The Innovation of Augmented Reality in the Tourism Industry

A Case Study of the Tourism Destination Stockholm

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Abstract

This master thesis will discuss the innovation process of Augmented Reality and how it shaped the tourism offer. The main objective of this paper is to present an overview of existing AR applications used in the tourism industry. As empirical part, AR offers from the tourism destination Stockholm will be analyzed. Although there has already been a first approach in developing AR technology in the seventies there is still a limited use of touristic AR applications today. Apart from the already established MAR applications this paper will also discuss the first attempt of a 3D AR application in one of Stockholm’s museums.

The findings of this paper should assist tourism destinations to get a general overview of the innovation of AR applications and how they can be embedded in tourism offers.

Key words: Innovation, Tourism, Augmented Reality, Mobile Augmented Reality, 3D Augmented Reality, Stockholm Tourism
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List of Abbreviations

3D - Three-Dimensional space
AAR - Audio Augmented Reality
AR - Augmented Reality
BFUF - Besöksnäringens Forsknings och Utvecklingsfond
CEO - Chief Executive Officer
CRS - Computer Reservation System
GDS - Global Distribution System
HMD - Head-Mounted-Display
MAR - Mobile Augmented Reality
MRV - Mario Romero Vega
RV - Reality-Virtuality
TA - Thomas Andersson
VR - Virtual Reality
1 Introduction

The first chapter gives an overview of the master thesis. It provides a short introduction about the research background and research problem of the paper. Furthermore, the research aim and the resulting research questions are given. As conclusion, the research design and a short chapter outline will be presented.

In order to clarify the terminologies used in this thesis it should be mentioned that this paper exclusively addresses Augmented Reality [AR]. However, to state the development of AR, the literature review of this paper will also discuss briefly the connection to Virtual Reality [VR], since both, AR and VR are similar in the goal of immersing the user. Therefore, AR can be defined as technology that continues to let the user be in touch with the real world while interacting with virtual objects around them. With VR the user is isolated from the real world while immersed in a world that is completely fabricated (McKalin, 2014).

1.1 Background and Problem Definition

Innovation is an intensely studied phenomenon in the tourism field among researchers since the late 80’s and it got intensified in the 2000’s when especially entrepreneurs started to notice how important innovation is for the tourism development (Nagy, 2012). Research also depicted that the development in the global tourism industry is affected by the five key factors: human, geopolitical, economic, technological and environmental. It is well known that tourism is a service industry, which has discovered the effects of information on tourist experiences a very long time ago. It has always found its way to strategically position itself on the marketplace. However, the rapid technological progress and the increasing prosperity over the last few decades set new foundations for further growth of global tourism flows in the future (Anwar and Hamilton, 2005, p. 77).

In terms of technological innovations, tourism has always embraced the rise of new introductions like the Computer Reservation System [CRS], or the Global Distribution System [GDS] and the Internet. ‘Experience’ and ‘value’ are the most rel-
evant concepts for the modern tourism industry and the great dynamic structure allows both, producers and consumers, to react instantly to new trends and develop new products (Sezgin, 2016).

One of the many outstanding technical innovations is AR, which is a visualization technique that synthesizes various multimedia information with the real view (Chung, Hahn and Joun, 2015, p.589). Research has shown that AR was picked up by the tourism industry at an early stage, long before the era of smartphones. For instance, Benjamin Bederson introduced the term Audio Augmented Reality [AAR] that demonstrated an augmentation of the audition modality. The developed prototype was used as part of a museum guide (Arth et al., 2015, p.6).

When in 2009 the first smartphone apps began to use AR technology to add a layer of guidance, content and entertainment to physical locations, a new era of innovation in the tourism industry has begun. Tourists could experience attractions through their phone’s camera view. In 2010, an Italian tourist destination launched ‘Tuscany+’, the first AR tourism application. It was an interactive, real-time guide app intended to enhance the visitor experience in that region (DestinationThink, 2017). From that time onwards AR opened a new world of innovation in the tourism industry and consumer-based mobile AR applications development has grown very quickly over the past few years.

Nowadays, AR technology is used in a number of fields such as medicine, education and simulated training among others. Especially the tourism sector discovered AR for itself to enhance the tourist experience to a great extent (Kounavis, Kasimati and Zamani, 2012, p. 1). One reason for the fast adoption of AR in recent years is the readiness for using technology and the positive attitude toward AR. The development of AR is dependent on three main aspects: The first one is the personal propensity toward AR. It refers to the readiness of people and if they have an overall state of mind for new technology. This technology readiness influences the users’ beliefs about the technology. The second aspect is the visual appeal associated with AR. Finding valuable information can be a goal of travelers wishing to gratify functional and esthetic information needs. The third aspect for using AR in tourism is the situational factor in terms of facilitating conditions, which
means that users recognize when the environment is good to use technology (Chung, Hahn and Joun, 2015, p.588-589).

AR, as an emerging technology in the mobile computing domain, is becoming mature enough to engender publicly available applications for end users. Various commercial applications have recently been emerging in the mobile consumer domain at an increasing pace. Some of the most prominent ones are Junaio, Google Goggles and Wikitude (Olsson and Salo, 2011, p.75). Although several research studies have been conducted to analyze the overall acceptance and user experience of Mobile Augmented Reality [MAR], no information has been found about how exactly this advanced technology has changed the tourism appearance in popular tourist cities like Stockholm.

Even though a body of academic literature can be found that deals with the application possibilities of AR and VR and how it is used in the tourism industry, no specific research could be found about how it changed the approach to tourism destination marketing. Finding some papers about different case studies related to AR tourism examples all over the world raised the question how city tourism in Europe adapted this trend. Considering that Stockholm is seen as a hub of technological innovations and a very popular tourist destination, the author wants to find out the degree of innovation in AR applications in the city Stockholm.

1.2 Research Question and Research Aim

The aim of this master thesis is to identify the extent of innovation in the tourism industry due to AR. To narrow down the area of innovations, the paper will focus exclusively on AR applications which are used by tourist attractions and tourist destinations. As tourism related AR offers can be found all over the world, the author will focus in her empirical part on the case of the city Stockholm in Sweden. Reasons for that are explained in the section above.

The objective of this research can be broken down into the following research questions:
RQ1: "To what extent did AR change the tourism industry and how can it shape the innovation of new tourism offers?"

RQ2: "Which AR tourism applications exist in Stockholm and how are they perceived by tourists?"

1.3 Research design

This research paper is divided into two parts, namely a hermeneutical and an empirical part. The first part consists of a review of recently published literature in order to present the theoretical background of AR and how it has spread as well as to identify the innovation of AR. As precise knowledge is used to fully analyze the case study of Stockholm’s AR applications, expert interviews will be conducted as well as visitor interviews of an exhibition where AR is used, in order to estimate the perception of AR offers by tourists in Stockholm.

1.4 Chapter Outline

In order to give an overview of the topic, this master thesis will include an introduction about the impacts of innovation in tourism in general, the purpose of this research, the study's aim, the methods used and a short chapter outline.

After that, an extensive literature review will be provided including the history of AR, examples of innovations in AR and the impacts on the tourism industry. This part will also include an insight in the change from a consumer to a prosumer society and how it affected the innovation of tourism.

In the second part of the thesis, a case study will be conducted. The first part of the case study includes touristic AR application offers founded in Stockholm. After that, expert interviews will be analyzed and the outcomes of the visitor interviews of an AR application attraction will be presented.

As a conclusion, all relevant findings will be summarized and recommendations will be derived from it. Additionally, further research will be suggested.
2 Literature Review

The following chapter deals with the theoretical components of AR. First of all, several definitions of AR will be stated. After that, the author lists milestones of the development in AR. To apply an appropriate model for this research paper, the author covers the theoretical background of diffusion of innovation and states examples of the tourism industry.

2.1 Definition of Augmented Reality

AR is a visualization technique that superimposes computer generated data, such as text, video, graphics, GPS data and other multimedia formats, on top of the real-world view, as captured form the camera of a computer, a mobile phone or other devices. In other words, AR can augment one’s view and transform it with the help of a computer or a mobile device, which enhance the user’s perception of reality and of the surrounding environment (Kounavis, Kasimati and Zamani, 2012, p. 1).

Craig (2013, p. 2) points out that AR mediates between humans and computers, humans and humans and computer and humans and the core essence of AR is that you can experience things that are not possible in a normal interaction in the real world. Therefore he states following definition for AR:

“Augmented reality is a medium in which digital information is overlaid on the physical world that is both spatial and temporal registration with the physical world and that is interactive in real time.“ (Craig, 2013, p. 20)

According to Pulli et al. (2009, p. 3), AR means experiencing the real world and augmenting the experience, often by adding images of virtual objects or textual annotations over the scene. He also states that AR can provide a fundamentally better user experience on a mobile system than on other computer advices.

Another approach to discuss AR in a general sense was displayed by Milgram et al. (1994, p. 283) with classifying the relationship between AR and a larger class of
technologies, the so called “Mixed Reality” [MR]. He states that AR and VR are related and both concepts have to be considered. The commonly held view of a VR environment is one in which the participant or observer is totally immersed in a completely synthetic world, which may or may not mimic the properties of a real-world environment. It can exceed the bound of physical reality by creating a world in which the physical laws governing gravity, time and material properties no longer hold. In contrast, a strictly real-world environment clearly must be constrained by the laws of physics. The center of these two environments is defined as Reality-Virtuality (RV) continuum.

*Figure 1: Simplified representation of a RV Continuum*

![RV Continuum Diagram](source: Milgram et al., 1994, p. 283)

The left side of the figure above defines any environment consisting solely of real objects and includes whatever might be observed when viewing a real-world scene either directly in person or through some kind of a window or via some sort of a display. The right side of the continuum defines environments consisting solely of virtual objects, examples of which would include conventional computer graphic simulations, either monitor-based or immersive. Everything within this framework can be defined as a generic MR environment. Or in other words, MR is where real world and virtual world objects are presented together within a single display (Milgram et al., 1994, p. 283).

### 2.2 The History of AR

Looking back on the history of AR, it can be noticed that the development of AR already took place over the last 50 years. However, the last decade formed the
interpretation itself of what AR really is, especially in terms of MAR. The first instance of MAR can be associated with the development of wearable AR, in a sense of experiencing AR during using a mobile including a motional act. With the transformation and miniaturization of physical devices and displays, the process of MAR changed innovatively and rapidly (Arth et al., 2015). To provide an overview of the development in AR, a timeline with significant technological introductions is listed below (Arth et al., 2015). However it has to be mentioned that the inventions and development processes in AR are far more extensive and could not all be covered in this paper.

1968: Ivan Sutherland creates the first augmented reality system, which is also the first virtual reality system. It uses an optical see-through head-mounted display that is tracked by a mechanical tracker and an ultrasonic tracker. First, simply wireframe drawings could be displayed in real time.

1992: Tom Caudell and David Mizell coined the term “augmented reality“ to refer to overlaying computer-presented material on top of real world. Furthermore, IBM and Bellsouth introduced the first smart phone, the IBM Simon Personal Communicator, which was released in 1993.

1993: The Global Positioning System (GPS) achieves initial operational capability. Although GPS was originally launched as a military service, nowadays millions of people use it for navigation and other tasks such as geo-caching or AR. It calculates its position by carefully timing the signals sent by the constellation of GPS satellites. The accuracy of civilian GPS receivers is typically in the range of 15 meter.

1995: The first Audio Augmented Reality [AAR] was introduced by presenting a system that demonstrated an augmentation of the audition modality. The developed prototype uses a MiniDisc-Player which plays audio information based on the tracked position of the users as part of a museum guide.

1997: The touring machine, the first Mobile Augmented Reality [MAR] system was introduced. It uses a see-through head-worn dispaly with integral orientation
tracker including a computer, differential GPS and digital radio for wireless web access as well as a hand-held computer with stylus and touchpad interface.

1999: A Mobile Augmented Reality [MAR] system was presented that included indoor user interfaces to interact with the outdoor user. While outdoor users got a multimedia presentation via a head-mounted display, indoor users could get an overview of the outdoor scene.

2001: The system “GEIST” was presented which was developed for interactive story telling within urban and historical environments. A complex database setup provides information queues for the appearance of buildings in ancient times or historical facts and events. Complex queries can be formulated and stories can be told by fictional avatars or historical persons.

2008: The founder Mobilizy launches Wikitude, an application that combines GPS and compass data with Wikipedia entries. The Wikitude World Browser overlays information on the real-time camera view of an Android smartphone.

2012: Google Glass is firstly presented to the public, which is an optical HMD that can be controlled with an integrated touch-sensitive sensor or natural language commands. Furthermore, PrimeSense, the creator of the Microsoft Kinect, introduced a smaller version of a 3D sensing device called Capri that is small enough to be integrated into mobile devices such as tablets or smartphones.

2014: Google announced another new innovation of AR technology. Google Tango is a real-time location and mapping mobile AR platform that uses computer vision to give the device knowledge about its location relative to the physical world. Therefore, the new advancement of hardware and software makes it possible to render 3D objects in real-world.

2015: Microsoft announced the Hololens, a headset to fuse AR. The device is a complete computer with a see-through display and several sensors.
2.3 The Diffusion of Innovation

Before depicting an insight in the diffusion of AR, the three-component model of diffusion of innovation has to be clarified. The following part provides a short explanation of the components innovation, source and adopter.

2.3.1 Innovation

Before talking about the core element 'innovation', the term has to be clarified. Innovation can be defined simply as a 'new idea, device, or method'. But it can also be seen as the application of better solutions that meet the market needs. Innovations can be new products, new processes or new ways to organize a business (Mohammadi, 2016). There is also a distinction between different levels of innovation. Cumulative innovation is defined as the incremental improvement and introduction of existing products, technologies or services. Radical innovation is defined as the development of significantly new ideas, which can result into a destruction of an existing market (Donnellan et al., 2006, p. 169-160).

In terms of diffusion of an innovation process, innovation is the core element. It can diffuse among potential adopters and it can be anything as long as it is perceived as new from adopters. (Karakaya and Sriwannawit, 2016). Kotler et al.
(2012, p.642) also describes the innovation diffusion process as the spread of a new idea from its source of invention or creation to its ultimate users of adopters.

2.3.2 Source

For many organizations outside actors are more important sources of innovation than the organizations themselves, which is called distributed innovation or open innovation. In many sectors the users of existing products are the largest source of innovation (Bengtsson, Ryzkhova, 2013, p. 656). That corresponds with the explanation given by Karakaya and Sriwannawit (2016) who state that other sources of diffusion can be innovators, government agencies, companies or any individuals. They are perceived as important, since they can influence potential adopters to a great extent.

To summarize, the source of innovation is a powerful contribution to a radical change in perspective and to understand the role of demand and profitability in the innovation process. It helps us to explain new aspects of the relationship between economic needs and technological innovations (Bengtsson, Ryzkhova, 2013, p. 656).

2.3.3 Adopters

As already mentioned above, adopters are individuals, organizations or institutions that take up or embrace the innovations. This means that individuals make the decision of adopting an innovation. Any individual can be a potential adopter, however, not all potential adopters necessarily welcome the innovation at a certain point of time (Karakaya and Sriwannawit, 2016).

According to Kotler et al. (2012, p.160), the adoption of an innovation depends also on various factors like perceived compatibility, the relative advantage or the perceived complexity and that all is related to the innovation itself and to the consumer. Furthermore, they categorize the adoption process into five stages, which will be explained below (Kotler et al., 2012, p. 643).

- Innovators: These people are the technology enthusiasts. They are defined as venturesome and enjoy tinkering with new products and mastering their
intricacies. In return for low prices, they are happy to conduct alpha and beta testing and report on early weaknesses.

- Early adopters: The second category can also be described as opinion leaders who carefully search for new technologies. They are less price sensitive and willing to adopt the product if personalized solutions and good service support are given.
- Early majority: Adaptors of this group are deliberate pragmatists who adopt the new technology when its benefits are proven and a lot of adoption has already taken place. They make up the mainstream market.
- Late majority: Can be defined as skeptical conservatives who are risk adverse, technology shy and price sensitive.
- Laggards: These people are tradition bound and resist the innovation until they find that the status quo is no longer defensible.

To sum up, every innovation is dependent on its sources and the stages of adoption. Especially, the adoption of the individuals contributes most to the process of an innovation. Due to the fast development in technology, the diffusion of innovation becomes even more important for many industries nowadays. One of them is the tourism industry, which will be discussed in the following subchapter.

### 2.4 The Diffusion of AR in the Tourism Industry

The evolution of information technology in the past two decades has revolutionized tourism business operations worldwide and impacted mostly industries dependent on information, like tourism (Banes and Boglut, 2013, p.36). Nowadays, AR is used as an important tool for tourism presentation and promotion to attract new visitors all over the world. The 3D virtual world provides opportunities for tourist organizations and attractions to communicate with targeted markets by offering a rich environment for potential visitors (Huang et al., 2015, p. 116). However, coming to this point AR had to pass a long way of development process and consumer adoption journey, since new technologies such as AR affect not only consumers' behaviors but also society as a whole. Technology innovations are seen as radical innovation
and the last groups of adopters are often unable to catch up with new technology, feel uncomfortable to actively use it and therefore avoid it (Chung, Han and Joun, 2015, p.590).

Long before smartphones, the task of augmenting the traveler’s reality fell to guidebooks, and for more than two centuries some of them did an excellent job. However, since smartphone AR apps were introduced, people appreciate the additional features that travel books cannot offer. They can hold far more information, provide maps, which are easy to update, can point out where you are, where you are going and present the information in text, full-color photos, videos, and audio (Schatzker, 2010).

The introduction of AR applications for mobile phones took travel to a whole new level of experiencing. It delivers more valuable experience without a tourist guide. In particular, diverse application tools for mobile phones with AR features have been developed. For example, Condé Nast traveller, a magazine that developed AR guides for some popular cities, or Google Goggles and Wikitude, which was mentioned in the subchapter about the history of AR. An article by Schatzker (2010), explains how the travel journey of a city trip changed with using AR mobile applications. For instance, when you are walking down a street and get the attention of a building, you simply have to switch from Google Maps, which is a mobile map, to Google Goggles, a new app that can analyze a photo of almost any historic site, item or painting, and tell you what it is. Another way to find out about that site makes Wikitude possible. You only have to hold your smartphone up and right before your eyes reality becomes augmented with a box popping up next to the building with a lot of information about the site, item or painting.

Furthermore, Google achieved a break through in wearable computing with their product ‘Google Glass’. Wearable computing in the technical sense refers to any device that can perform computation within the device that is worn (Leue, Jung and Dieck, 2015, p. 463). It includes activity trackers, smart watches, sensor band, or Google’s introduction of glasses. Google glass is the first device to incorporate significant amount of components into relatively small, lightweight and unobtrusive device. A touristic example is the test of introducing Google Glass in the Manches-
ter Art Gallery. The visitors could receive augmented information while looking at paintings and therefore, enhance the user experience and learning outcomes within the art gallery environment. A major outcome of this experiment was that a large number of participants confirmed that they were pleased about the feature to see new links and to look deeper. Furthermore, some participants confirmed the advantage of flexibility in moving around within an exhibition. All in all, Google Glass is seen as a more personal and convenient device due to the hand-free approach and set a new milestone for the development in AR in the tourism industry (Leue, Jung and Dieck, 2015, p. 472-473).

The latest innovation in AR of the company Google was the introduction of 'Google Tango'. This tracking capability is a corner for experience that attempts to provide the visual illusion that rendered 3D objects to react and behave just like real-world physical objects. The location of the user’s viewpoint must be tracked in 3D space. The hardware and software of this technology enables three new major capabilities on the phone. The first one is 'Motion Tracking', which keeps track of the position in 3D-space. With 'Area Learning' the device may recognize an area it has been before and can identify key features of the environment. The third capability is the 'Depth Sensing', a Google Tango device that detects the distance to surfaces in the environment (Lee, 2017). The first project of 'Google Tango' was made in cooperation with the 'Museu Nacional d’Art de Catalunya' in the city Barcelona in 2016. In cooperation with Lenovo Google created an indoor location guide tablet, called the Project Tango app. It uses AR features to create your own personal tour guide, showing hidden details that are invisible to the naked eye. Unique of this tablet app was that no GPS was used. All the indoor navigation features were run through the camera technology on the back of the device. Locating the tablet took only a few moments and it was supported with a 3D AR path superimposed on the floor (Peckham, 2016).

To summarize, it is up to today’s destinations and tourist attractions to imagine the future of AR in the tourism industry. There are plenty of possibilities to use AR. For instance, visitors could travel to ancient battlefields and get an accurate impression of how they looked centuries ago. AR will likely be useful to travellers in many
ways. Information, inspiration, navigation, education, translation. All this is combined in one single app (Sezgin, 2017). The literature review of this chapter verifies the author’s assumption that AR technology has already significantly shaped the innovation of new tourism offers. In chapter four the degree of AR innovation will be further discussed as well as an analysis of the perception of AR tourism applications in Stockholm will be presented.
3 Methodology

The following chapter explains the research design chosen for this paper. In order to analyze the innovation of AR in the tourism industry, secondary data was collected, as well as primary data in form of in-depth expert interviews and visitor interviews. Additionally, an overview of the data collection, the data analysis and ethical issues will be outlined.

3.1 Research Design

The design used in this study is a qualitative method since the core of a qualitative research is to identify the characteristics and structure of phenomena and events examined in their natural context (Jonker & Pennik, 2010). Furthermore, a qualitative method is suitable for the case study since it is used to investigate single settings and phenomena (Collis & Hussey, 2013).

3.2 Collection of Data

Primary data is generated from an original source, whereas secondary data has been collected from an existing source (Collis and Hussey, 2013). Primary data was collected in form of expert interviews as well as visitor interviews concerning the perception of a current AR application. Secondary data was collected through desk research.

3.2.1 Secondary Data

First of all, an extensive literature review from recently published academic literature has been conducted in order to identify the importance of AR in the tourism industry and to answer the research questions. According to Veal (2006, p. 121), a literature review provides the entire basis of every research. It is the “process of identifying and engaging with previously published research relevant to the topic of interest” (Veal, 2006, p. 52). Thus, the literature review also gives a foundation and context to analyze the outcomes of the primary data. In order to depict a com-
Comprehensive overview of the development of AR, the author used the framework of the diffusion of innovation in order to analyze the development of AR in the tourism industry.

3.2.2 Primary Data

The empirical data was conducted by using two different types of interviews. On the one hand, two semi-structured expert interviews were conducted. This method was addressed as the most appropriate because free exchange of information took place in an adequate atmosphere, where opinions and recommendations could then be investigated (Malhotra, 2002, p. 175). The first expert interviewee was Dr. Mario Romero Vega, an Associate Professor and director of the Human-Centered Visualization Group at the Department of Computational Science and Technology at the KTH Royal Institute of Technology. The second interview was conducted with Thomas Andersson, the CEO of Visit Stockholm AB. Both interviews were arranged by email and the interview guideline can be found in the annex. The first interview with Dr. Mario Romero Vega was conducted on 9th of June 2017 via Skype. The second expert interview was carried out face-to-face at the office of Thomas Andersson on 3rd of July 2017.

Additionally, tourists who visited the Swedish National Museum of Science and Technology were interviewed. Sampling in qualitative research is not based on selecting subjects randomly out of the whole population. It is about collecting considered samples in order to analyze the particular field of interest (Flick, 2007, p.27). Therefore, ten visitors were interviewed about how they perceived the AR application experience, which is part of the exhibition ‘100 Innovations’. The interviews took place on 26th of June 2017 from 2pm until 4pm at the entrance area of the museum and the interview guideline can be found as well in the annex.

3.3 Data Analysis

The two expert interviews were tape-recorded and verbatim transcriptions were produced. Based on the interview guidelines, a coding tree was produced. A code in qualitative inquiry is most often a word or short phrase that symbolically assigns
a summative, salient, essence-capturing of visual data as like the interview transcripts (Saldaña, 2013, p. 3). According to this coding, the subchapters of the discussion have been titled.

In order to analyze the interviews, an interpretative model was chosen, because it has been considered as most appropriate to summarize descriptions with illustrative quotes followed by an interpretation by the author. It has to be mentioned that only the expert interviews have been quoted since the answers of the visitor interviews were corresponding to a certain extent due to structured interview questions.

3.4 Ethical Issues

For ethical reasons, the researcher is responsible for preserving information obtained from the participants confidentially. Furthermore, the researcher’s subject is to be advised that the work will not be anonymous and names will be stated (Babbie, 2013, p. 66). Therefore, ethical issues were of primary concern to the researcher during the entire research process. An extensive explanation of the purpose of the research was provided beforehand and the expert participants were asked for permission to tape-record the expert interviews and to use their names in the paper. Participants were given the opportunity to refuse to agree to the conditions.

To respect the privacy no names of the visitor interviewees were required and only notes of the interview answers have been made. As a result, the answers were coded with interviewee 1 to interviewee 10.
4  A Case Study of AR Tourism in Stockholm

While in chapter two the theoretical aspects of the innovation of AR has been discussed, the following chapter will focus on the empirical part of this thesis. Hence, tourist AR applications in Stockholm will be analyzed and the outcome of interview discussions will be presented. The collected information will assist to answer the research questions about which AR tourism applications in Stockholm exist and how tourists perceive them. To depict a comprehensive picture, some general facts about tourism in Stockholm will be outlined as well.

4.1  Facts and Figures about the Tourism Destination Stockholm

With close to 13 million commercial overnight stays in 2015, Stockholm ranks eleventh on the list of the most attractive destinations in Europe according to the European Cities Marketing Benchmarking Report 2015-2016. In retrospect to the development over the past five years, an annual growth rate of 0,5 percent could be recorded. Furthermore, it has to be mentioned that Stockholm is the only Scandinavian city listed among the top 15 most attractive destinations in Europe in 2015. A large part of the number of commercial overnight stays in Stockholm can be accounted by domestic demand, but the foreign demand has indicated a stronger increase. In 2015, an increase of 14 percent of foreign visitors could be stated. Most of the foreign visitors come from European countries.

Stockholm offers a large number of events and exhibitions all over the year, which attracts millions of visitors. The table below lists the major attractions in Stockholm in 2015 (Visit Stockholm, 2016). The Kulturhuset Stadsteatern leads the ranking with 3.2 million visitors in 2015. The second place is taken by Stockholm’s Globe Arena that includes the possibility to drive to the top with a sky view elevator. The ranking indicates that the famous attractions like the open-air museum Skansen or the worldwide known Vasa Museum are on place five and six after the amusement park Gröna Lund. One can also deduce of the table below that seven indoor mu-
A Case Study of AR Tourism in Stockholm

Museums are listed among the top 20 tourist attractions in Stockholm with a total visitor number of four million in 2015.

*Figure 3: Major attractions in Stockholm County, 2015*

<table>
<thead>
<tr>
<th>Rank</th>
<th>Destination</th>
<th>Number of visitors (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kulturhuset Stadsteatern (incl. Theatre in the Parks and Theatre Skärholmen)</td>
<td>3,200</td>
</tr>
<tr>
<td>2</td>
<td>Stockholm Globe Arenas (incl. Skyview)</td>
<td>2,000</td>
</tr>
<tr>
<td>3</td>
<td>Gröna Lund</td>
<td>1,491</td>
</tr>
<tr>
<td>4</td>
<td>Sightseeing, Strömma Group</td>
<td>1,470</td>
</tr>
<tr>
<td>5</td>
<td>Skansen</td>
<td>1,377</td>
</tr>
<tr>
<td>6</td>
<td>The Vasa Museum</td>
<td>1,320</td>
</tr>
<tr>
<td>7</td>
<td>Eriksdalsbadet, Swimming Center</td>
<td>1,226</td>
</tr>
<tr>
<td>8</td>
<td>Stockholmsmässan</td>
<td>1,152</td>
</tr>
<tr>
<td>9</td>
<td>Friends Arena</td>
<td>1,100</td>
</tr>
<tr>
<td>10</td>
<td>Slottsträdgården Ulriksdal</td>
<td>575</td>
</tr>
<tr>
<td>11</td>
<td>Swedish Museum of Natural History (incl. Cosmonova)</td>
<td>532</td>
</tr>
<tr>
<td>12</td>
<td>Moderna Museet</td>
<td>515</td>
</tr>
<tr>
<td>13</td>
<td>Fotografiska</td>
<td>500</td>
</tr>
<tr>
<td>14</td>
<td>City Hall</td>
<td>441</td>
</tr>
<tr>
<td>15</td>
<td>Casino Cosmopol</td>
<td>424</td>
</tr>
<tr>
<td>16</td>
<td>The Royal Chapel</td>
<td>406</td>
</tr>
<tr>
<td>17</td>
<td>Royal Palace, The Royal Apartments</td>
<td>370</td>
</tr>
<tr>
<td>18</td>
<td>The Swedish Centre for architecture and design</td>
<td>366</td>
</tr>
<tr>
<td>19</td>
<td>The Butterfly House Haga Ocean</td>
<td>352</td>
</tr>
<tr>
<td>20</td>
<td>Museum of Science and Technology</td>
<td>347</td>
</tr>
</tbody>
</table>

Source: Facts about Stockholm’s Tourism Industry, Statistics for 2015

Analyzing the positive development of the tourism destination Stockholm leads to the assumption that further growth in overnights and a greater diversity of foreign tourists can be assumed in the future. According to Sezgin (2016), the components ‘experience’ and ‘value’ are very important to react instantly to new trends and to develop new products. Therefore, the following part of this chapter will discuss founded AR tourist applications, which are offered so far in Stockholm.

### 4.2 Stockholm’s AR Travel Guide Applications

Literature underlined that AR will likely be useful to travellers in many ways. Information, inspiration, navigation, education, translation – it is all there in one app. Travellers will use AR technology to choose their destinations and activities before and during their trip. Ultimately, they will experience planning and travelling in a much more interactive and enriching way that will feel like a journey of its own (DestinationTHINK, 2017). Since the tourism industry is aware of that fact, a broad
range of MAR travel guide applications are offered from various companies nowadays. However, it has to be mentioned that these applications are mostly build on location-based tracking, because this technology has been well developed over the last years and can be found in almost every smartphone nowadays. In other words, these applications using GPS and Internet content to overlay it with information for certain points of interest on the real-time camera view of smart phones (Schmitz, 2017). The subchapter below describes the travel guide applications eTIPS and mTrips to demonstrate the created travel experience by using an MAR travel application.

4.2.1 eTIPS

eTIPS is an American company which already has several years of experience in producing, distributing and publishing travel apps and bringing multiple solutions to travelers and locals. They offer applications for landmarks, places, cities and museums. With the eTIPS Stockholm travel guide app can travellers discover the city in a new and experience oriented way. The AR function in this app provides a 360° view on the screen and therefore, close by attractions can be found very easily. It is a very practical city guide since it was designed for using interactive itineraries. The app offers four different itineraries for the city depending on the duration of your journey. Further features like advices to travelers, an interactive zoomable offline map, shopping tips, hotel and restaurant recommendations, or most popular places including safety tips are provided in this app. The app can be downloaded for free and the AR packages including all the information can be purchased for 4,49 Euro (eTIPS, 2017). The picture below shows the AR traveller experience through a smartphone and a tablet.

Figure 4: Screenshot of eTIPS MAR travel application

Source: eTIPS, 2017
4.2.2 mTrip

mTrip was founded in 2009 and is a leader in the mobile travel application industry with a distinctive collection of solutions for travel and tourism. Its diverse portfolio includes custom solutions for tourism boards, DMO, CVB, tour operators, OTA, travel agencies and travel publishers. Certainly, there also exists a MAR application for the city Stockholm. This app creates a very personalized itinerary of over 800 Stockholm tourist attractions with ratings, reviews, descriptions and pictures. With the AR feature, the app creates a heightened view to the users and includes special features like creating and sending virtual postcards via Facebook or email. mTrip also offers an Stockholm Travel Guide, including an offline map, where all relevant information about Stockholm’s museums, restaurants, bars, and pictures about attractions can be retrieved. The download of the application costs 5,49 Euro and is available for iPhone, iPad and Android (mTrip, 2017).

4.3 New Era of AR Experience in Stockholm

Next to the already established interactive travel guide applications, the author was searching for 3D AR applications among Stockholm’s tourist attractions. Surprisingly, almost no AR application offers could be found that focus on placing virtual 3D objects in real-time environment. This can be justified with the fact that the technology is not at a point yet where the requirements of an ultimate 3D experience can be achieved (Schmitz, 2017). However, one novelty in 3D AR application could be identified in Stockholm’s Science and Technology Museum that is described below.

4.3.1 Swedish National Museum of Science and Technology

The Swedish National Museum of Science and Technology, also called Tekniska Museet, has always been a pioneer of technical innovations. Virtual reality and other digital applications have already been integrated in the exhibitions for several years. Since 2017, the AR experience was brought to the next level. In April, the first fully interactive AR system was introduced to visitors of the museum. On the digital stage of the exhibition ‘100 Innovations’, dinosaurs and astronauts are wan-
dering around for tourists. You cannot see them in real life, but on a large projected mirror image, you will suddenly find yourself eye to eye with a Tyrannosaurus or you can join a space explorer on a weightless walk (Tekniska Museet, 2017). This temporary AR system combines interaction, education and entertaining at the same time. Min-Jung Jonsson, Head of Creative Development at Tekniska Museet, states that nobody can be left indifferent before the huge impact and presence of digital development in our daily life and the museum wants to be the hub that offers inspiring experiences to the audience (INDE, 2017).

The figure below shows how visitors can experience the new interactive AR application at the exhibition ‘100 Innovations’. According to Agneta Sjöborn, the floor manager of the technical installations at the Tekniska Museet, the visitors needed some guidance at the beginning of the AR introduction. Therefore, the museum marked the specific area to help the visitors for a better interaction with the virtual objects.

*Figure 5: AR application Tekniska Museet*

![Figure 5: AR application Tekniska Museet](source: Tekniska Museet, 2017)

![Figure 5: AR application Tekniska Museet](source: By the author)
A Case Study of AR Tourism in Stockholm

4.4 Discussion of the Expert Interviews

Reflecting the finding that the diffusion of touristic AR offers in Stockholm’s museums has not taken place so far, the author conducted two expert interviews in order to find out more about the innovation of AR offers in Stockholm. Hence, Mario Romero Vega [MRV] from the KTH Royal Institute of Technology was interviewed with a focus on the theoretical possibilities of AR and Thomas Andersson [TA], CEO from Visit Stockholm AB, was consulted concerning how this technology is integrated in the tourism product development.

4.4.1 The State of the Art of AR

To gain an overview of the theoretical background of AR, questions about the state of the art of AR applications were asked.

MRV stated that the definition of AR is rather flexible. He points out that originally, AR is about placing 3D content in a 3D world. However, the problem with it is that the area is not as fast as it could be, because the technology is not there yet and not robust enough to provide the surface for placing 3D content into the real world. As reason, he mentioned that the registration method in 3D is still an unsolved problem and there are still a lot of challenges. He also addressed the issue that currently running AR applications, which are not working properly, are creating a dislike by people. Discussing the innovation of Google Glass MRV added that Google Glass is more an information system and is about recognizing images and then giving information. Therefore, he refers to Google Tango, which has a camera in it and matches the 3D world.

Supplementary, TA has been asked about the role of the tourism destination Stockholm respective the knowledge transfer of AR technology within Stockholm’s tourist attraction providers.

Here, TA stated that no special attention is given to analyzing and transferring information about the development of AR applications since that is not part of their responsibilities. TA indicated that Visit Stockholm’s focus is on promoting the destination abroad and attracting international tourists.
4.4.2 AR Applications in Stockholm

Next to the technical request, the author questioned the interviewees about current and recent touristic AR applications offers in Stockholm.

Thus, an interesting output could be stated by TA who told about the exhibition stand on the event MIPIM - the world’s leading property market fair, held in Cannes in 2012. There, Visit Stockholm presented an AR interaction through programmed iPads that showed a 3D picture on a small specially printed card. Thus, this AR application has been already used in a very early stage to emphasize the fact that Stockholm is known for having advanced technology.

Additionally, TA mentioned that there exist several AAR guides in Stockholm like 'The talk of the town' or the AAR guides of the museums 'Moderna Museet' and 'Vasa Museet'.

MRV addressed his current project related to MR in cooperation with the Swedish Tourist Industry’s Research and Development Fund [BFUF]. There, two different projects with the Stockholm Transport Museum and the Museum of Mediterranean and Near Eastern Antiquities are currently developed. He explained them as follows:

MRV: “In the transport museum, we will augment bus tours around the city with AR components. But it is a huge challenge. We are not sure how we will make it work. Because we are not going to be able to do GPS based localization. And we are not going to be able to do image based tracking of the world outside. The project with the Mediterranean museum will be about the cypress exhibition, which includes some old objects of the island. The idea there is to use VR/AR experience to allow visitors to create their own objects. Hence, they use AR to create it and then, they place it in the VR exhibition“.

Furthermore, he mentioned that the goal of these exhibitions is to make the prototypes work. Due to budget issues the projects are only limited and possible extensions are dependent on the museums themselves.
4.4.3 Outlook of AR Development

The last questions dealt with the future development of AR and how it will shape tourist offers.

Here, MRV referred to his assumption that the technology will be ready soon and that once the phones are equipped with sensitive technology it will allow them to fully understand and use the 3D technology, likely numerous applications will exist then. Furthermore, he mentioned that the development of AR depends on the market itself. The technology may be ready in the next couple of years, but only when the market is as well, then it will become wide spread.

Asking about the change in future tourist offers due to AR, MRV stated that with AR we have the opportunity to create excellent experiences for both, tourists and citizens who want to learn more about their city. Therefore, he thinks that the technology will influence tourism in an extensive way.

On the other hand, TA defines Stockholm as an early adopter and AR technology should be developed to position the technology in the way where visitors can experience it. However, he also agreed to the fact that the realization of providing AR offers is not possible yet. Moreover, TA stressed that the tourism destination Stockholm cannot go into production of AR offers, but they can spread the innovation of touristic AR offers and can create awareness within the tourism industry to make Stockholm a more tech-savvy experience for visitors.

To sum up, although the technology is not advanced enough yet to diffuse AR applications in the tourism industry in a bulk, some milestones in enhancing the development of AR experiences can be listed. For instance, one of the interviewees mentioned that Google Tango was the next step in the development of 3D AR. This can be confirmed by Arth et al. (2015), who stated that Google Tango is a real-time location and mapping mobile AR platform that makes it possible to render 3D objects in real world. Furthermore, the established use of AAR has been indicated as examples of AR applications in Stockholm. Here it has to be clarified, that this kind of AR application was already introduced in 1995 and cannot be seen as new innovation in the development of touristic AR offers (Arth et al., 2015)
nowadays. Looking at the mentioned MR projects by MRV the theoretical background of MR has to be taken into account as well. According to Migral et al. (1994, p.283) AR and VR are related and both concepts have to be considered and the center of these two environments can be defined as Reality-Virtuality continuum.

4.5 Discussion of the Visitor Interviews

Considering the finding that only one museum of Stockholm integrates a 3D AR application in an exhibition at the moment, the author assessed it as important to interview tourists as well about the perception of the AR installation in order to answer the second research question. This can be justified with the fact that the core of a qualitative research is to identify the characteristics and structure of phenomena and events examined in their natural context (Jonker & Pennik, 2010). Only with the information of how far this invention is recognized and appreciated by the visitor audience, the stage of innovation can be determined.

4.5.1 Demographics

Ten visitors have been interviewed after the visit of the exhibition '100 innovations'. The demographic results of the interviews can be summarized as followed: Six male and four female have been interviewed between the age of 12 and 43. The average age of the interviewees was 33,3 years. Five interviewees stated that they are tourists in Stockholm and from the countries India, USA, Denmark, Zambia, or Thailand. The other five interviewed persons indicated that they live in Stockholm and the purpose of the visit is to make an excursion with the kids or because they have holidays.

4.5.2 Exhibition '100 Innovations'

As introduction, the interviewees have been asked about the impression of the exhibition itself and how much time they spent at '100 Innovations'. The range of minutes spent there was between ten minutes and two hours and the average time was 41 minutes. To a certain surprise, half of the interviewees quoted that they did
not visit the digital stage in the exhibition. They explained that they have seen it from afar, or the stage was too crowded with children. Only interviewee 6 stated that he did not recognize the application on the digital stage and therefore, he cannot give an opinion to that. Consequently, this interviewee had been excluded from the remaining questions. Nevertheless, nine of ten have recognized the application and liked it to a great extent. Only two asked visitors stated that the application was okay but did not attract a lot of their interest. The result about a revisit at '100 Innovations' was relatively balanced. Half of the asked persons stated that they would very likely visit the exhibition again, three persons said that they did not know and only two interviewees specified it as unlikely.

4.5.3 The Interactive AR Application

Another component of the interview was the interrogation about the exhibited AR application. The interviewees have been asked if they recognized that the digital application on the stage of '100 Innovations' was a big-screen AR experience. In connection to that, the interviewer also queried the theoretical level of knowledge about AR itself. Here, six of the nine asked persons indeed recognized that the projection of dinosaurs and astronauts were AR applications. However, when asked about the theoretical background, two of the six interviewees who recognized the AR application pointed out, that they are not aware of the theoretical background. Thus, to create awareness of the perception of AR application the next question asked whether the interviewees have seen similar applications somewhere else. Here, six of nine interviewees answered the question with no. Interviewee 3 pointed out that he also saw an AR application with dinosaurs in a shopping center in Seoul / South Korea, and interviewee 7 stated that she has seen an AR exhibition in a museum in Thailand but she cannot reflect details about it any more. Interviewee 9 referred on experiences with MAR apps but could not name specific ones.

4.5.4 Added Value for Visitors

The last goal of these interviews was to find out the extent of value created due to the fully interactive AR system. Hence, the visitors have been asked if they think
that this application enhances the visitor experience and if they would recommend visiting the museum because of the AR offer. There was no denying that the AR application is seen as valuable for the exhibition. All interviewees stressed that it enhances the visitor experiences of the exhibition. Interviewee 4 added that it should be designed for all age groups because currently, the focus is on the young audience. Moreover, six of nine questioned stated that they would recommend an exhibition visit on the basis of the AR application. As reason they named the fun experience, the adventure for children and the fact that the whole exhibition can be recommended. Only one interviewee would not recommend it and one person could not commit oneself to an answer. To receive a clear picture of the created value due to 3D AR applications, the author also asked the visitors if they see this innovation as trigger for museum visits in general. The outcome of this question was considerably instructive. Half of the audience perceives it as definite trigger since it is new, you do not have it at home and it creates fun. However, interviewee 8 pointed out that it is only a trigger if it works on a high level. If the application is not working properly, no additional value can be gained through this offer. Interviewee 9 stated that it is hard to make this technic work at the moment and it will take more time to see this kind of offer more frequently. Only two persons thought that an AR application is nice but not the main reason to visit a museum.

Following conclusion could be made after analyzing the outcomes of the visitor interviews:

In general, nine out of ten visitors have recognized the interactive application and liked it to a great extent. From them, six have seen that it was a 3D AR system but two interviewees could not explain the technical background of it. Hence, the author was analyzing the findings with the first theoretical aspect of technology readiness by Chung, Hahn and Joun, (2015, p.588-589). It states that only when people have an overall state of mind of a new technology, and when they have been already influenced in their beliefs about the technology, a fast adoption of AR applications is possible. Thus, it could only be determined a partly readiness of 3D AR applications, which influences the future adaption of touristic 3D AR offers.
Another finding of this interview was concerning the technology itself. Although only ten people have been interviewed, several visitors pointed out that the AR application offer is only a trigger to a certain extent. Thus, vital requirements are that the application has to work properly and the offer has to attract all age groups. This corresponds with the findings in the literature review. According to Schmitz (2017), the technology is not at a point yet where the requirements of an ultimate 3D experience can be achieved.

The third main insight was the degree of perceived value. Since all interviewees estimated this experience as valuable, the author came to the assumption that 3D AR offers have a great potential for tourism attractions. Sezgin (2016) has already stressed that 'experience' and 'value' are the most relevant concepts for the modern tourism industry, and the great dynamic structure allows both, producers and consumers to react instantly to new trends and develop new products. Consequently, a rapid increase in touristic interactive 3D AR application can be expected as soon as the required technology ensures a smooth operation.
5 Conclusion and Recommendation

The final chapter summarizes the most important findings of this paper. Moreover, implications and limitations of the study are presented. At the end, suggestions for further research are suggested.

5.1 Summary

The aim of this research was to increase awareness of existing touristic AR applications in Stockholm and to explore the extent to which AR has shaped the innovation of tourism offers. To summarize the key findings, the author uses the model of the diffusion of innovation.

AR can be seen as cumulative innovation, since AR is described as an incremental development and introduction. Already in 1968 the first AR system was created and consisted of an optical see-through head-mounted display. However, the diffusion of the innovation process has taken a long path with some significant milestones in technological development. One of them was the introduction of smartphones, which makes it possible for tourism destinations and attractions to present themselves interactively with GPS based AR applications or AAR guides in an easy way.

Considering the source of innovation, it can be determined that the diffusion of innovation is strongly dependent on two components. On the one hand, due to the technical challenges, the development of further 3D AR applications is dependent on a few key players like Google, Microsoft or market leaders in the smartphone industry, since the technology must be brought to the mainstream and it has to be affordable. Another reason for the fast adoption of AR in recent years is also the readiness for using technology and the positive attitude toward AR, which was indicated by Kounavis, Kasimati and Zamani (2012, p. 1).

The third part of the diffusion of innovation are the adopters. According to Kotler et al. (2012, p. 160), the adoption of an innovation depends on various factors like perceived compatibility, the relative advantage or the perceived complexity. There-
fore, the goal of further AR introductions from tourist attractions is to bring the
mainstream of visitors from the early adopters to the early majority stage. In other
words, tourists should benefit from the new and working technology in order to
enhance the tourism experience. In the case of the tourism destination, it is im-
portant to await the development in technology to be able to assure a smooth AR
experience for their touristic products. Visit Stockholm has already used their rela-
tive advantage in terms of a hub of digital innovations and represented themselves
with a 3D AR application at a property market fair in 2012. However, nowadays
challenge is the question of how to support the museums in Stockholm in order to
create and diffuse excellent 3D AR applications to enhance the experience for
both, tourists and citizens who want to learn more about the city.

5.2 Practical Implication

The findings of this research might be used by tourism destinations to estimate the
importance of AR application in relation to tourism product development. First of
all, this paper should clarify the theoretical background of AR and how it has al-
ready been applied in the tourism sector. Next to that, the author wanted to arouse
attention in the diffusion of innovation, since tourism is very strongly driven by
technological innovations. Hence, information for future product development
strategies could be provided. The findings from the visitor interviews can also be
seen as essential for the Tekniska Museet and other museums, affecting the fu-
ture product development in interactive 3D AR applications.

5.3 Limitation

This research has several limitations. First of all, the findings of this paper do not
allow generalization, since a qualitative approach has been used and the selected
study participants did not constitute a representative sample of all museum visi-
tors. Although the first part of this research was focusing on the general develop-
ment of AR application offers in the tourism industry, the findings in the second
part were limited since they only contained information about the city Stockholm.
Hence, the outcomes of this research cannot be transferred to other cities.
Another great limitation was the general finding that the technology of AR applications is not ready yet for a commercialization in the tourism industry. So far only GPS based MAR applications have been established all over the world, but the development in pushing AR to the next level is only reserved for a few visionary leaders in the technology industry.

Last but not least, further limitation of this research could be found in the gap of experienced AR applications in Stockholm’s museums. The author found that AR has been used in some previous exhibitions in Stockholm, like in the Postmuseum. However, no or only obsolete information could be found, therefore, it could not be taken into account in this paper.

5.4 Further Research

Possible fields for further research are definitely depending on the technology development in AR applications. As one of the experts mentioned, the technology for advanced 3D AR experiences is not there yet. Therefore, the author suggests awaiting the next milestone of the technology development in this field before undergoing further surveys about the stage of innovation of AR applications in other cities or tourism destinations.

However, a need of further research to the stage of technological development is recommended, since this was not within the scope of this paper. One of the interviewees stated that a project is currently carried out in order to develop touristic AR offers further by the KTH Royal University of Technology.

Moreover, the randomly selected visitor interviews at the Tekniska Museet also raised the question about how the majority of visitors experienced the AR application of the exhibition ‘100 Innovations’. Therefore, it would be recommended to carry out a quantitative survey concerning how visitors perceived and rated this application.
List of References


McKalin, V. (Tech Times). (2014). *Augmented Reality vs. Virtual Reality: What are the differences and similarities?*. [online] Available at:


Annex 1  Expert Interview Guideline

Date: ........................................................................
Time: ........................................................................
Interviewer: ........................................................................
Interviewee: ........................................................................
Company: ...........................................  Position: .................

- Presentation of the Interviewer
- Description of the topic
- Declaration of consent for recording
- Declaration of consent for use of name

<table>
<thead>
<tr>
<th>A</th>
<th>AR Applications in Stockholm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What do you know about AR applications used in Stockholm’s tourist attractions?</td>
</tr>
<tr>
<td>2</td>
<td>Can you explain how they are used?</td>
</tr>
<tr>
<td>3</td>
<td>Do you think that tourist attractions are aware of the innovation of AR applications?</td>
</tr>
<tr>
<td>4</td>
<td>Do you think that AR applications add value to a tourism product?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B</th>
<th>Knowledge about AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Does your R&amp;D department focus on the newest trends in AR applications?</td>
</tr>
<tr>
<td>6</td>
<td>Do you support museums to develop/implement AR applications to enhance the visitor experience in museums and other cultural attractions?</td>
</tr>
<tr>
<td>7</td>
<td>Do you cooperate with touristic providers who offer the city of Stockholm as MAR app?</td>
</tr>
<tr>
<td></td>
<td>If yes, how does the cooperation look like? If no, why not?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>Future of AR</th>
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<tbody>
<tr>
<td>8</td>
<td>Do you think that the innovation of AR will shape the future of touristic offers?</td>
</tr>
<tr>
<td>9</td>
<td>What do you think of how this technology will develop in the near future?</td>
</tr>
<tr>
<td>10</td>
<td>Is there anything more what you want to add to this interview?</td>
</tr>
</tbody>
</table>
Annex 2  Visitor Interview Guideline

- Presentation of the Interviewer
- Description of the topic
- Declaration of consent to use Data anonymously

<table>
<thead>
<tr>
<th></th>
<th>Exhibition '100 Innovations'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Did you visit the exhibition '100 Innovations'?</td>
</tr>
<tr>
<td>2</td>
<td>How much time did you spend in the exhibition?</td>
</tr>
<tr>
<td>3</td>
<td>Did you also visit the digital stage in '100 Innovations', where dinosaurs and astronauts are wandering around?</td>
</tr>
<tr>
<td>4</td>
<td>How did you like it?</td>
</tr>
<tr>
<td>5</td>
<td>Did you recognize that it was an Augmented Reality application?</td>
</tr>
<tr>
<td>6</td>
<td>Do you know what Augmented Reality is?</td>
</tr>
<tr>
<td>7</td>
<td>Have you seen a similar application so far in another museum? If yes, where?</td>
</tr>
<tr>
<td>8</td>
<td>Do you think this application enhances the visitor experience of the exhibition?</td>
</tr>
<tr>
<td>9</td>
<td>Would you recommend visiting the exhibition, especially because of the Augmented Reality walk and why?</td>
</tr>
<tr>
<td>10</td>
<td>Would you define a 3D AR application as trigger for a museum visit?</td>
</tr>
<tr>
<td>11</td>
<td>How likely would you visit the exhibition again?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>How old are you?</td>
</tr>
<tr>
<td>13</td>
<td>Gender</td>
</tr>
<tr>
<td>14</td>
<td>Are you visiting Stockholm as a tourist? If yes, from which country/Region are you? If no, why did you decide to visit Tekniska Museet</td>
</tr>
<tr>
<td>15</td>
<td>Who accompanied you during your visit?</td>
</tr>
</tbody>
</table>