of tourism development. Some examples can be learned from the project:

- In the region stretching from Gesäuse National Park and the Eisenwurzen Nature Park in Styria, Austria, an integrative mobile application called GSEISPUR offers flexible mobility for both local and visitors from May to October. Since its launch in 2013, GSEISPUR consists of a shuttle service to/from the main railway station, a door-to-door taxi service and an e-scooter rental. Further sustainable mobility options are to be introduced over time, including a car sharing facility. In order to make services and tourism packages more generally accessible, a website and smart phone app with an order and dispatch system have been introduced.

- Tourists were used to take the car to arrive in Nature Parks in Alpine region. Therefore, Fahrziel Natur is the cooperation between the German national railway company “Deutsche Bahn” and three major environment associations in Germany to improve the connectivity between 20 different natural/protected areas in three
countries Germany, Austria and Switzerland. The objective is to shift more leisure traffic from the roads to public transport to protect natural landscapes by means of providing accessibility to 20 Nature Parks by train.

- The connection to ski resort areas are fostered by public transport such as Dolomiti Express or “Train des Neiges des Alpes du Sud”. Dolomiti Express is the direct access by train from Trento to the ski area, next to the cabin lift of the valley. Guests save money since the price for the return journey is deducted from the fee for the day ski pass. The other case is the French Railway Company (SNCF) in association with the region Provence – Alpes – Côte d’Azur. They provide a seasonal train on winter weekends to connect ski areas in the Southern French Alps via train and shuttle bus and to reduce car traffic.

5.1.2 TransDanube:

Transdanube is the concrete background for development of sustainable mobility along the Danube including train, bus, bike and boat to improve accessibility in the whole Danube region. The project is under the South East Europe Transnational Cooperation Programme framework and lasted from October 2012 to September 2014, led by Environment Agency Austria and also had partnerships from many countries: Germany, Italy, Hungary, Bulgaria, Slovakia, Romania, etc. Some important outputs of the project are:

- Sustainable transport offers are the soft mobility tourism packages which include transport service to the destinations, natural and cultural touristic attractions also transport at the destination and accommodation. For example, the Ruse EcoPearls Tour and Ruse historical velo tour offered a local and regional bus combined with bicycle. Or the multimodal transport of bus, boat and train to eco and rural tourism destinations in Moldova.

- A digital map presents comprehensive information about existing mobility and tourism offers. That is the Transdanube Interactive Map Tool (http://www.danubetour.eu/) which is an internet mapping application which provides information on tourism attractions and sustainable means of transport, how to get there and around by ship, train, bus, tram or subway. It is an easy-to-use geographic information system (GIS) and provides an intuitive access to information.

In the European Transport Conference 2013, Kurzweil Agnes presented successful factors for implementing sustainable tourism mobility from these two projects as:

- The plan needs to be demand-oriented. In Access2mountain, the project partner Nationalpark Gesäuse (from Austria) developed the mobility platform GSEISPUR2 with different sustainable offers (taxi, shuttle, e-moped-rental). The case was highlighted as example for other regions where sustainable transportation infrastructure has to be improved and the availability of these transport modes should be connected with each other.

- High quality in services is essential for the acceptance by the users in terms of the travelling time and the rapidity of a service. The direct connection which is one transport mean from the origin to the destination is highly appreciated. An example is the Schnee – Express 3 in Access2mountain, which directly connects the Northern countries with Alpine Ski-resorts during the high season. Supporting services, information service at the stations or regional product offers in trains find good practice implementation.

- For the use of sustainable mobility offers it is essential to know clearly about available sustainable offers. There are different information systems to communicate with the
visitors usually by transportation providers or tourism industry. The ultimate tool should be a combined navigation and information system for all means of transport, including accessibility to the regions, sustainable transport modes, tourism attraction, tourist facility, etc displayed on websites and mobile device synchronised. For example, the Digital Transdanube Interactive Map Tool is introduced in the TransDanube project.

- Professional marketing by tourism stakeholders is needed to address all relevant target groups to switch into sustainable transport. The best and most popular example is “Alpine Umbrella Brand for Soft Mobility in Tourism”, which displayed promotions and advertisements in catalogues, tourism websites, communities, transport providers and brochures. The Hungarian project partner Miskolc Holding in the project Access2mountain even produced a film focusing on cycling. Additionally, Touristic packages were developed which take into account sustainable transport modes to motivate tourists to arrive by train or bus.

- A competitive price ratio of value – ticketing can convince car users to change to sustainable mobility. Various systems of integrated service cards (including transport of different types, sight visits, etc.) or special reduction cards encourage tourists to use public transport. Such tickets and cards are easy to find at train/bus stations and tourist hot spots.

- In both projects Access2mountain and TransDanube the participatory process of many partnerships is a key point of the mobility plan. The cooperation was carried out by workshops, events and awareness campaigns, especially numerous face to face contacts with effected stakeholders. Moreover, cross – border connection requires strengthened cooperation to be successful.

5.1.3 Alpine Pearl Passage:

Taking back the Alpine region to research in more detail, the region also is investigated in the Access2mountain project by Alpine Pearls Association. The objective of this project is inspired by the aim of Thomas Cook in 1840 to encourage tourists to travel by train for holiday even though travelling by train was still perceived as expensive and difficult at that time. (D.H.P Verbeek, 2009). Therefore, it is required to execute sustainable tourism mobility by means of public transport that is well suited and accessible for tourists. Less polluting transport modes such as bus, train and electric vehicle are focused on. The lessons from the project are interesting:

- Tour operators, transport companies, and hotels are also important actors in the creation of a passage for Alpine Pearls holidays. Railway tour operator Ameropa has chosen to market their holiday packages as Alpine Pearls holidays, and hotels in several villages are committed to Alpine Pearls. Furthermore, Alpine Pearls holidays encompass innovative technologies for environmental-friendly travelling (e.g. electric bicycles) that tourists can use during their Alpine Pearls holiday.

- Furthermore, the Alpine Pearl holiday creates a unique storyline to give it a specific image that going on a holiday that is environmental friendly is still comfortable and convenient travelling, enjoyable, fun, and high quality holidays spent in beautiful landscapes and economical expenses. The storyline proves as a unique character of the Alpine region that emphasises ecological advantage as different experience from other holiday destinations. In conjunction with providing Origin – Destination connection, the region also supplies excellent environmental friendly mobility at the spot. For that, the tourists change their perception and believe in the holiday without a car.

- Guests can furthermore make use of luggage transport services, stay in soft mobility hotels that they can do the groceries or visit biological farmer shops in surrounding areas by just by walking, cycling, or electric bicycle. They can collect information on public transport options from the mobility center.
- When people are gathering information to decide on their next holiday, they can run into information from many resources (on Alpine Pearls on the website of Ameropa, the German railway). More importantly, it is obligatory for every Pearl village to provide information on Alpine Pearls both on their websites and in their catalogues. This information concerns the goals and background of Alpine Pearls, how to reach the village by environmental-friendly transport means, and the bookable ‘Alpine Pearls package holidays’.

5.2 Main weaknesses in public transport networks for visitors travelling to Limburg

To evaluate public transport used by tourists coming to Limburg, the thesis uses the evaluation criteria for public transportation operation as following: (Jiabin Li, et al., 2013):

- Safety: accident rate
- Speed: average running speed in terms of duration travelled for distance travelled.
- Punctuality: Scheduling adherence, Service Reliability, Coefficient
- Comfort: Passenger Load rate, Seat comfort, Running smooth degree, etc.
- Economy: travel cost
- Convenience: Hours of Service, Transfer time, accessibility, etc.

From a personal critical reflection, the research reviewed main weaknesses in the public transport network for visitors coming to Limburg according to each criterion.

5.2.1 Safety:

In general, travelling by train and bus in Limburg is perceived as safe transport modes. Belgian Railways also aims to be one of the top three European infrastructure managers in terms of rail safety. The trains are equipped with an automatic braking system and still on advancement of safety standards for the whole system. However, there is a lack of safety information for passengers travelling by bus. Nevertheless, this is a competitive point to get tourists to the public transport market.

5.2.2 Speed:

Speed is one of the drawbacks of the public transport for tourists to Limburg.

As mentioned in the previous chapter, the travelling time by train from Liege to Hasselt takes 1 hour for the distance of less than 50 kilometers. The same situation to connect Antwerp with a road connection of 79.3 kilometer with Hasselt, trains from and to Hasselt take 1 hour 38 minutes and 1 hour 43 minutes respectively. Trains from and to Brussels also take long, more than 1 hour for about 90 kilometer long. It will take another hour from Brussels to continue to East and West Flanders on the same train. And this is not accumulated with the time to get to the station from base locations.

On the other hand, if travelling by car, the trip from Maastricht to Hasselt takes about 40 minutes in normal traffic condition. Similarly, driving by car from Antwerp takes less than 1 hour and from Brussels 1 hour is supposed as door to door transport time.

The train from Hasselt to Maastricht in the Netherlands takes very long detour to Liege before going to Maastricht which makes the trip from Hasselt to Maastricht by train not an ideal choice.

Connections from Germany and other areas of Belgium such as the provinces of Hainaut, Namur or Luxembourg have to take a transit at Liege, Antwerp or Brussels that prolong the travelling time by train more than travelling by private cars.
From the Netherlands to Limburg, there are 2 direct routes by bus to Hasselt that are from the urban city Maastricht. One route takes 1 hour travelling and the other one takes 1 hour 30 minutes. The route is 40 km which takes 40 minutes if travelling by car. The connection to Eindhoven is locally operated and mainly devoted for local communities which are not directly linked with any tourist spot (Haspengouw, Limburgse Kempen, Hasselt, Voerstreek…). Therefore, it increases the travelling time to these places due to changing buses.

The travelling time by public transport compared with private cars is in this table. The estimated travelling time is according to Google map calculation application.

<table>
<thead>
<tr>
<th>Connection</th>
<th>Distance</th>
<th>By car</th>
<th>By public transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Liege</td>
<td>45.5 km</td>
<td>30 minutes</td>
<td>1 hour (train)</td>
</tr>
<tr>
<td>From Antwerp</td>
<td>79.2 km</td>
<td>53 minutes</td>
<td>1 hour 30 minutes (train)</td>
</tr>
<tr>
<td>From Brussels</td>
<td>82.1 km</td>
<td>57 minutes</td>
<td>1 hour 15 minutes</td>
</tr>
<tr>
<td>From Maastricht</td>
<td>33.7 km</td>
<td>30 minutes</td>
<td>1 hour (bus)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 hour 43 minutes</td>
</tr>
<tr>
<td>From Aachen</td>
<td>72.4 km</td>
<td>51 minutes</td>
<td>1 hour 53 minutes (train)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 hour 43 minutes (bus)</td>
</tr>
</tbody>
</table>

**Figure 38. Travelling time by public transport compared with car to Hasselt**

5.2.3 Punctuality:

The rail network often suffers from service disturbances causing delayed and out of service trains (Belgian rail website). In addition, the service at night time and on weekend is reduced. For instance, the train from Antwerp is reduced to one direct train per hour after 6 PM on Sunday. (Belgian rail website). The demand for travelling between Limburg and cities such as Brussels, Antwerp and Liege is sometimes greater than capacity and its frequency. However, there is only one train from Liege to Hasselt every hour or 2 trains from Antwerp to Hasselt every hour that make tourists hesitant to use public transport.

The same problem occurs with the bus service from Maastricht and its frequency. The buses run fewer trips at night time and during weekends, even during holiday periods. Moreover, the bus usually delays, sometimes arriving earlier at stations, inappropriate with the travel schedule that makes it difficult for tourists planning their trip. The bus service also has a problem of strikes and out of service that happens occasionally in Belgium. This can affect the decision for bus usage of inbound tourists to Limburg province.

5.2.4 Comfort:

The bus from and to Maastricht is regularly over capacity of loading. There are sometimes not enough seats during peak hours. This causes difficulties for tourists who are travelling with suitcases, bicycles or baby strollers.
The space and equipment on the bus also do not facilitate visitors travelling with sport bikes. And most significantly, there is often lack of real travelling time displaying at the bus station and during the bus journey.

Regarding train service, some train compartments date back a long time ago and are not as comfortable as the new train and lack travel information and are difficult to board on with large luggage. For instance, the train to Liege is not a new train and the train to Antwerp is often replaced by using the old facilitated compartments. The compartment with high platforms is not convenient for passengers with a lot of luggage or baby strollers or reduced mobilized people.

During the weekend, trains running from Brussels require passengers to sit on the “right compartment” that goes to Limburg direction, otherwise it splits at Landen station and heads to another direction which really confusing for visitors who firstly come to the region.

5.2.5 Economy:

Travelling by bus is not an ideal way for group visitors due to the relatively high fare of 3 euro per single ticket if purchased on the bus. The accumulated cost of many tickets may exceed the cost coming by car to the province. There is the availability of 10 a time-pass which results in a cost of 1.4 euro for one single ticket, however it can only be purchased once you get inside Limburg province, at Hasselt station for instance where there is a restricted opening and closing time. The trip from Germany will increase expenses due to another ticket from Germany to the Netherlands because the combination of these fare systems is impossible.

5.2.6 Convenience:

At indicated on the rail network map and bus network map, Limburg has limited connection to its main attraction places such as Haspengouw, Limburgse Kempen, Maasland. It is noticed that there is no train service directly to Voerstreek area and the bus connections are very limited while it is geographically located nearest to the Netherlands and Germany. The possibility for multimodal transport is limited among train, bus and bicycle. Electric bicycles are only available at Hasselt station. (http://www.blue-bike.be/en/blue-bike-points/hasselt)

For connection by train, the train network does not cover to Hoge Kempen where the national park locates and also not stretches till Maasland of Muse River Valley. It is required to change transport mode usually at Hasselt or Genk station.

In general, train stations are designed in simple way and there is lack of facilities to serve tourists such as a tourism information help desk. It is considered inaccessible for reduced mobilized passengers in many stations. Hasselt, Genk and Sint-Truiden are the few stations with services for tourists and assistance for reduced mobilized people. However, it is required to book assistance in advanced which tourists may not know. (Belgian rail website)

For connection by bus, the bus routes with neighborhood areas are only for short distance and dedicated for local people living in that areas only but not for tourists to get to their desired holiday places. There is no bus service running to central cities of both Flanders and Wallonia region. While the bus from Maastricht detours and has many stops as well as long a waiting time at Genk or Bilzen station.
In holiday season, there is one express coach service that runs directly from Brussels to the shopping village Maasmechelen while the visitors coming from Antwerp have a higher travel demand to Limburg. (see Table 10. origin of visitors)

5.3 Main actions required to make the public transport network more accessible for inbound tourists

The main focus of this section is creating an Action Plan to improve the inbound visitors’ mobility by means of improving convenience, punctuality, comfort and economical travelling by public transport for inbound tourists to Limburg. Furthermore, it is also aimed to improve the service experience to change tourist’s perception from travelling by cars to public transport modes. It also calls for coordination among transport providers and related stakeholders to enhance their partnership to make the actions a success and communicate with visitors about the provision of public transport. Moreover, it is an opportunity for the tourism business sector to engage in the process of more effective transport for tourists.

Furthermore, understanding the relation between the speed-ratio and mode choice, the objective of these actions is aimed to reduce the travelling time by public transport for tourists. Once travelling time by public transport is at an acceptable ratio as in the below chart which is roughly 1.4 time travelling by car, public transport can gain customers from car usage.

![Figure 39. Relation between speed-ratio and mode choice](image)

In addition to that, the plan also applied the central place theory by Walter Christaller (German economic geographer) who asserted that settlements simply function as ‘central places’ providing services to surrounding areas. It can infer that some stations such as Hasselt, Genk, Tongeren, Sint – Truiden are chosen as hub stations where tourists can easily find soft mobility modes to travel to their desired places. At their accommodation location, they can also find necessary services for holiday such as catering, recreational services, local product shopping then they do not need private cars accompanying them during the trip.

Since it is a challenging attempt therefore the public transport plan is divided into short term and long term objectives.

5.3.1 Short term actions:

<table>
<thead>
<tr>
<th>Action</th>
<th>Stakeholder</th>
<th>Outcome</th>
</tr>
</thead>
</table>

63
<p>| Increase the regularity and frequency of bus from Maastricht | De Lijn in Limburg Cooperation of Delijn and Veolia of the Netherlands to save the investment on buses | More buses running between Limburg (Hasselt) and Maastricht. |
| Increase the regularity and frequency service from Maasland and from the Netherlands to Maasland during summer holiday | De Lijn in Limburg Cooperation of Delijn and Veolia of the Netherlands | Develop the current bus route 72 from Roemond of the Netherlands till vacation lodge districts of Maaseik of Maasland. |
| Increase the regularity and frequency of bus connection from Wallonia, longer distance bus route that can cover greater settlements (Liege, Namur) to Limburg | De Lijn TEC of Wallonia bus operator | Attract the Wallonia tourists by the provision of bus connections which are limited at the present. |
| Replace by better train compartments | Belgian railways | To improve the journey experience and the comfort for the tourists |
| Increase the frequency train service from Antwerp city. | Belgian railways | Tourists from Antwerp represent 20.7% of total tourist arrivals in Limburg. So a good train connection can buffer the mobility between these 2 provinces. |
| Shuttle service from Hasselt to Hoge Kempen and Voerstreek | Limburg authority Private partnership | It will compensate the weakness of public transport to these main tourist areas. |
| Provide more e-bikes at stations | Limburg authority | E-bikes make easy travel from the station to tourists’ staying place. The convenience of e-bikes usage could eliminate the need of own private cars. |
| Holiday package including public transport, food, accommodation, activities. | Tourism Limburg with the help of: Belgian railways De Lijn Tour operators | The package at interesting price allows visitors to have a holiday in an economical way, environmental friendly and comfortable from the public transport service. The package is bookable on |</p>
<table>
<thead>
<tr>
<th><strong>Hotels and rental lodges</strong></th>
<th><strong>internet as one step to have accommodation and transport arranged for the whole holiday.</strong></th>
</tr>
</thead>
</table>
| **Develop mobile application for whole holiday in Limburg consisting of information on mobility and activities, attractions, etc.** | **Tourism Limburg** | **Currently, there is a mobile application for cycling network. It is interesting to improve the current tourist application and translate into English, integrated with the cycling network.**  
*Cycling network* has 20 years development by Tourism Limburg and consists of detailed information on cycling routes for tourists going for cycling holiday in Limburg. |

**Table 12. Short term actions**

5.3.2 Long term actions:

<table>
<thead>
<tr>
<th>Action</th>
<th>Stakeholder</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement/Recall the fast train service from Antwerp city to Limburg.</td>
<td>Belgian railways</td>
<td>To reduce the travelling time from Antwerp to Hasselt and Genk.</td>
</tr>
<tr>
<td>Implement new bus service from Aachen to Limburg</td>
<td>De Lijn DeinBus (German bus company)</td>
<td>The route can cover the region of Voerstreek on the way to Haspengouw area via Hoge Kempen national park entrance and Hasselt center.</td>
</tr>
<tr>
<td>Long distance Tramway between Hasselt and Maastricht.</td>
<td>Belgian railways Maastricht railways</td>
<td>Optimize the capacity to bring more passengers and tourists coming from the Netherlands at an acceptable investment cost.</td>
</tr>
<tr>
<td>Smartly designed train stations which are friendly with family travelling with children, reduced mobilized people, etc and integrated facilities at stations</td>
<td>Belgian railways</td>
<td>Tourists easily find travel information at the train station, the possible connections in the province by public transport.</td>
</tr>
</tbody>
</table>
Table 13. Long term actions

5.4 How does the current phase of Limburg’s tourism development impact on findings/recommendations?

Development of a sufficient public transport network will not only help to switch tourists changing their behavior from using private cars to public transport but also bring a new proportion of visitors coming to Limburg by public transport service. According to Butler’s theory of tourism life cycle, Limburg is still on the stage of attracting tourists. Therefore, convenient and comfortable mobility is required to catch up with the development process. For the longer run, as Tourism Limburg has engaged in promoting Limburg as a brand name on the tourism market and implemented advertisements to foster it, more visitor arrivals are expected to come. This calls for environmental friendly modes by means of public transport to mitigate pollution from car emissions and a sustainable development.

The connections to the main attraction areas at present are still weak and lacking. In addition, Hasselt will reach excessive capacity of accommodation provision. It means that public transport should develop further to the regions having most overnight visitors (Haspengouw, Maasland, Voerstreek, especially Hoge Kempen) in a comprehensive way to bring tourists directly to their holiday places. The connections should regard tourist’s demography, visiting season, arrival and departure time of day for scheduling. However, tourists staying in Hasselt spend more money than other regions: to benefit from the chain of restaurants and shopping stores, it is suggested to have a shuttle connection from Haspengouw, Maasland, Voerstreek, Hoge Kempen which is express and direct, not consists of many stops as in the case in the local service. At these areas, local communities should provide electric bikes or bicycles so that the tourists really do not need a car to travel to Limburg as they also have transport means provided during their holiday. At the moment, there are several bike rental possibilities for visitors however the capacity is not sufficient enough, for instance 43 standard bikes and 6 electric bike at Hasselt station (Blue bike service, http://www.blue-bike.be/en/blue-bike-points/hasselt).

The current phase of Limburg tourism also suggests recommendations on public transport research. The perspectives of Limburg tourism and its potential mobility market for tourists should encourage the authority to carry out research on public private partnership on providing public transport service for visitors. It is the way to better supply competitive service fully dedicated to tourists’ requirements. That high quality service is a key factor to gain loyalty of tourists.

Visitors coming to Limburg are mainly 40 years and older with the group from 50 to 65 year old the greatest part. For that, the use of train and bus should be regard to elderly. Moreover, the station design needs to be adapted to tourists. It is also noticed that designated bicycle compartments on train are required for tourists coming with their own bicycles. On the other hand, in the future, Limburg wants to increase the segment of families with children according to the strategic planning of Tourism Limburg. It means that transport providers should develop more holiday packages for families which cover the use of train and bus to encourage the use of public transport. Also, the assistance facilities for wheelchair or carry of luggage should be considered.

The international tourist represents a potential emerging market for tourism in Limburg province. It is required from the authority to put on promotions and broadcast information on tourism in Limburg. However, the connection to bring them to the province is very important. The cross border cooperation between Limburg and the Netherland and Germany is needed
to provide a better fare system, more frequent service and an easy trip to Limburg. For instance, a one time purchased ticket from Germany to Limburg with a cheaper fare than the separate fares from Germany to Maastricht plus Maastricht to Hasselt.

5.5 Sustainable public transport indicators for inbound tourists to Limburg

This final section is going to represent a set of indicators for public transport dedicated for inbound tourists to Limburg province. The indicators are selected from chapter 3 expressing sustainable transport system. However, they are modified to capture public transport for inbound tourists. In addition, the below indicators also take criteria of high quality public transport service in section 5.1 and actions to improve public transport for tourists in Limburg in section 5.3 into consideration.

The indicators are expressed how public transport performance for tourists but also supporting tools for mitigating environmental impacts. For managing work, local authority and transport planner need indicators to measure the trend of development, to reveal the work in a quantity method. Sustainable mobility tourism is under mission of preservation of the natural and cultural resources of the tourist destination and region, whilst simultaneously ensuring the greening of the products and services that deliver the visitor experience (ECOTRANS, 2004). Tourism mobility is part of the transport system and contains three dimensions of economic sphere, social sphere and environmental sphere.

**Economic indicator:**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time</td>
<td>Average travel time regarding to distance travelled (from home location to arrival points and within destinations)</td>
<td>Less is better</td>
</tr>
<tr>
<td>Accessibility</td>
<td>The availability of public provision and commercial services connecting to attraction places</td>
<td>More is better</td>
</tr>
<tr>
<td>Land Use Mix</td>
<td>Average number of basic amenities (medics, shops and restaurants and food court) within walking distance from tourist concentrated areas that allows tourists to travel free of car to reach necessaries.</td>
<td>More is better</td>
</tr>
<tr>
<td>Availability of information</td>
<td>Provision of Internet connectivity and on-site travel information (time, direction, cost)</td>
<td>More is better</td>
</tr>
<tr>
<td>Affordability</td>
<td>Expenditures devoted to transport in kilometres travelled, in terms of Origin-Destination transport and local transport.</td>
<td>Less is better.</td>
</tr>
<tr>
<td>Cost efficiency</td>
<td>The share of transportation cost as a portion in comparison of other cost and expenditure of the destination (food, accommodation, entrance ticket)</td>
<td>Less is better.</td>
</tr>
</tbody>
</table>

| Table 14. Economic indicators Limburg |

**Social indicator:**
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus usage</td>
<td>The proportion of tourists using the bus to come to Limburg</td>
<td>More is better</td>
</tr>
<tr>
<td>Train usage</td>
<td>The proportion of tourists using the train to come to Limburg</td>
<td>More is better</td>
</tr>
<tr>
<td>User rating</td>
<td>Overall satisfaction of public transport system by tourists</td>
<td>More is better</td>
</tr>
<tr>
<td>Unsafty</td>
<td>Number of crashes reported.</td>
<td>Less is better</td>
</tr>
<tr>
<td>Disabilities</td>
<td>Quality of transport facilities and services for disabled people.</td>
<td>More is better</td>
</tr>
<tr>
<td>Non-motorized transport</td>
<td>Quality and availability of non-motorised transport modes to connect Limburg with neighbor provinces.</td>
<td>More is better.</td>
</tr>
<tr>
<td>Children’s travel</td>
<td>The availability of a supporting service for travelling with children.</td>
<td>More is better</td>
</tr>
<tr>
<td>Stakeholder cooperation</td>
<td>The effectiveness degree rated among involved stakeholders in providing and promoting public transport</td>
<td>More is better</td>
</tr>
</tbody>
</table>

Table 15. List of social indicators

Environmental indicators:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change emissions</td>
<td>Per tourist fossil fuel consumption, CO2 by train/bus</td>
<td>Less is better</td>
</tr>
<tr>
<td>Noise pollution</td>
<td>Portion of local residents exposed to high levels of noise due to bus/coach served tourists</td>
<td>Less is better</td>
</tr>
<tr>
<td>Land use impacts</td>
<td>Land devoted to tourism transportation facilities</td>
<td>Less is better</td>
</tr>
</tbody>
</table>

Table 16. List of Environmental indicators

To carry out data collection, a partnership between Limburg authority and the accommodations where tourists stay is required to fill in survey and questionnaires. Also, it is needed to release an evaluation standard at every community for managing. Finally, the data collection for these indicators can be associated with the general annual tourism survey conducted by Tourism Limburg.
Chapter 6. Conclusions & recommendation for future research

The research has investigated sustainable tourism mobility by means of review of transport means for tourists and their impacts. For sustainable development, the research highlights public transport as the intervention to bring inbound tourists to the region in a more sustainable way. Limburg province is taken as research case study and a public transport accessibility plan was drafted for inbound tourists.

In detail, the research presents the relationship between tourism and transportation. Nowadays, depending on the scale of space, people use different transport means to mobilise for holidays. Each transport mean has a specific history of development and technical advancement resulting in negative impacts on the environment. It is noticed that emission from tourism mobility is a major portion in total tourism emission. In that context, air transport, the major transport mean for international tourism (Peeters, 2004) has a share of 50%-78% of all impacts.

The World Tourism Organization has predicted that Africa, Asia and Middle East will attract most tourist flows while America and Europe remain the second and the largest tourism market. One typical holiday is city sightseeing and the most visited cities are from Europe. Tourists nowadays can seek for tourist information including accessibility options on internet and applications on mobile devices. The tourism business sector also has improved in many ways to provide better hospitality service. Significantly, the explosion of low cost carriers triggers travelling by flight and raises environmental concerns from the air transport sector. However, the global issues such as terrorist attacks, war and infectious diseases cannot decrease travelling demand. They just happen temporally and regionally affect tourism.

However, the development of a tourist area fluctuates as explained by Butler’s Tourism Area Life Cycle. It has a period that calls remarkable attraction of tourists as well as investment to gain revenue from tourism business. From the management point of view, it is interesting considering tourism in an area into phases of development to have understandings of that region and forecast future development. The transport network should be comprehensively developed accordingly to that. The authority can execute appropriate improvements on the transport network to adapt with the tourist’s requirements as well as mitigate the impacts of mobility on environment.

Public transport is a key intervention to manage sustainability of tourism mobility. Within this research, case studies were selected from popular tourist areas to convince the validity of public transport. Alpine region and along Danube River are areas where environmental impacts are taken seriously but the connections by public transport before the project conductions were lacking. Lessons were learned from these projects chosen to be valuable for Limburg province with similar characteristics of tourism in terms of natural landscape, outdoor activities and in lack of good public transport connections for inbound tourists.

In detail, Limburg has major arrivals of domestic visitors who are mostly from Flanders. The two most important foreign markets are the Netherlands and Germany. Visitors usually do not stay in the capital city of the province, Hasselt but the regions Haspengouw, Maasland and Voerstreek especially Hoge Kempen where the national park is located. Most visitors are 40 years and older with the main group visiting from 50 to 65 years old.

In the view of transportation, there is a remarkable portion of tourists coming by private cars, which is 92,1%. It partly explains why the public transport has the least score in the satisfaction survey of tourists. It has only 7.6 among other factors of tourism in Limburg which all score more than 8. One of the drawbacks is the travelling by train as well as by bus usually takes relative long time. The punctuality and comfortability of service are also concerns. The frequency of service does not support tourists travelling at night time, on weekends or holiday periods. It also has limited direct connection from other provinces of Belgium and internationally. Therefore, it puts the travelling cost higher due to transit time and changing transport mode.
Therefore, the research has created a public transport accessibility plan in terms of short term and long term actions for inbound tourists coming to Limburg and its major attractions. The actions are suggested based on the priority of work needed to address to improve connections to Limburg. The objective of the actions is to increase the frequency of the service, implement bus service to the areas lacking of public transport connection. Also, the plan suggests the combination for multimodal modes of bus and train with other modes such as bicycles, electric bicycles or shuttle bus. Train service is aimed to provide connection from other areas of Belgium to Limburg while a direct bus connection is designed to target the international guests from Germany and the Netherlands. Accompanied with the action plan is the public transport indicator set for Tourism Limburg which is the tool to see if the public transport service meets the expectations and to see which aspects need to be tackled and improved.

The attempt to mitigate the impacts of tourism mobility on environment could be exploited in different ways qualitatively and quantitatively. Within this research framework, it presents the approach of managing the sustainability of tourism mobility by means of appropriate indicators. They are categorized into environment, society and economy for the local authority to see the current status of tourism mobility, foresee and mitigate its negative impacts. To create an indicator setting, the research tried to integrate sustainable transport system indicators and sustainable tourism indicators. The tourism mobility indicators are strongly dependent on the specific region’s requirement and the availability of data resource.

From this limitation, it is further suggested that, in future research one sustainable index will be created. Based on the indicator values, one final value is produced presenting the trend of public transport service for tourists. The solid index value can be used to compare the sustainability among regions.

In conclusion, the research has given an overview picture on tourism mobility in the world, by transport usage for leisure activity and raised awareness on the arising environmental impacts from the tourism industry. In the research the example of applying public transport as key approach for sustainable development was elaborated, especially for tourism in a region containing tranquil landscapes and in lack of efficient public transport connections. However, within this framework, the research does not indicate a method to measure environmental impact reduction or quantity of transport supply for tourists. Therefore, these remain issues for specific investigation in future research.
References:


Auteursrechtelijke overeenkomst

Ik/wij verlenen het wereldwijde auteursrecht voor de ingediende eindverhandeling:
Towards more sustainable tourism mobility

Richting: Master of Transportation Sciences-Mobility Management
Jaar: 2016

in alle mogelijke mediaformaten, - bestaande en in de toekomst te ontwikkelen -, aan de Universiteit Hasselt.

Niet tegenstaand deze toekenning van het auteursrecht aan de Universiteit Hasselt behoud ik als auteur het recht om de eindverhandeling, - in zijn geheel of gedeeltelijk -, vrij te reproduceren, (her)publiceren of distribueren zonder de toelating te moeten verkrijgen van de Universiteit Hasselt.

Ik bevestig dat de eindverhandeling mijn origineel werk is, en dat ik het recht heb om de rechten te verlenen die in deze overeenkomst worden beschreven. Ik verklaar tevens dat de eindverhandeling, naar mijn weten, het auteursrecht van anderen niet overtreedt.

Ik verklaar tevens dat ik voor het materiaal in de eindverhandeling dat beschermd wordt door het auteursrecht, de nodige toelatingen heb verkregen zodat ik deze ook aan de Universiteit Hasselt kan overdragen en dat dit duidelijk in de tekst en inhoud van de eindverhandeling werd genotificeerd.

Universiteit Hasselt zal mij als auteur(s) van de eindverhandeling identificeren en zal geen wijzigingen aanbrengen aan de eindverhandeling, uitgezonderd deze toegelaten door deze overeenkomst.

Voor akkoord,

Nguyen, Ngoc Thuy

Datum: 11/01/2016